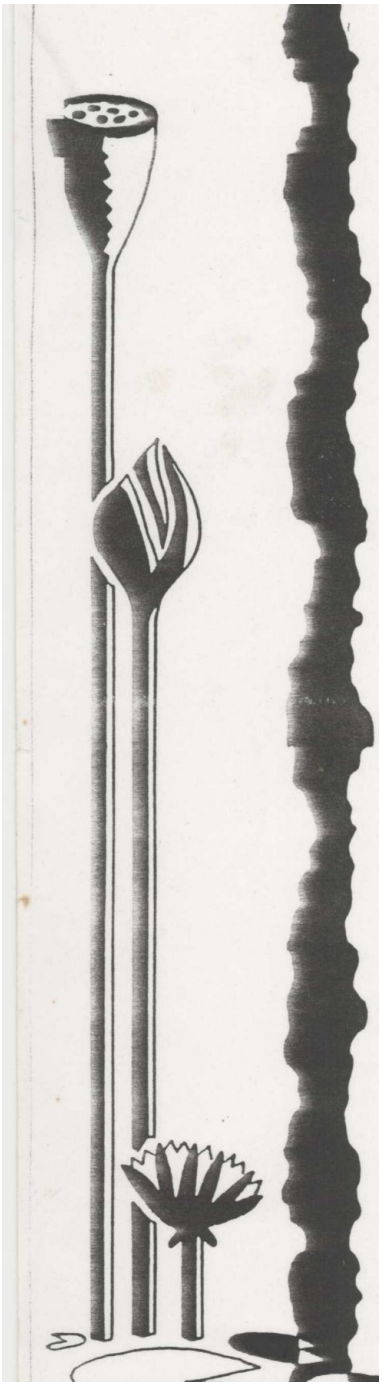
REHABILITATION AND MANAGEMENT PLAN

Kahibah, Iluka & Ettalong Creeks, Kahibah & Iluka Lagoons, and Selected Reserves at Umina Beach

Report to Gosford City Council by
SWC Wetlands & Ecological Management Consultancy
in conjunction with Envirosciences Pty Ltd

May 1994



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STATEMENT OF AUTHORSHIP p.2

This report, Kahibah, Iluka & Ettalong Creeks, Kahibah & Iluka Lagoons, and Selected Reserves at Umina Beach - Management and Rehabilitation Plan, and the study described therein were undertaken under contract by SWC Wetlands & Ecological Management Consultancy in conjunction with Enviros-ciences Pty Ltd for Gosford City Council.

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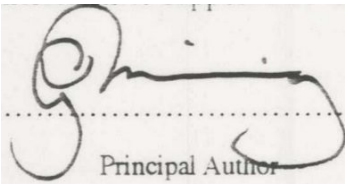
The information presented in this report is based on an objective study undertaken in response to the brief provided by the client. Although conclusions were based on the available data, the essential variability of the natural environment coupled with the general lack of comparative research data required that some professional judgment be applied in reaching these conclusions. Whilst the use of such judgments is unavoidable, every attempt has been made to ensure the accuracy and objectivity of the report's conclusions.

Any opinions expressed in the report are the professional, objective opinions of the authors and are not specifically intended to advocate any particular proposal or pre-determined position. This report should be reproduced in full in any document which seeks to use the study and its conclusions to support a development proposal.



1. INTRODUCTION p.6

1.1 BACKGROUND

Umina and its environs have been settled for some considerable time. However, over the last ten years urban development has increased dramatically. As a result of this growth and development the local environment has been subjected to considerable stress and a variety of encroachments.

Development has also had an impact on flooding of the area, and engineering works designed to mitigate flooding have had a detrimental effect on the environmental quality of the Kahibah, Iluka and Ettalong Creeks system. A number of studies have been carried out in relation to the flood liability of the area, and recently, substantial engineering works have been carried out in the lower parts of the creeks system.

As is common in urban bushland, some parts of the creek have been used as a rubbish tip while others areas have been encroached upon by private landholders. A significant proportion of the community have little understanding of the local ecosystem and in the face of rubbish, weed infestations and flooding place pressure on Council to “clean the creeks”. Such pressure has, in the past, led to the adoption of ad hoc and inappropriate responses.

In contrast to this pressure to keep the creeks clean, concerns have been raised by residents and groups with an environmental and conservation focus. These groups and individuals seek to enhance and protect the remnant native bushland and creeks, and object strongly to the engineering works aimed at improving the hydraulic efficiency of the creeks. Although it is acknowledged that the flood capacity of the creeks needs to be maintained, there are concerns about the timing and manner of clearing operations.

In acknowledgement of the various environmental problems of the creeks and the differing expectations for their management, Gosford City Council commissioned a Rehabilitation and Management Plan for the creek system. This plan was required to incorporate a community education strategy to increase the community’s understanding of the local ecology, with the aim of reducing the pressure on Council to adopt short term and inappropriate management practices, and of increasing local participation in the care and protection of this important resource.

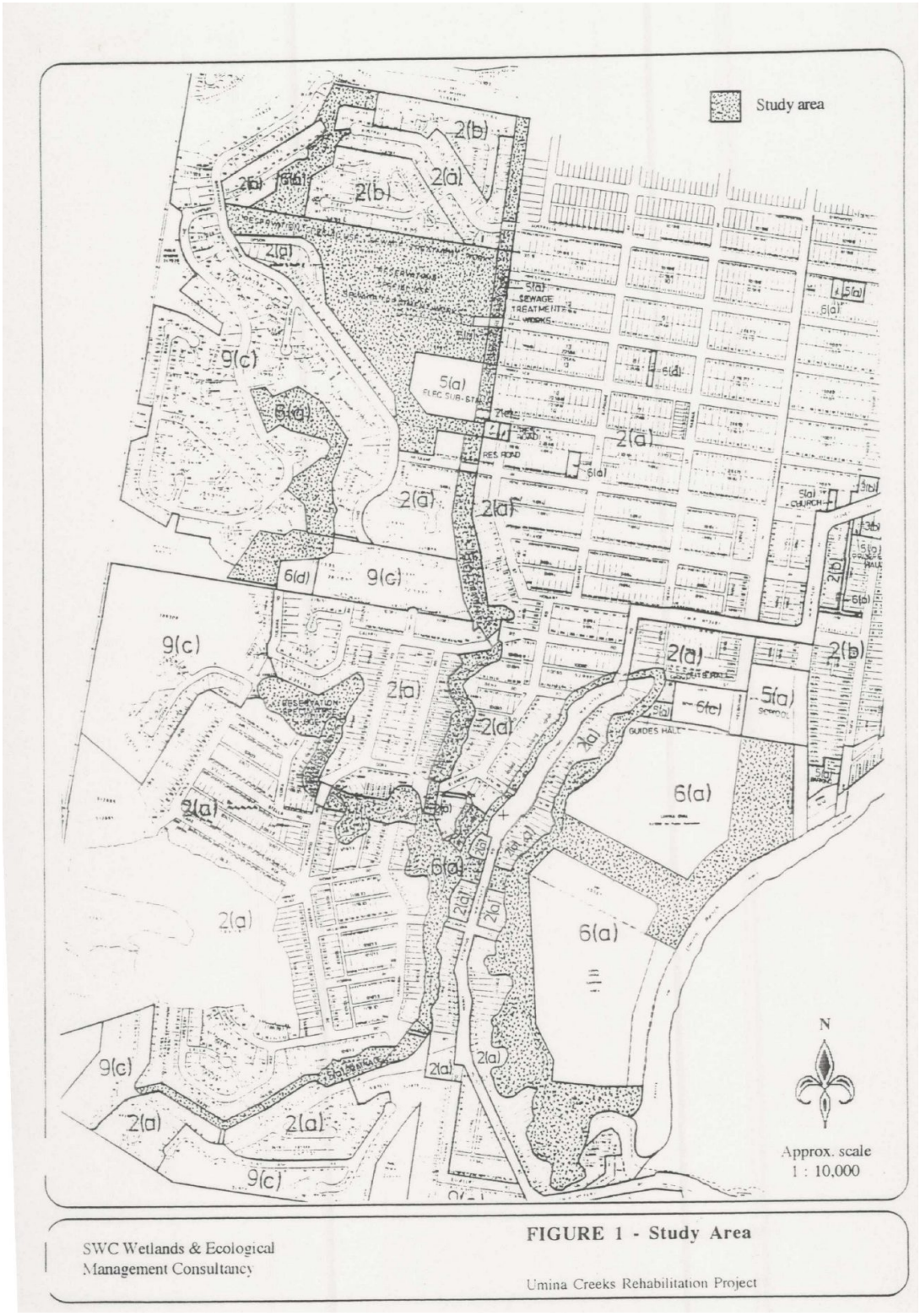
Background material is largely extracted from the study brief.

p.7 The creeks system has been well studied as part of the engineering flood mitigation proposals. Statements of environmental effects and other documents prepared for the various proposals have included, among other things, detailed studies of vegetation, fauna and water quality (e.g. Willing & Partners and Andrews.Neil, 1989; Willing & Partners, 1991; McMillan Britton & Kell and Andrews.Neil, 1991). The data presented in these studies have been used in the preparation of this Rehabilitation and Management Plan, and have been supplemented by original field investigations.

1.2 STUDY AREA

The Rehabilitation and Management Plan was required to cover a network of drainage lines and reserves throughout the Umina area, comprising Kahibah, Iluka and Ettalong Creeks, Kahibah and Iluka Lagoons, as well as a number of associated reserves.

The extent of the study area is shown in Figure 1.



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2. OBJECTIVES FOR THE PLAN p.9

Any management plan needs to be based on a set of specific objectives which establish a framework within which rehabilitation and management strategies are developed. The objectives for this plan have been derived from the study brief issued by Council, as well as discussions with Council officers and members of the community committee established to assist with management of the area.

The objectives for the Rehabilitation and Management Plan are:

Principle Objective

- to maintain and enhance the natural values, both ecological and aesthetic, of the creeks system;

Supplementary Objectives

- to provide strategies for rehabilitation of the creeks system, including revegetation, where appropriate, and improvement of water quality;
- to provide opportunities for appropriate passive recreation activities;
- to suggest management regimes for both riparian and in-creek areas that are in accordance with rehabilitation objectives as well as flood mitigation requirements;
- to develop a community education strategy to promote the natural values of the creeks system and to encourage appropriate care of the system.

3. MANAGEMENT AREAS p.10

The study area for the Rehabilitation and Management Plan is quite diverse, including areas of sand dunes, creek channels, riparian forest, bushland and parkland. As an aid to description of the system and to identifying appropriate rehabilitation and management strategies for parts of the system, the study area has been divided into twelve management areas. These units are more or less internally homogeneous with regard to physiography, hydrology and vegetation.

The management areas are shown in Figure 2 and are briefly described below:

Area A - Umina Beach Dunes

This area comprises the foredune along Umina Beach.

Area B - Umina Beach Park

This area comprises parts of the parkland behind Umina Beach which have been set aside for informal recreational activities and which support many mature trees with a mown grass understorey.

Area C - Umina Beach Bushland

This small area of sand plain bushland supports a relatively intact native understorey.

Area D - Lower Ettalong Creek

Downstream of the McLaurin Road channel[2] Ettalong Creek essentially retains its natural shape and much of the original riparian vegetation.

Area E - Ettalong Creek "Billabong"

Construction of the McLaurin Road channel has resulted in a natural bend of Ettalong Creek becoming and artificial "billabong", which is now effectively isolated from flows in other parts of the creek.

Area F - Channels of Ettalong, Iluka and Kahibah Creeks

This area comprises the channels of the three creeks upstream of the McLaurin Road channel. The natural shapes of the creeks have been substantially altered by channelisation works, and much native riparian vegetation has been removed.

[2] McLaurin Road is a cadastral road which has been used for construction of a diversion channel across Mount Ettalong Road, between upper and lower sections of Ettalong Creek.

Area G - Iluka Lagoon p.11

Iluka Lagoon occurs at the head of Iluka Creek and is one of two remnant wetlands within the system, and is gazetted as wetland no. 951 under State Environmental Planning Policy 14 - Coastal Wetlands (SEPP 14).

Area H - Kahibah Lagoon

Kahibah Lagoon occurs at the head of Kahibah Creek, and is gazetted as SEPP 14 wetland no. 950, although the wetland area mapped under the policy appears to be significantly different to the extent of the existing wetland.

Area I - McEvoy Avenue Bushland

This area of remnant sand plain bushland occurs within a sewage treatment works reserve at the end of McEvoy Avenue.

Area J - Greenhaven Drive Bushland

This small area of remnant bushland occurs on low slopes of deposited colluvium at the end of Greenhaven Drive.

Area K - Tuluma Road Bushland

This area occurs at the end of Tuluma Road and comprises a large area of bushland growing on a steep rocky escarpment, as well as a small area of bushland on low slopes of deposited colluvium at the base of the escarpment.

Area L - Playing Fields / Parkland

This area comprises a large playing field within the sewage treatment works reserve at the end of McEvoy Avenue, as well as a small children's playground at the corner of Greenhaven Drive and Brisbane Avenue.


A Umina Beach Dunes
B Umina Beach Park
C Umina Beach Bushland
D Lower Ettalong Creek
E Ettalong Creek 'Billabong'
F Channels of Ettalong, Iluka & Kahibah Creeks
G Iluka Lagoon
H Kahibah Lagoon
I McEvoy Avenue Bushland
J Greenhaven Drive Bushland
K Tuluma Road Bushland
L Playing Fields / Parkland
N
Approx. Scale
1 : 10,000
SWC Wetlands & Ecological
Management Consultancy
FIGURE 2 - Management Areas
Umina Creeks Rehabilitation Project

p.12

4. EXISTING CONDITIONS p.13

4.1 PHYSIOGRAPHY AND HYDROLOGY

The Kahibah - Iluka - Ettalong Creeks system is a modified remnant of the natural drainage system of the Umina sandplain, which originally comprised a network of meandering creeks and swamps. Much of the length of the creeks has been channelised for flood mitigation purposes, parts have been isolated by diversion channels, and swamps have been partly or wholly filled (particularly Ettalong Swamp). The existing system is essentially a network of drainage channels, designed for hydraulic efficiency, although some of the natural features have been retained.

The existing physiography and hydrology of the system is shown in Figure 3.

4.2 SOILS

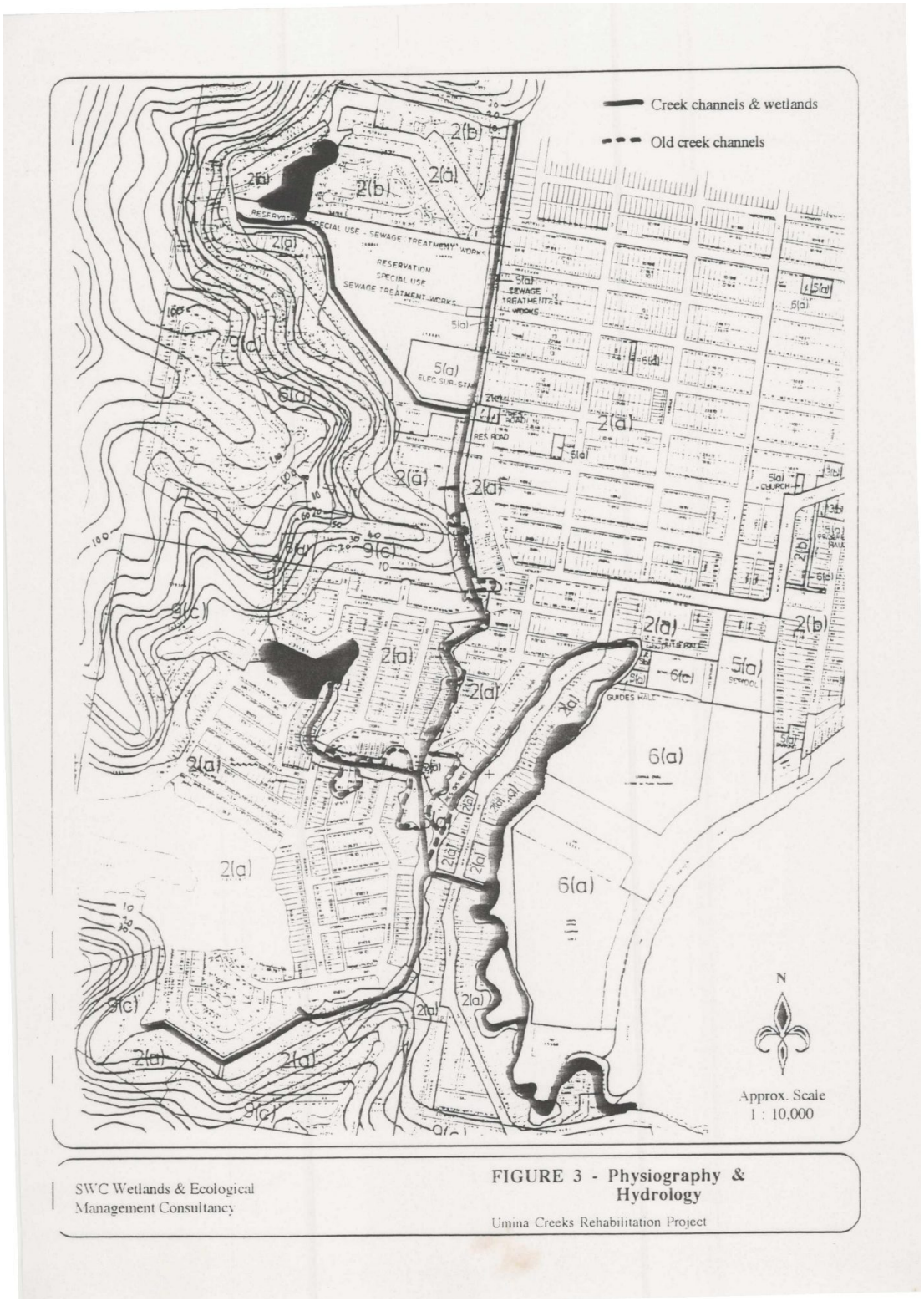
Soil landscapes within the study area have previously been mapped by Chapman and Murphy (1989). Constraints to urban development of land are related to both landform and soil limitations. The soil landscape concept permits the integration of both soil and landform constraints into a single mapping unit. Each soil landscape is given a name based on the locality where a typical example occurs.

The study area is dominated by the Woy Woy soil landscape unit. These marine soils include Siliceous Sands (Uc 1.22, Uc 5.11) and occasional Podzols (Uc 2.8) on the non-tidal beach ridges. Humus Podzols (Uc 4.2) occur in poorly drained areas. Calcareous Sands (Uc 1.11, Uc 1.18) are located within the Umina Beach dune system.

The western side of Mt Ettalong Road is a highly disturbed transitional zone between the Woy Woy and Watagan soil landscape units. Complete disturbance and removal or burial of soil is common. Turfed fill areas typically capped with up to 40 cm of sandy loam or up to 60 cm of compacted clay over fill.

A black loamy topsoil with loose apedal single-grained structure and sandy fabric is evident throughout the area.

The well drained coarse sandy soils have very low erodibility. The erosion hazard for concentrated flows is moderate.



p.14

p.15 Colluvial soils of the Watagan soil landscape unit occur in the upper reaches of Kahibah Creek. Shallow to deep (80 - 200 cm) Lithosols / Siliceous Sands (Uc 1.24) and Yellow Podzolic Soils (Dy 8.21, Dy 8.41, Dy 4.11) are common.

Some of the well graded soils with porous and coherent fabric are moderately erodible.

4.3 FLORA

4.3.1 Vegetation

The vegetation of much of the study area has been adequately described by a number of previous studies (e.g. Payne, 1989; McMillan Britton & Kell and Andrews.Neil, 1991), which include detailed lists of plant species as well as general descriptions of the vegetation. Whilst the data from these previous studies has been generally useful in the preparation of this Rehabilitation and Management Plan, it was considered desirable to provide a description of the vegetation of each management unit, as defined in Section 3 above, to assist in developing site specific rehabilitation strategies.

The vegetation description presented below for each management area is based on an original ground survey undertaken as part of the present study. The complete list of plant species recorded during the survey is presented in Appendix 1.

Area A - Umina Beach Dunes

The frontal dune along Umina Beach has been subject to recent revegetation as part of stabilisation works. The beach-side of the dune supports shrub-dominated vegetation ranging in structure from closed-heath to open-heath[3], with the dominant species being Coastal Wattle (Acacia sophorae), Sydney Golden Wattle (A. longifolia) and Coastal Teatree (Leptospermum laevigatum). Open areas support a number of native and introduced groundcover species, including Hairy Spinifex (Spinifex sericius), New Zealand Spinach (Tetragonia tetragonoides), Cakile (Cakile esculentum) and Kikuyu (Pennisetum clandestinum).

Vegetation on the back of the dune is less developed and includes many weed species as well as scattered native shrubs.

[3] Vegetation structural terms used in this report follow Specht (1981).

Area B - Umina Beach Park p.16

That part of the study area occurring immediately behind the dune is maintained as a parkland. Scattered remnant mature native trees, mostly Bangalay (Eucalyptus botryoides) and Coastal Banksia (Banksia integrifolia), occur in this area, along with introduced trees, such as Coral Tree (Erythrina x sykesii). The original native understorey has been replaced by a mown grassland dominated by mostly introduced grass species and weeds, including Harestail Grass (Lagurus ovatus), Parramatta Grass (Sporobolus indicus var. africanus), Buffalo Grass (Stenotaphrum secundatum) and Common Couch (Cynodon dactylon).

Area C - Umina Beach Bushland

This is a small area of remnant sand plain open-forest dominated by Bangalay, Smooth-barked Apple (Angophora costata) and Old Man Banksia (Banksia serrata). The understorey vegetation includes many native shrub, grass and herb species, such as Coastal Banksia, Black She-oak (Allocasuarina littoralis), Kangaroo Grass (Themeda triandra) and Burrawang (Macrozamia communis). Weed invasion is essentially limited to edges and along the main track through the bushland. Common weed species include Bitou Bush (Chrysanthemoides monilifera), Lantana (Lantana camara), Purple Top (Verbena bonariensis) and Guinea Grass (Panicum maximum).

Area D - Lower Ettalong Creek

This area contains a relatively large area of riparian vegetation that is a good example of the moist hardwood open-forest that would have originally occurred along much of the creek system, and includes many healthy mature specimens of Bangalay, Swamp Mahogany (Eucalyptus robusta), Broad-leaved Paperbark (Melaleuca quinquenervia), Swamp Oak (Casuarina glauca) and Cabbage-tree Palm (Livistona australis), along with many mesophyllic (rainforest) understorey species, such as Bleeding Heart (Omalanthus populifolius), Cheese Tree (Glochidion ferdinandi), Native Peach (Trema aspera), Creek Sandpaper Fig (Ficus coronata), Pearl Vine (Stephania japonica) and Rainbow Fern (Calochaena dubia).

Unfortunately the understorey of the riparian forest has been heavily infested with an array of weed species, including typical bushland weeds, such as Lantana, Cassia (Senna pendula var. glabrata), Small-leaved Privet (Ligustrum sinense) and Wandering Jew (Tradescantia alba), as well as a range of garden escapees, such as Golden Bamboo (Phyllostachys aurea) and Nasturtium (Tropaeolum majus). Mowing of the understorey by local residents, and planting of specimen species such as Jacaranda (Jacaranda mimosifolia) has created a park-like appearance in other areas.

p.17 The creek flowing through this area has been partly altered by some channelisation and the construction of a rocky bank to protect the adjacent caravan park from erosion. The aquatic vegetation is a mix of native and introduced species, including Common Reed (Phragmites australis), River Lily (Crinum pedunculatum), Cladium (Cladium procerum), Mexican Water-lily (Nymphaea mexicana) and Parrots Feather (Myriophyllum aquaticum). A small patch of the noxious weed Alligator Weed (Alternanthera philoxeroides) was located in the creek during field inspections.

Area E - Ettalong Creek "Billabong"

This part of Ettalong Creek has been essentially hydrologically isolated from the remainder of the creeks systems, creating an artificial billabong. However, apart from occasional clearing of dense reed growth from the creek, this area has been largely untouched by other works. As a consequence, the narrow band of riparian forest includes many native tree species, such as Swamp Mahogany, Broad-leaved, Swamp Oak and Cabbage-tree Palm, as well as mesophyllic understorey species, such as Bleeding Heart, Cheese Tree and Native Daphne (Pittosporum undulatum). As with Area D, this riparian vegetation has also been subject to extensive weed infestation, although the extent of weed growth has been limited by the relatively narrow width of the remaining riparian vegetation. The introduced Weeping Willow (Salix babylonica) is replacing native riparian trees in some areas.

The water depth in the creek is generally shallow, and varies from approximately 30 cm to no surface water in some parts. The aquatic vegetation varies with water depth, and is dominated mainly by reeds and sedges, such as Cladium, in shallower areas and by aquatic herbs, such as Parrots Feather, in deeper areas.

Area F - Channels of Ettalong, Iluka and Kahibah Creeks

This management area comprises the highly modified sections of the three creeks. Most of these areas have been channelised, resulting in the removal of much native vegetation. Several native tree species, such as Bangalay, Swamp Mahogany, Broad-leaved Paperbark and Swamp Oak, remain although they are much less abundant than in less disturbed sections of the creeks. The introduced Weeping Willow and White Willow (Salix alba) and quite common, and dominate the riparian vegetation in parts. Understorey vegetation is dominated by weed species, such as Vasey Grass (Paspalum urvillei), Crofton

Weed (Ageratina adenophora) and Canna Lily (Canna indica). Mown easements along the edges of the creeks support a variety of introduced grasses and weeds, such as Kikuyu, Parramatta Grass, Cobblers Peg (Bidens Pilosa) and Railway Daisy (Coreopsis lanceolata).

p.18 Aquatic vegetation is a mix of native and introduced species, including Water Primrose (Ludwigia peploides), Water Couch (Paspalum distichum), Parrots Feather, Sagittaria (Sagittaria graminea var. platyphylla) and water-lilies (Nymphaea spp.).

Area G - Iluka Lagoon

This is one of two dune-upland contact swamps* remaining in the Umina area. Iluka Lagoon supports sedgeland vegetation dominated by Lepironia (Lepironia articulata), with shallower marginal areas supporting species such as the fern Hypolepis (Hypolepis muelleri) and Hard Water fern (Blechnum indicum) and Spotted Knotweed (Persicaria strigosa), as well as scattered Swamp Mahogany and Broad-leaved Paperbark. Areas in the immediate vicinity of the creeks flowing into the lagoon support growth of Broad-leaf Cumbungi (Typha orientalis) and other opportunistic species which have established in response to increased inputs of nutrients and finer sediments resulting from poor management of the developed catchment.

Area H - Kahibah Lagoon

Kahibah Lagoon also supports sedgeland vegetation but is dominated by Jointed Twig-rush (Baumea articulata) and Tall Spike-rush (Eleocharis sphacelata). As with Iluka Lagoon, shallower areas support species such as Hypolepis, Hard Water Fern and Spotted Knotweed, and colonisation by Broad-leaf Cumbungi is evident where the Kahibah Creek enters the lagoon upstream. The lagoon drains into a small area of Broad-leaved Paperbark swamp forest.

Area I - McEvoy Avenue Bushland

This area comprises a remnant open-forest occurring on sandy soils. The dominant trees are Bangalay and Rough-barked Apple (Angophora floribunda), with common smaller trees including Old Man Banksia, Black She-oak and Tree Broom-heath (Monotoca elliptica). Common understorey species included Burrawang, Bracken, Broad-leaf Wedge-pea (Gompholobium latifolium) and Shrub Plum-pine (Podocarpus spinulosus).

Area J - Greenhaven Drive Bushland

This small reserve occurs upstream of Kahibah Lagoon, and comprises an open-forest occurring on colluvial soil which has been deposited at the base of the adjacent escarpment. The dominant tree species are Rough-barked Apple, Spotted Gum (Eucalyptus maculata) and Grey Ironbark (E. paniculata). The understorey has been infested with weeds, especially Lantana, although much native vegetation remains, with species such as the Forest Oak (Allocasuarina torulosa), bush-pea (Pultanaea flexilis), Tussock Grass (Poa labillardieri) and Common Maidenhair Fern (Adiantum aethiopicum).

- A dune-upland contact swamp is formed in a topographical depression between sand dunes / sand plains and the adjacent upland formed over bedrock (Winning, 1993).

Area K - Tuluma Road Bushland p.19

This relatively large reserve includes open-forest occurring on a steep escarpment, as well as a small area of forest vegetation occurring on colluvial soil at the base of the escarpment. The dominant tree

species are Smooth-barked Apple, Bangalay, Rough-barked Apple, Forest Oak and Turpentine (Syncarpia glomulifera). On the escarpment, the understorey is characteristically dominated by Rainbow Fern and is essentially weed-free. On the colluvial slopes at the base of the escarpment, Lantana infestation of the understorey is severe.

Area L - Playing Fields / Parkland

This area comprises mown areas of playing fields and parkland in the northern part of the study area. The mown grassland comprises mostly introduced grasses and weeds, such as Kikuyu, Parramatta Grass, Paspalum (Paspalum dilatatum) and Common Couch (Cynodon dactylon). The playground on the corner of Greenhaven Drive and Brisbane Avenue retains a number of native trees as well as several planted specimens.

4.3.2 Significant Plant Species

No rare or threatened plant species, as listed by Briggs & Leigh (1988), have been recorded within the study area. However, at least four plant species occurring within the study area have been considered by various authors to have local conservation significance:

Swamp Mahogany (Eucalyptus robusta) is often considered to be under threat (e.g. Specht et al., 1974), although it is not officially listed as such (by Briggs & Leigh, 1988) and is not considered to be of conservation significance by all authors (e.g. Benson, 1986). Communities dominated by Swamp Mahogany are specifically excluded from SEPP 14 and are therefore not afforded the same protection as other coastal wetland communities, and substantial areas have been cleared in the Central Coast Region. This species is a consistent winter flowerer and provides an important source of nectar when other species are not in flower. It occurs throughout the study area and is concentrated along the lower reaches of the creeks, particularly Lower Ettalong Creek (Area D) and Ettlong Creek Billabong (Area E).

Maundia (Maundia triglochinoides) is considered by Benson (1986) to be a species of particular conservation significance in the Gosford / Lake Macquarie area where it is at the southern limit of its distribution. In fact, Benson (1986) lists its southern limit as Wyong, and the population within the study area is almost certainly now the southern known limit for this species. Maundia is a herbaceous, emergent aquatic plant that typically occurs in shallow swamps and freshwater streams. Within the study area it has been recorded in p.20 Ettalong Creek in the vicinity of Neera Road, in Iluka Creek between Albany Square and Kalaroo Road, and in Kahibah Creek upstream of Albany Square.

Three-leaf Water Vine (Tetrastigma nitens) is also considered by Benson (1986) to be a species of particular conservation significance in the Gosford / Lake Macquarie area where it is at the southern limit of its distribution. This species is a straggling climber that occurs in rainforest and other moist forests. Within the study area it was recorded in the Tuluma Road Bushland (Area K).

Cladium (Cladium procerum) is considered to be uncommon by McMillan Britton & Kell and Andrews.Neil (1991), but is not listed as being of conservation significance by Benson (1986). This species typically has a patchy distribution, tending to primarily occur in the brackish parts of creeks and wetlands on coastal sandplains. In the study area, it was locally common in in the Ettalong Creek Billabong (Area E) which was recently cleared as part of creek 'cleaning' operations. It presently occurs in small numbers within the Ettalong Creek Billabong, as well as Lower Ettalong Creek (Area D).

4.3.3 Weeds

As can be seen from Appendix 1, the study area supports a large number of weeds species, both aquatic and dryland. A number of these species are known to be extremely invasive in disturbed bushland situations and have the potential to eventually totally replace the remaining native plant species. These problem weed species include: Crofton Weed (Ageratina adenophora), Bitou Bush (Chrysanthemoides monilifera), morning glory (Ipomoea spp.), Camphor Laurel (Cinnamomum camphora), Small-leaf Privet (Ligustrum sinense), Potato Vine (Acetosa sagittata), Weeping Willow (Salix babylonica), Lantana (Lantana camara) and Wandering Jew (Tradescantia alba).

In addition to these typical bushland weeds, a small patch of the noxious weed Alligator Weed (Alternanthera philoxeroides) was located in Lower Ettalong Creek (Area D). This is a particularly invasive aquatic weed that needs to be removed before it has the opportunity to further colonise the creek system, and a follow up monitoring program is required to ensure that it has been completely eradicated.

Two other species of noxious aquatic weeds, Salvinia (Salvinia molesta) and water Hyacinth (Eichhornia crassipes), have been recorded in small numbers by a previous survey (Payne, 1989) but were not observed during field investigations for the present study.

4.4 FAUNA p.21

4.4.1 Habitat Attributes of the Study Area

Past residential development of adjoining land and flood mitigation works within the creeks have substantially modified the fauna habitat attributes of the study area. Factors which have contributed to habitat modifications include:

- clearing of riparian and aquatic vegetation;
- weed invasion of bushland and aquatic habitats;
- structural simplification of habitats (e.g. mowing of understorey vegetation);
- linearisation of remnant habitats (increasing the length of edges relative to width of remnants);
- simplification of creek physiography as a result of dredging and channelisation;
- alteration of creek flow regimes; and
- pollution of aquatic habitats, mainly from increased nutrient and sediment loads.

The close proximity of residential development has also increased predation pressure from domestic dogs and cats, further decreasing the habitat value of remnants for native fauna. Despite these substantial modifications, the study area still supports habitat attributes suitable for a number of species of native fauna.

Modifications to the upstream sections of the creeks have greatly simplified aquatic habitats in these areas. Creeks naturally have a varied physiography, including shallows, deeper ponds, irregular banks, and submerged & partly submerged litter, such as tree branches. These features provide a variety of habitats for plants, fish and aquatic invertebrates, and thereby for larger fauna, such as waterbirds. The channelisation of these parts of the creeks has reduced their habitat variety, although they still provide a simplified aquatic habitat which would support a number of aquatic fauna, although diversity and abundance would be reduced.

Much of the eastern bank of the downstream section of Ettalong Creek has recently been converted into a dry packed sandstone wall to control erosion, significantly altering its natural habitat values, although gradual colonisation of the rock wall by plants will return some of the lost microhabitats. The remainder of this section of the creek, however, essentially retains its natural physiography, and provides a varied, more or less natural habitat for aquatic fauna.

The aquatic parts of the creeks would be expected to provide habitat for aquatic invertebrates, fish, frogs, waterbirds and possibly turtles. The water in the creeks would also be an important source of drinking water for terrestrial fauna using adjacent bushland.

p.22 Riparian vegetation along the upper sections of the creeks has also been substantially modified, being reduced in many places to a narrow, and often sparse, band of trees. However, some small remnant patches of bushland remain, especially as part of old creek meanders that have been bypassed by channelisation works. Largely because of the small size and narrowness, as well as because of weed invasion, mowing and partial clearing, the habitat value of riparian vegetation in these areas has been significantly reduced.

Much more substantial riparian vegetation remains along the downstream section of Etialong Creek, although it has been subject to substantial weed infestation. Due to the relatively large area of the remnant riparian vegetation in this area, and the density of the understorey and ground litter, it would be expected to provide secure habitat for many species of native birds, reptiles, frogs and some mammals, such as possums and bandicoots.

The two remaining sedge swamps in the study area, Iluka and Kahibah Lagoons, retain much of their original habitat character other than for marginal clearing and weed invasion. The dense sedges in these swamps would provide secure habitat mainly for small birds and frogs.

The several remnant bushland reserves included in the study area generally retain their original habitat attributes, although their reduced size and relative isolation from other bushland areas by surrounding residential development would compromise their habitat values to some extent. All of the remnant bushland areas would be expected to provide habitat for a range of native bird and reptile species, as well as several species of native mammals, such as possums and bandicoots.

Another important habitat attribute of the creeks system is its role as a fauna movement corridor. Although much of the length of the creeks has been substantially modified by flood mitigation works, most areas still retain some native vegetation, even if only a narrow band of trees in some places. The more or less continuous band of vegetation along the creeks would provide a movement corridor for many species of birds but is unlikely to be of benefit to other native fauna.

4.4.2 Fauna Assemblage p.23

The fauna assemblage of the study area has been sampled by a number of past studies (Payne, 1989; Laxton & Duell, 1991) which have provided lists of fauna observed in the study area as well as predictive lists of fauna considered likely to occur. Some additional fauna investigations were undertaken for the present study, specifically targeting frogs which were poorly sampled by previous studies. A full list of vertebrate fauna recorded in the vicinity of the study area has been compiled from these studies and is presented in Appendix 2[5], and the observed fauna assemblage of the study area is summarised below:

Fish

The fish fauna of the study area is known only from limited sampling undertaken by Laxton & Duell (1991) who recorded seven species of fish: Striped Gudgeon (Gobiomorphus australis), Mosquitofish (Gambusia affinis), Short-finned Eel (Anguilla australis), Long-finned Eel (Anguilla reinhardtii), glassfish (Ambassis jacksoniensis), Sea Mullet (Mugil cephalus) and Australian Bass (Macquaria novaemaculata). The last three species were restricted to the brackish waters of the lower section of Ettalong Creek.

It is likely that more detailed fish sampling would result in records of more species of fish. Other species of gudgeons are likely to occur in the freshwater reaches of the creeks, and other species of estuarine fish in the lower reaches of Ettalong Creek.

The recorded fish fauna of the study area is typical of small creek systems of coastal New South Wales with a connection to estuarine waters.

Frogs

Earlier studies, especially that of Laxton & Duell (1991) commented on the absence of frogs from the study area. Original field investigations undertaken as part of this study recorded four frog species: Eastern Dwarf Tree Frog (Litoria fallax), Leaf-green Tree-frog (Litoria phyllochroa), Common Eastern Froglet (Crinia signifera) and Brown Striped Frog (Limnodynastes peronii). These species are typical of small freshwater swamps and creeks along the central coastal area of New South Wales, and it is likely that other common frog species also occur in the area.

[5] Two species listed as being observed by Laxton & Duell (1991) are highly questionable and have not been included in Appendix 2. The Four-toed Skink (Hemiergis peronii) according to Cogger (1992) occurs in South Australia, Western Australia and Victoria. Similarly, the Black-tailed Native-hen (Gallinula ventralis) is essentially an inland bird (Blakers, et al., 1984).

p.24 The failure of previous studies to locate many frogs in the study area may be due to timing of the surveys (the Laxton & Duell (1991) study was undertaken in June when few frogs are active), prevailing weather conditions, or recent disturbance of habitats as part of flood mitigation works.

The permanent and temporary waters of the various parts of the creeks and the swamps provide suitable habitat for most species of frogs, providing that aquatic and riparian vegetation is also present.

Reptiles

The recorded reptile fauna of the study area is restricted to three species of snakes, four species of lizards, and one turtle: Yellow-faced Whipsnake (Demansia psammophis), Marsh Snake (Hemiaspis signata), Red-bellied Black Snake (Pseudechis porphyriacus), Copper-tailed Skink (Ctenotus taeniolatus), Eastern Water Skink (Eulamprus quoyii), Pale Garden Skink (Lampropholis guichenoti), Weasel Skink (Saproscinus mustelinus), Eastern Blue-Tongued Lizard (Tiliqua scincoides) and Eastern Snake-necked Turtle (Chelodina longicollis).

Whilst it is likely that other species are also present, the reptile fauna of urban bushland remnants is typically depauperate as a result of habitat destruction and predation by domestic cats and dogs.

Birds

Due to their high mobility, birds can move more freely between habitats than most other fauna, and therefore the bird fauna assemblage of urban bushland remnants is typically more diverse than for other groups of fauna, although not all of these species may be resident in the area.

A total of 83 species of birds have been recorded in the study area. Waterbirds, such as Black Duck (Anas superciliosa) and Dusky Moorhen (Gallinula tenebrosa), occur primarily in the aquatic habitats but would also use riparian vegetation for nesting, roosting and some foraging. Small bush birds, such as Superb Fairy-wren (Malurus cyaneus) and White-browed Scrubwren (Serticornis frontalis) rely on dense understorey vegetation for protection from predators. Larger and more mobile bush birds, such as Laughing Kookaburra (Dacelo novaeguineae), Sulphur-crested Cockatoo (Cacatua galerita), Australian Magpie (Gymnorhina tibicen) and Rainbow Lorikeet (Trichoglossus haematodus) typically make use of the canopy of trees and taller shrubs, often also foraging in nearby parklands and gardens.

p.25 Payne (1989) recorded two pairs of Australian Brush Turkey (Alectura lathami) in remnant patches of vegetation along Ettalong Creek. One of these birds was also observed during field investigations for the present study. Because they are essentially ground dwelling birds, Australian Brush Turkey are particularly vulnerable to predation by domestic dogs and cats.

Mammals

The mammal fauna of bushland remnants is usually the most decimated by the close proximity of urban development, especially through predation by domestic cats and dogs, and competition from introduced mammals such as Black Rat (Rattus rattus). The mammal fauna of small remnants tends to be limited to several species of possums and gliders, bandicoots and possibly the Short-beaked Echidna (Tachyglossus aculeata). Native small terrestrial mammals are usually replaced by introduced rats and mice. Macropods, which require a large range, are usually quickly displaced as a result of habitat clearing and predator pressure. Koala (Phascolarctos cinereus) and other larger arboreal mammals also typically require large areas and do not survive in smaller remnants even if suitable habitat is still present.

Mammal records for the study area include: Long-nosed Bandicoot (Perameles nasuta), Common Ringtail Possum (Pseudocheirus peregrinus), Sugar Glider (Petaurus breviceps), Common Brushtail Possum (Trichosurus vulpecula) and Grey-headed Flying Fox (Pteropus poliocephalus). Whilst no trapping has been undertaken for small terrestrial mammals, it highly unlikely that any native rats, mice or small marsupials remain other than for the Water-rat (Hydromys chrysogaster). It is likely that the remnant vegetation in the study area would be used as foraging habitat for several species of bats other than the one species recorded. No systematic bat survey has been undertaken within the study area.

4.4.3 Significant Fauna Species

No species of endangered fauna, as listed on the current Schedule 12 of the National Parks & Wildlife Act 1974, have been recorded within the study area, and none of the species recorded are considered to have any particular conservation significance.

4.5 WATER QUALITY p.26

A detailed study of the chemistry of Ettalong Creek was undertaken by Laxton & Duell (1991). This study took measurements of:

- water temperature,
- conductivity,
- salinity,
- pH,

- dissolved oxygen,
- specific gravity,
- water transparency,
- nitrogen (NH_3, TKN, NO_2, NO_3),
- phosphorus (TP, OP),
- chlorophyll-a,
- suspended solids (total and volatile),
- faecal coliform bacteria.

The detailed results of these studies are presented in the Laxton & Duell (1991) report. In discussing their results, Laxton & Duell found that at the time of sampling, most parameters of the water quality Ettalong Creek fell within accepted standards except for pH, dissolved oxygen and nutrients (nitrogen and phosphorus).

Although below the standard adopted by the study, the low pH in the upper reaches of the creek is not atypical of creeks and swamps occurring on sandplains and is not considered to represent an abnormal ecological situation.

Dissolved oxygen levels in most waterbodies fluctuate in a daily cycle as well as in response to longer term weather and other environmental conditions. The occasional low levels recorded by Laxton & Duell would be unlikely to adversely affect the ecology of the creek unless they were maintained for extended periods. Such a prolonged reduced dissolved oxygen level could result from extensive algal blooms that often accompany eutrophication (excessive levels of nutrients).

Elevated levels of nutrients was considered by Laxton & Duell to be a potentially serious problem in Ettalong Creek, and considered dog and cat faeces, as well as sediment eroded from the catchment to be the most likely sources of nutrients in the creek. In addition to these sources, nutrients can derive from detergents and fertilisers used on residential properties in the catchment.

5. REHABILITATION & MANAGEMENT ISSUES p.27

5.1 NATURE CONSERVATION

The two remnant dunal swamps in the study area, Iluka and Kahibah Lagoons, are included in State Environmental Planning Policy 14 - Coastal Wetlands and, as such, have nature conservation value at a State level (see Figure 4). Preservation of these areas is encouraged by the State Government policy, and protection of these areas from adverse impacts is therefore a major consideration of this plan.

Other remnants within the study area cannot be considered to have significant nature conservation value at a State level for a number of reasons:

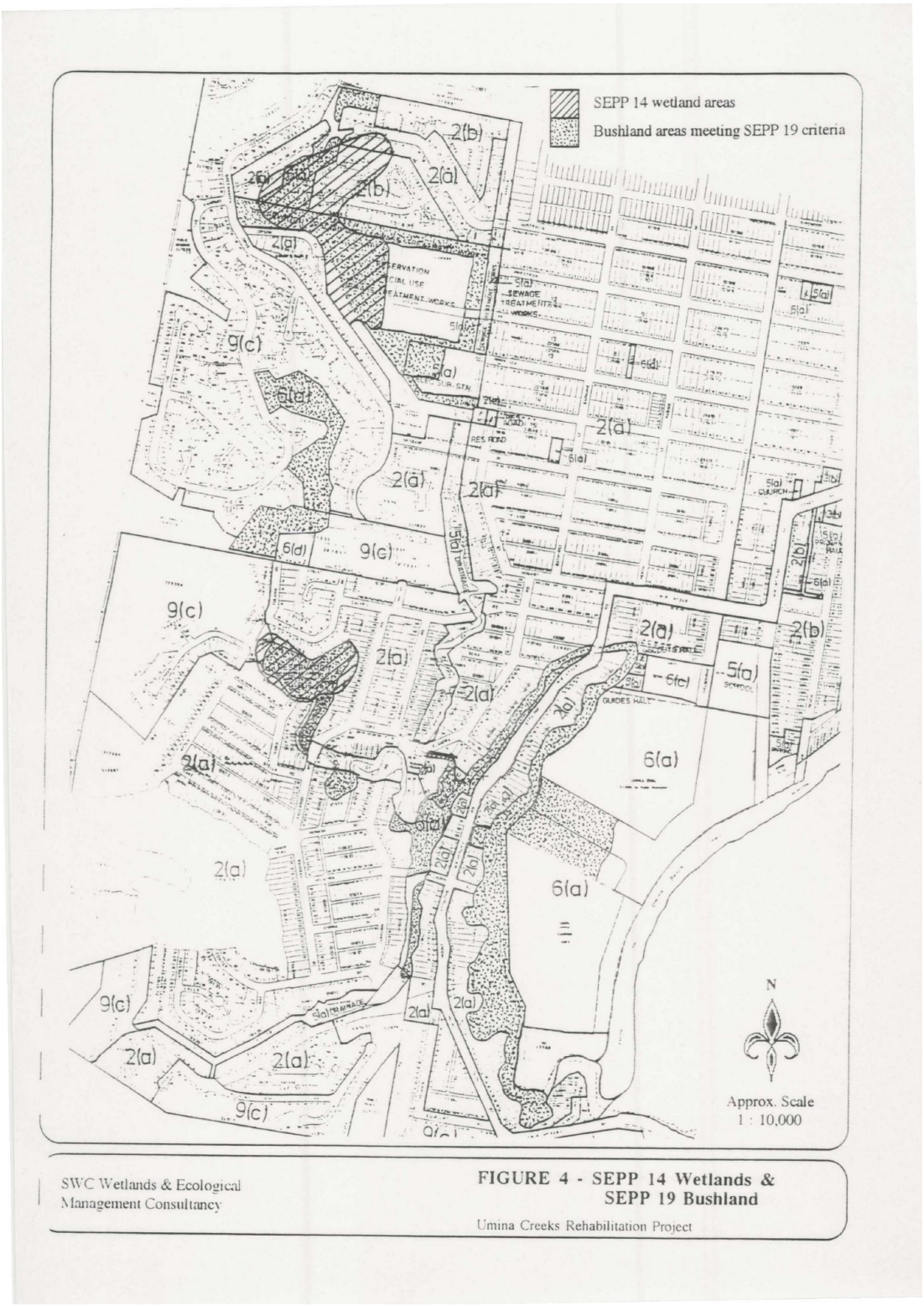
- the small size and fragmented nature of remnants within the study area;
- the serious weed infestation; and
- the general absence of significant flora and fauna species (other than a few plant species of local interest).

However the study area does have local conservation interest, containing the last remnants of the original sandplain vegetation in the umina area. Many of the remnants retain enough of their original character to be considered as “bushland” within the context of State Environmental Planning Policy 19 - Bushland in Urban Areas (see Figure 4). Preservation and appropriate management of these remnants is encouraged by this State Government policy.

Despite the many past disturbances, the study area retains many natural values, and maintenance and enhancement of these values is the principle objective of this plan. Without intensive active management, the natural remnants within the study area will eventually degrade to a condition virtually devoid of native plants.

5.2 BUSHLAND REHABILITATION

As noted above, natural remnants within the study area require active management to prevent their further degradation and eventual loss, and where appropriate this management should lead to rehabilitation of natural communities. When applied to natural communities, the term rehabilitation implies an aim of re-establishing a relatively stable community of native species that generally resembles the original community. In many circumstances, especially within urban areas, it is not possible to completely replicate and sustain the character of the original community, and practical maintenance requirements often favour the rehabilitation / creation of simpler, lower maintenance communities.



p.28

p.29 Within urban situations, the continuing impacts on natural remnants deriving from the close proximity of residential development means that even rehabilitated areas will require on-going maintenance, although the level of this maintenance will generally be considerably less than that required to get the remnant to a rehabilitated state. Further, the sensitivity of regenerating bushland generally requires that most maintenance be done by hand, making rehabilitation projects very labour intensive.

Given the high maintenance and labour requirements for bushland rehabilitation projects, it is important that care be taken at the planning stage to select areas for which rehabilitation is justifiable and sustainable. Further, rehabilitation is not always the best option for a small remnant, especially where weed infestation is severe and the remnant is relatively narrow, which makes it more susceptible to on-going impacts. In such areas, a more formal form of management, such as a landscaped park area, may be more appropriate.

The high labour requirements generally make it difficult for Councils to fund such rehabilitation and maintenance works as part of their normal budgets. Consequently bush regeneration projects are often initiated and undertaken by community groups, such as Landcare groups, sometimes with funding assistance through programs such as Land Environment Action Program (LEAP).

5.3 AQUATIC WEEDS

Many of the aquatic species recorded in the creeks are introduced, such as Parrots Feather (Myriophyllum aquaticum), Sagittaria (Sagittaria graminea) and Sprouting Clubrush (Isolepis prolifer). These plants cannot be controlled in the same manner as bushland weeds (mechanical clearing or spraying) without causing considerable damage to the ecology of the creeks. Even if it was decided to implement a control program and most of the weeds were successfully removed, they would quickly re-establish from seed, requiring on-going control and consequent damage to the ecology of the creeks.

Accordingly, it is considered that control of most aquatic weeds in creeks within the study area is undesirable given the potential ecological impacts of mechanical and chemical controls. However, measures should be implemented to control potentially serious weeds that have the potential to dominate and alter the ecology of the creeks. All such weeds are listed as noxious in New South Wales. Two noxious weed species, Water Hyacinth (Eichhornia crassipes) and Salvinia (Salvinia molesta), have been recorded in the past but were not recorded during field investigations for this study, although they may still be present in small numbers. Another noxious weed species, Alligator Weed (Alternanthera philoxeroides), was located by this study in Lower Ettalong Creek (Area D). The existing small patch of this weed should be removed as a matter of urgency to prevent it from colonising other areas of the creek.

5.4 MAINTENANCE OF WATER QUALITY p.30

The main potential water quality problems in remnant waterbodies in urban areas are elevated levels of nutrients and the associated problem of excessive sedimentation. These problems encourage growth of weeds and algae, which in turn can affect other water quality parameters, such as dissolved oxygen.

The Laxton & Duell (1991) study of the water quality of Ettalong Creek identified existing levels of nutrients above their adopted standards for these parameters. The most likely sources of these elevated nutrient levels were identified as dog and cat faeces, detergents, fertilisers and sediment eroded from the catchment (nutrients are often attached to particles of sediment).

Reducing the volumes of dog and cat faeces, detergents and fertilisers entering the creeks system will require changes in people's attitudes, not only the people who live in the catchment but also the broader community as a whole. Whilst Council could make a contribution towards this process through public education programs (e.g. letterbox drop of leaflets), substantial control of these potential pollutants is likely to be only slowly achieved as broader community attitudes change.

Control of catchment erosion and subsequent sedimentation in creeks and wetlands can be more effectively achieved in the shorter term by enforcement of erosion controls on building and development sites, and by the use of structures to intercept and filter sediment from stormwater.

5.5 FLOODING AND EROSION

5.5.1 Flood Mitigation Maintenance

Flooding of residential properties in the vicinity of the creeks is obviously a major concern in the area, having resulted in a number of flood management studies and subsequent flood mitigation works. It is understood from Council officers that the works that have been completed to date are considered to adequately address flooding problems in the area, and no further mitigation works are planned, although some maintenance of existing works and channels will be required. The floodplain management study for Kahibah Creek recommends that maintenance activities will include the need to maintain the hydraulic efficiency of the channels through periodic removal of built-up sediment and plant growth in the channels which could retard flood flows.

p.31 The periodic maintenance of the creeks is a contentious issue. On the one hand, regular maintenance reduces the risk of flooding, and on the other hand it is perceived to cause ecological degradation. There is little doubt that clearing of vegetation from a creek does substantially simplify aquatic ecosystems, by not only removing substantial populations of aquatic plants, but also the fauna habitat that they provide. Aquatic plants in creeks also serve an important role in removing excess nutrients from water.

There is an increasing trend to design drainage systems in an environmentally sympathetic manner, such that engineered drainage channels resemble natural channels in terms of habitat variety (e.g. Halder, 1993). However, these principles are more easily applied in the design of new drainage systems, and it is more difficult to redesign existing systems, especially when potential flooding of nearby properties is a consideration. In this regard, the management options for the creeks within the study area are somewhat constrained by the effects of past inappropriate planning and development of the area.

Re-evaluation of the flood mitigation developments in the study area, and the floodplain management strategies adopted for the area is outside of the scope of this plan. Accordingly, the recommendations of this rehabilitation and management plan must make allowance for the need identified in the floodplain management study for regular maintenance of the creeks within the study area.

Whilst it is beyond the scope of this plan to question the need for periodic maintenance of creeks, a number of issues can be raised regarding the frequency of works:

Sedimentation

The rate of build-up of sediment in the creeks would appear to be a major factor influencing the frequency of maintenance dredging, and the adoption of measures to reduce sedimentation in the creeks could reduce the frequency of works. Erosion and sediment controls at building and development sites in the creeks' catchments would assist in this regard, as would the placement of sediment traps throughout the catchments (the identification of suitable sites for sediment traps is outside of the brief for this study).

Dredged material should be placed well back from the creek banks or, preferably, totally removed from the area to prevent further sedimentation of the creek by this material.

Streambank erosion is another source of sediment. This issue is discussed below.

Plant Growth p.32

Friction of reeds and other aquatic plants influences the rates of stormwater flows in the creeks, and therefore potentially contribute to flooding (Willing & Partners, 1991). Periodic removal of excess plant growth is therefore apparently considered necessary to maintain the hydraulic efficiency of the creeks.

Dense growth of reeds and other waterplants can be typically directly correlated to excessive build-up of sediment. Implementation of strict erosion and sediment control strategies within the catchment can therefore reduce the need for maintenance removal of dense plant growth as well as removal of sediment.

It has been suggested that shading of the creeks by trees planted along banks can control the growth of water plants in the creeks. Dense riparian shading can certainly limit plant growth, but the shade needs to be very dense to have a substantial effect on the growth of water plants, and is best achieved in very narrow creeks with tall dense forest on both sides, not just a narrow band of trees. The creeks within the study area present limited opportunity for this effect. In any case, it is considered desirable to encourage some aquatic vegetation for water quality control, at least in areas where this does not substantially interfere with flood flows.

Maintenance Plan

It is understood that creek maintenance works have generally been undertaken on an ad hoc basis to date. This approach has on occasions resulted in belated maintenance clearing of large sections of the creeks at one time, resulting in substantial changes to the ecology of the creek. It is suggested that maintenance clearing should be undertaken more frequently and only in areas where it is necessary. This should obviate the need for any large scale maintenance works.

Timing of creek maintenance works should be based on an objectively measured condition of the creek, which should be frequently assessed. It is recommended that the creeks should be inspected at six monthly intervals to identify areas of excessive sediment build up and/or dense reed growth. Only the areas of worst build-up should be cleared. Whilst larger shoals of sediment should be readily apparent, some degree of subjective judgement is unavoidable.

p.33 The Kahibah Creek floodplain study (Willing & Partners, 1991) provided typical cross sections for different sections of the creeks, which Council officers use as a guide for maintenance works. The study does not, however, provide any guidelines on acceptable variances from these cross sections. It is recommended that the flooding models be used to determine such acceptable variances, which can then be used as a guide to determine whether maintenance works are required at any time in any part of the creek. In the absence of this advice, and subject to concurrence of Council flooding engineers, it is recommended that as an interim guide that maintenance clearing should not be undertaken where the sediment build-up is less than 100 millimetres.

Where a need for maintenance clearing is identified, such works need to be kept to the minimum required, and it is recommended that a ‘patchy’ approach to maintenance be adopted. This approach requires that only small patches of sediment or plant build-up should be removed from any one location

at any one time. In general, as an interim guide, it is suggested that no more than 100 metres of the length of the creeks should be subject to maintenance works in any year, and that the works should be undertaken in patches no longer than 20 metres, with at least 20 metres of undisturbed creek left between each excavated patch.

The aquatic vegetation in the creeks is too valuable to be removed unnecessarily, and maintenance works should never be undertaken merely as a placating response to concerns expressed by local residents. Instead, in cases where dredging is not necessary, attempts should be made to inform the residents of the issues behind maintenance requirements.

In order to address the concerns of residents regarding creek maintenance, it has been suggested that Council organise a facilitated workshop involving Council engineers, Council environmental officers, members of the existing s. 377 Committee, members of the soon to be formed Landcare group, and other invited residents (M. Bennett, pers. comm. - see Appendix 5).

5.5.2 Streambank Erosion

A parallel issue is erosion of banks of the creeks. Development of the catchments of the creeks has increased the volume and velocity of stormwater runoff, which in the creeks, not only compounds flooding but also increases erosion of banks exposed to the faster flowing and increased volumes of water. Channel works along the creeks have also required the removal of much riparian vegetation that previously stabilised the banks, and despite attempts at revegetation, some areas remain unstable. These areas need to be stabilised to prevent further erosion (see Figure 5).

5.6 PASSIVE RECREATION p.34

5.6.1 Opportunities

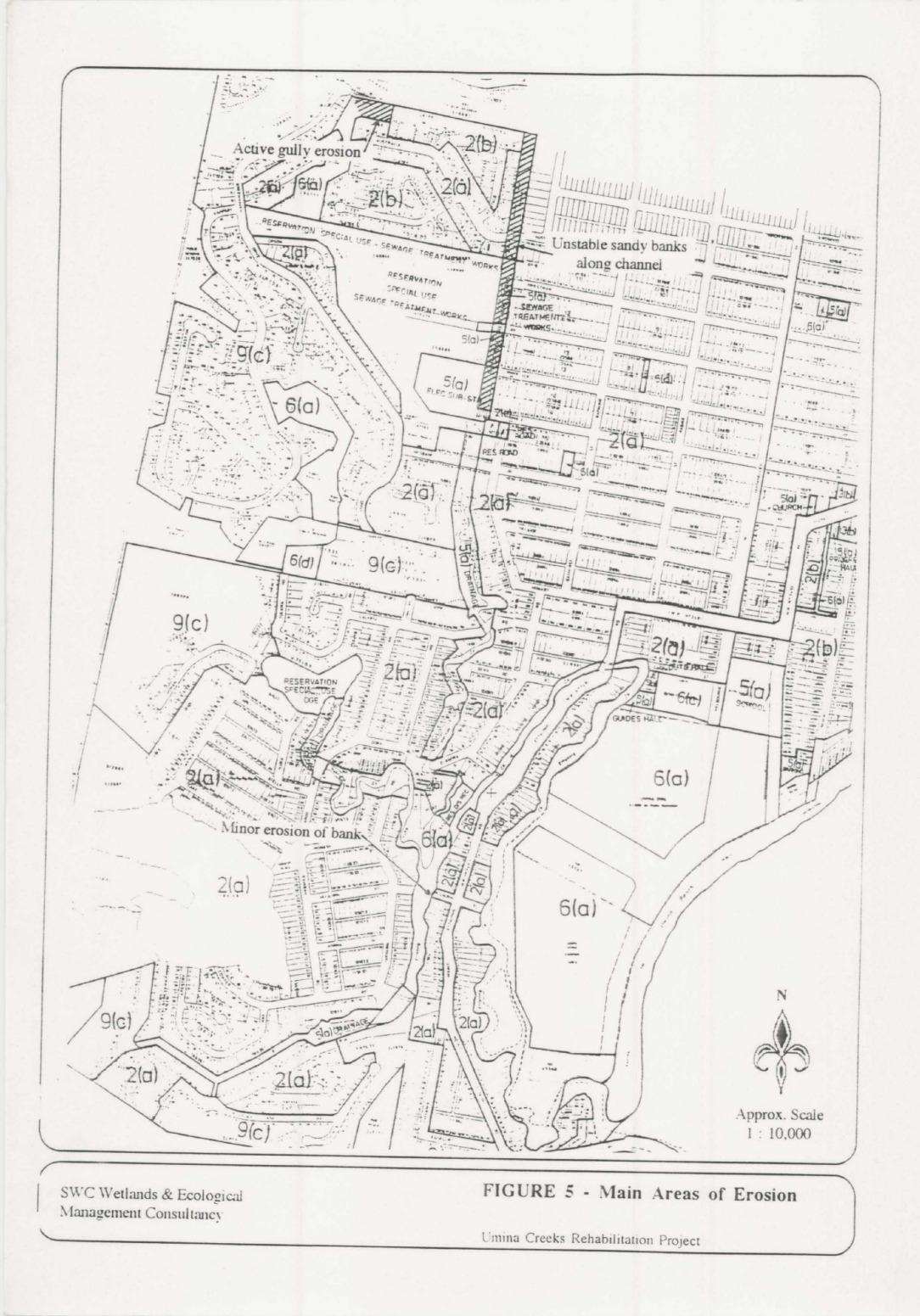
Opportunities for passive recreation are limited by the narrowness of the public corridors adjoining Ettalong, Iluka and Kahibah Creeks in most areas, however, the following recreational opportunities have been identified:

- Walkways and/or cycleways alongside suitable stretches of the middle to lower reaches of the creeks. The almost flat grade of some well-drained sections make them appropriate.
- Nature trail(s) incorporated into the rehabilitation of appropriate sections of the downstream section of Ettalong Creek (where some original vegetation remains), including signage identifying various plants and their role in the ecosystems.
- The family picnic area adjacent to Umina Oval which is already provided with wooden tables and benches in a suitable shaded grove of trees.
- The children's playground on the corner of Greehaven Drive and Brisbane Avenue which is provided with play equipment and picnic tables and benches.
- The playing fields at the end of McEvoy Road near the upper reaches of Kahibah Creek, which already have lights and sports equipment.
- Passive recreational pursuits such as nature observation, bird watching and photography may be provided by the two sedge swamps (Iluka and Kahibah Lagoons) and creek stretches which provide habitat for breeding waterbirds and other wildlife.
- Access towards Umina Beach which is presently provided by the wide sandy walkway from Etta Road through the recreation reserve, providing the opportunity to pass through remnant bushland.

5.6.2 Constraints p.35

The following constraints to the development of recreational opportunities have been identified:

- A lack of existing cycleways within the area into which to link.
- Walking tracks and cycleways may be incompatible for safety reasons if serving a dual purpose. Cyclists tend to be fast and silent, and approach walkers without warning.
- Areas prone to flooding or waterlogging are not suitable for walkways or cycleways.
- Cycleways require a firm, preferably sealed surface. Walkways need to be on a firm surface (not loose sand), graded and maintained, but do not need to be sealed.
- Public safety considerations, such as the water hazard which the creeks may present to children.
- The stabilisation and revegetation measures on the dunes behind Umina Beach need to be continued, which makes them unsuitable for recreational use.
- The upstream reaches of the creeks are unsuitable for active recreational pursuits, such as cycling, because of steeper topography (Kahibah Creek), poor accessibility to public land (Iluka Creek), and channelside erosion works in a confined corridor (Ettalong Creek).
- Access in the vicinity of Iluka Lagoon is restricted by the waterlogged surrounds and tall, dense vegetation of sedges and reeds. A boardwalk would be necessary to provide better observational opportunities.



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5.7 BUSHFIRE HAZARD p.37

Dense vegetation in close proximity to residential properties poses a fire hazard for those properties. Whilst it is far preferable to design residential developments and house structures to minimise such hazards, many existing residential areas are poorly designed in this regard. Consequently, in such areas, bushfire hazard should be considered as an issue in the management of remnant vegetation.

Dense vegetation along parts of the creeks in the study area occurs in very close proximity to residential properties, and this is likely to be an issue behind some requests to Council for clearing of some creek areas. However, because of the relatively small areas of remnant vegetation along most parts of the creeks, and the relative permanence of water, these areas represent only a relatively minor fire risk.

Of more concern is the close proximity of dwellings to dense bushland in upper parts of the catchment within the study area.

Potential fire hazard reduction strategies include:

- construction and maintenance of fire breaks;
- periodic mechanical clearing of understorey vegetation;
- periodic hand clearing of understorey vegetation;
- periodic hazard reduction burning.

5.8 STATUTORY CONSIDERATIONS

5.8.1 Gosford LEP

All of the land within the study area is designated under the Gosford Local Environment Plan as either public open space (6a) or drainage reserve (5a). Rehabilitation, landscaping and passive recreational usages would be permitted uses under these zonings.

5.8.2 SEPP 14 - Coastal Wetlands p.38

Whilst still in relatively good condition, the two wetlands within the study area (Iluka and Kahibah Lagoons) are subject to on-going impacts, especially sedimentation from upstream areas, and consequent weed invasion. Whilst some protective and/or rehabilitation works in and around these wetlands are desirable, their gazettal under SEPP 14 means that most works would be deemed to be "designated development" under the Environmental Planning and Assessment Act 1979, and would need to be the subject of a development application and environmental impact statement.

5.8.3 SEPP 19 - Urban Bushland

SEPP 19 has the general aim of "to protect and preserve bushland bushland within ... urban areas because of:
(a) its value to the community as part of the natural heritage;
(b) its aesthetic value;
(c) its value as a recreational, educational and scientific resource." (cl. 2(1)).

Apart from giving Councils the power of consent for activities that will disturb bushland "zoned or reserved for public open space purposes", SEPP 19 also encourages the preparation of management plans for bushland that is to be "developed" for recreational purposes. Once adopted by Council, this Rehabilitation and Management Plan would constitute such a plan under SEPP 19.

5.8.4 National Parks & Wildlife Act 1974

The National Parks & Wildlife Act 1974 requires that a licence is required to "take" endangered fauna (s. 92B), which includes "significant modification of the habitat of the fauna which is likely to ad-

versely affect its essential behavioural patterns" (s. 5(1)). Where a licence is required, the application needs to be accompanied by a fauna impact statement (s. 92B).

No endangered fauna species have been recorded within the study area, and therefore these provisions of the NPW Act do not apply to the recommendations of this plan.

The endangered fauna provisions of the Environmental Planning & Assessment Act 1979 also do not apply to the recommendations as they do not require development consent.

6. REHABILITATION & MANAGEMENT CONCEPT p.39

6.1 OVERALL CONCEPT

The key elements of this Rehabilitation and Management Plan are outlined below:

Ettalong Creek Nature Park

Despite major weed infestation, the vegetation of the lower reaches of Ettalong Creek is considered significant in a local context and warrants high priority in terms of protection and management. It also has value and potential as a recreational area, supported by its proximity to the caravan park and beach, and to ponds of permanent water in the creek.

The weed infestation in this area requires intensive rehabilitation, and given the narrowness of the remnant and the close proximity of residential properties will require on-going intensive management. Rehabilitating the area to a condition resembling the original bushland would prove difficult, and may be opposed by adjacent residents as a fire hazard.

Instead, this plan recommends that the area be developed as a nature park or mini botanic gardens, which would be the focus of the rehabilitation project. The nature park would comprise Lower Ettalong Creek (Area D) and the part of Ettalong Creek Billabong (Area E) downstream of Etta Road (see Figure 6).

It is proposed that this area would be a mix of rehabilitated small patches of remnant native vegetation and more formal mown and landscaped areas. The park would incorporate a walking trail and several rest areas with seats and, possibly, some formal landscape features, such as stone sculptures. Limited interpretive signage, including tree name plaques, should also be provided.

It would be preferable to gain the support of adjacent residents to assist with on-going maintenance of the proposed park, who could assist with mowing of parts of the area, weed control, plantings and other maintenance tasks. In this regard it may also be diplomatic to leave some of the non-native trees planted by adjacent residents, particularly non-invasive species such as Jacaranda.

Boundaries between public land and private property in the lower Ettalong Creek area are presently poorly defined and need to be accurately identified. Vegetated barriers may be required along some property boundaries to provide privacy, such as between the caravan park and the proposed picnic area at the end of Ettalong Creek.

p.40 Existing informal access tracks and bridges (mostly comprising planks) should be rationalised as part of the establishment of the walking trail through this area. The walking trail shown in the conceptual plan presented in Figure 6 has been located so as to minimise potential conflict with private properties, but should also serve as an access to the beach for the residents of these properties.

Regular usage of the walking trail will increase public visibility of the area and should thereby limit undesirable activities such as rubbish dumping and vandalism.

Kooloonbung Creek Reserve at Port Macquarie is an excellent example of a nature park initiated, developed and managed by a community group. With the assistance of Port Macquarie Council, this group has developed a long walking trail through the reserve, incorporating boardwalks and bridges,

have developed a number of seating and rest areas, have provided interpretive signage, and undertake on-going weed control.

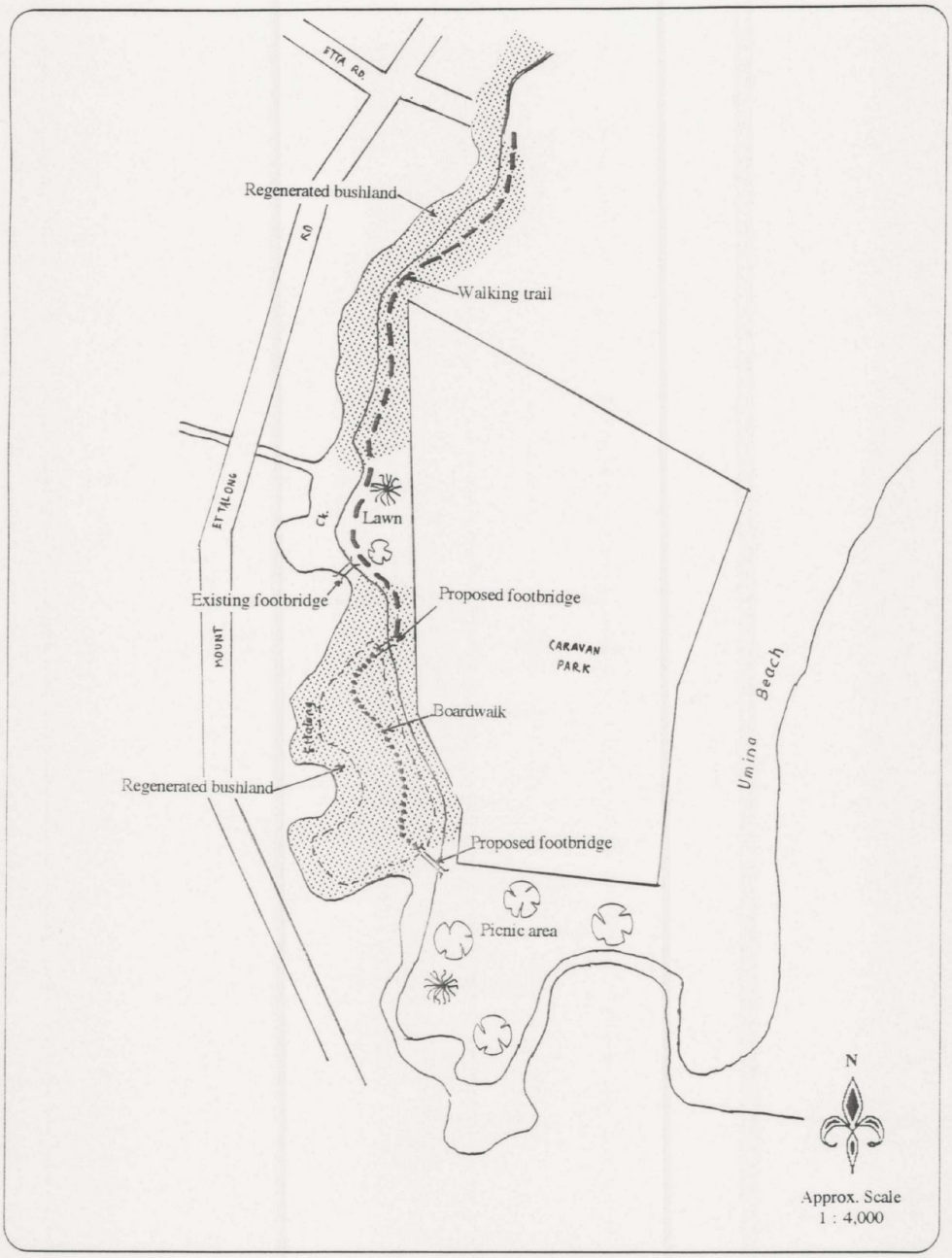
Creek-side Walking Trails

Walkways based on the informal tracks already in existence along the middle to lower reaches of the creeks should be upgraded and maintained, and extended where appropriate (see Figure 7). The community already makes use of these tracks and this recreational opportunity should be retained.

Recreational corridors encouraging local residents to make use of the creek-side areas should have the added benefit of discouraging the dumping of rubbish and garden refuse (a practice now occurring). Used walkways would tend to promote a protective community attitude towards the waterways and adjacent reserves.

It is considered inappropriate to provide for cyclists along these walkways because of the potential conflict with walkers. In addition, cycleways are generally developed as a means of separating cyclists from other road traffic, which is not a major issue in the streets surrounding the study area as they generally carry only small volumes of traffic and are relatively safe for cyclists.

Some rehabilitation and planting of vegetation along the creeks is proposed for aesthetic, wildlife habitat and bank stabilisation purposes.

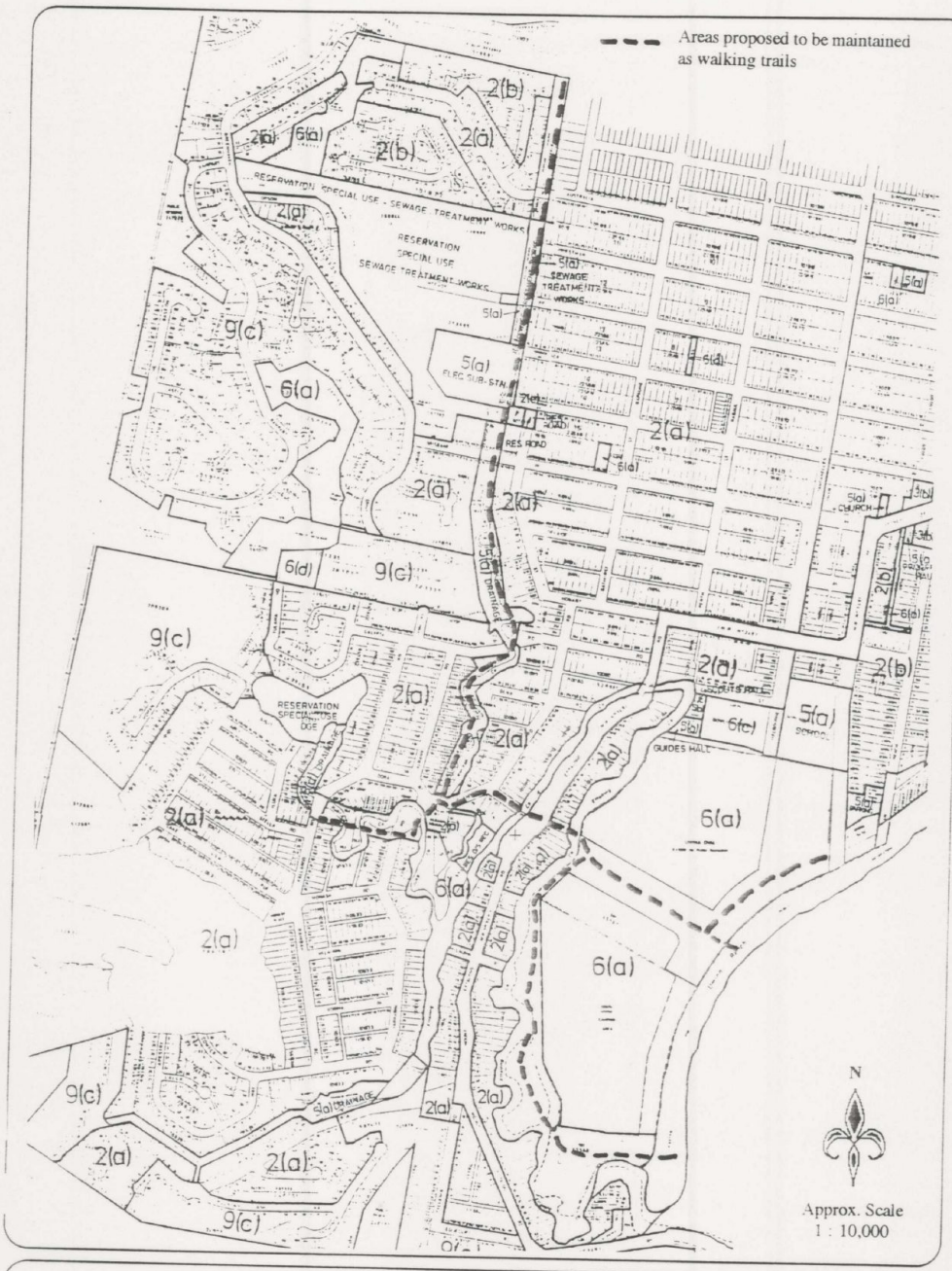


SWC Wetlands & Ecological Management Consultancy

FIGURE 6 - 'Ettalong Creek Nature Park' Concept

Umina Creeks Rehabilitation Project

p.41

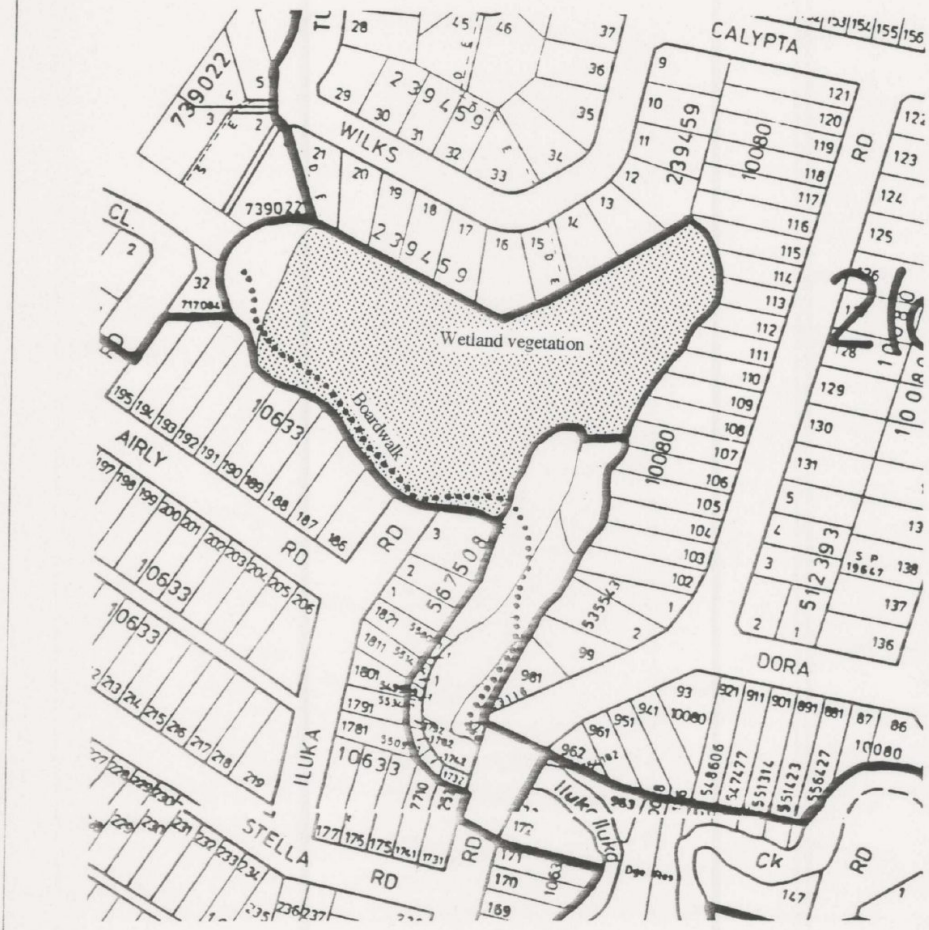


SWC Wetlands & Ecological Management Consultancy

FIGURE 7 - Proposed Walking Trail System

Umina Creeks Rehabilitation Project

p.42

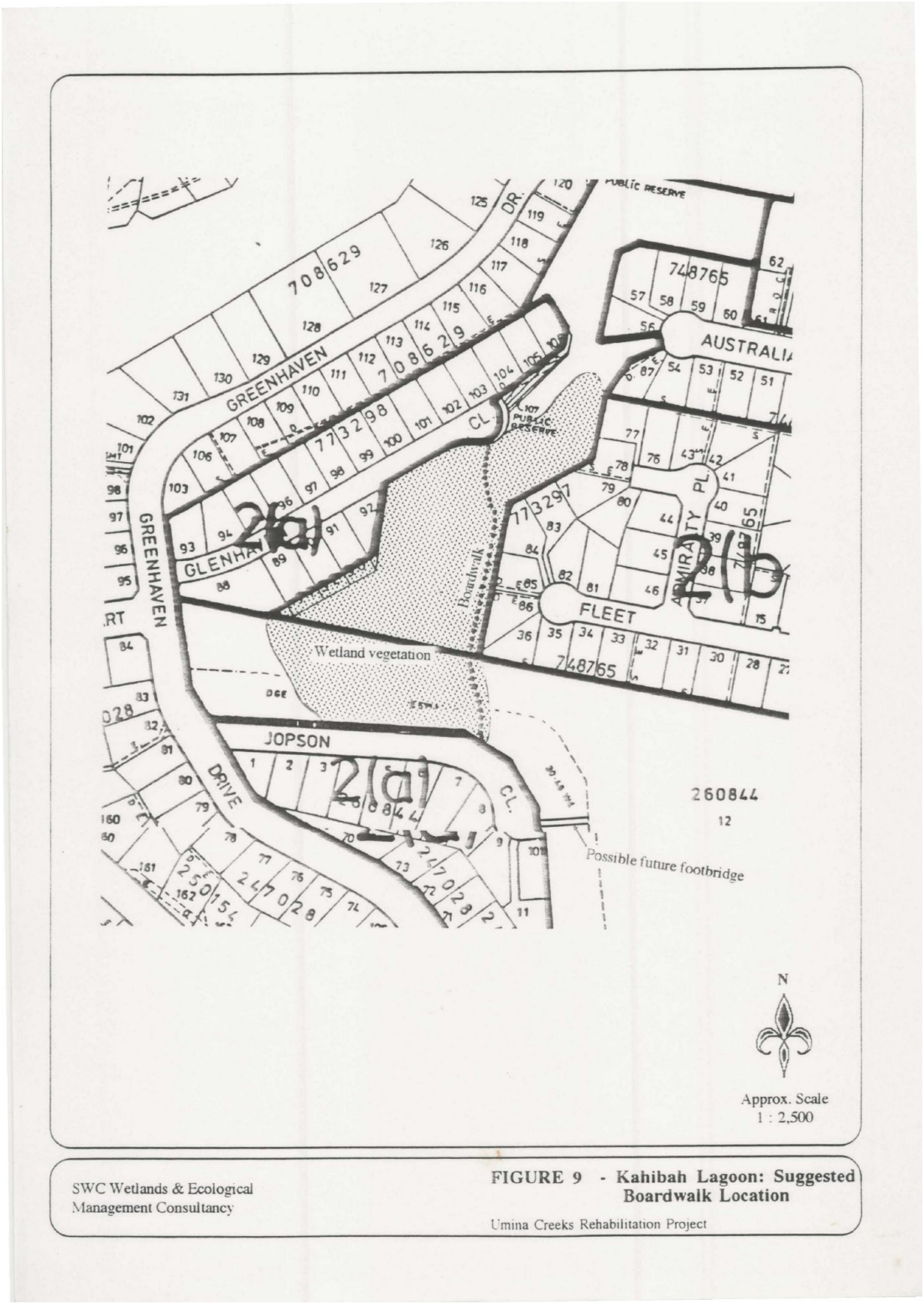


SWC Wetlands & Ecological Management Consultancy

FIGURE 8 - Iluka Lagoon: Suggested Boardwalk Location

Umina Creeks Rehabilitation Project

p.43



p.44

Bushland & Wetland Reserves p.45

The two remnant wetlands and the three bushland reserves in the study area should be rehabilitated, where appropriate, and retained in a natural condition. These will provide representative examples of the bushland originally occurring in the area, as well as conserve inherent wildlife habitat values.

These areas also have considerable value as educational and passive recreational resources, and basic facilities should be provided at each to encourage usage by local residents. Increased usage of these

areas will discourage undesirable activities such as rubbish dumping. Suitable basic facilities would include a small formal access point (fenced from the wetland), some seating, interpretive signage, and possibly boardwalks across the wetland areas (any works within SEPP 14 areas, including boardwalks, would need to be subject to an EIS). As with walking trails, boardwalks through the two wetland areas would discourage undesirable activities by increasing public visibility of these areas. Suggested locations for boardwalks are presented in Figures 8 and 9.

6.2 REHABILITATION STRATEGIES

The following specific rehabilitation strategies are recommended for each of the management areas. The costings for these works have been estimated based on the study team's past experience in revegetation and erosion control projects. Use of volunteer labour would substantially reduce some costs (especially for weed control), which have been based on the assumption that the work would be undertaken by contractors. These costings do not cover hazard reduction burning nor any specific non-rehabilitation developments (e.g. boardwalks, bridges).

Area A - Umina Beach Dunes

Extensive stabilisation and protection works have already been undertaken in the dune area. Efforts have been generally successful with dense thickets of native species covering much of the area. Most areas are relatively free of weed species, including Bitou Bush (Chrysanthemoides monilifera).

Areas adjacent to the beach and south of the carpark, in particular, have good native shrub cover. However, the road-side area north of the carpark requires enrichment planting. Recent plantings in this area have generally failed, apparently because of drought conditions, and opportunistic grasses and weeds are invading. These weeds will make future native plant establishment difficult in these areas. Further invasion of other weed species in this area is likely.

p.46 The recommended strategy for bare areas is:

- When grasses and weeds become green after rain, spray with a non-residual knockdown herbicide, such as glyphosate. Spray in warmer months when herbicide uptake is superior.
- Lightly cultivate ground and directly apply native shrub seed, particularly fast establishing Coastal Wattle. Supplementary plant with a range of tube-stock native species. Maintain planted species as required.
- Main shrub species suitable for planting in this area are:
Coastal Wattle Acacia sophorae
Sydney Golden Wattle Acacia longifolia
Coastal Tea-tree Leptospermum laevigatum
Coastal Banksia Banksia integrifolia

ESTIMATED COSTS: weed control and planting $3,000

Area B - Umina Beach Park

These areas contain scattered mature native trees together with the exotic Coral Tree (Erythrina x sykesii). The latter species appears well suited to the site, are not unattractive and provide good shade. Their long history in the area appears to have posed few problems, and given the semi-formal character of the area, removal of these exotic trees is not considered to be necessary. Neither further planting

nor tree removal is recommended for this area, and the existing maintenance (mowing) regime is considered to be appropriate.

ESTIMATED COSTS: no additional cost other than existing maintenance

Area C - Umina Beach Bushland

This bushland area is in surprising good condition. Canopy and understorey species are healthy, and a diverse range of native species are found. Minor weed invasion is present around the disturbed edges of the area.

The recommended strategy for this area is:

- No plantings are considered necessary.
- Woody weeds should be removed by hand or by selective spraying of herbicide. Selective spraying of individual woody weed species is critical, as broadacre or careless spraying that kills all vegetation allows opportunistic and aggressive weed species to invade.

- On-going weed management would be easily undertaken by hand.
- Low intensity hazard reduction burning of separate compartments (as defined by walking trails) is recommended as the area currently has high fuel loads.

ESTIMATED COSTS: woody weed control $3,000 /yr

Area D - Lower Ettalong Creek

This area is proposed to form the main part of a semi-formal nature park, which will require extensive weed removal and landscaping. The general rehabilitation strategy recommended for this area is:

- Establish a pathway network.
- Physically clear large areas of woody weed species. In areas where the understorey consists almost totally of weed species, mechanical removal using a bobcat would be appropriate, except where this could destabilise creek edges.
- Selectively spray remaining weeds in areas where little collateral damage to remnant native species would occur. Weeds will need to be removed by hand in areas with large numbers of native plants. The weed control program will need to be on-going, although the intensity of weed control activities can be reduced as rehabilitation proceeds.
- Expand mown areas to provide semi-formal areas.
- Undertake a replanting program. The native species presently occurring in the area (see Appendix 1) should form the core of plantings, although given the proposed semi-formal nature of the area, it is considered that plantings can include species that may not have originally occurred within the study area, such as rainforest species native to other areas of the Central Coast (Benson & Fallding (1981) provide a list of plants native to the Brisbane Water area).

The development and management of this area will require intensive labour input, making it very costly, and probably beyond the resources of Council, if paid labour is used. Accordingly, active community support will be essential to the success of the project. In addition to local residents, it is recommended that support be sought from service clubs, and technical support from organisations such as the Central Coast Group of the Society for Growing Australian Plants.

Whilst this plan provides conceptual guidelines for the development of this area, specific developments within the park should be guided by a detailed master plan which should be prepared by a landscape architect.

ESTIMATED COSTS: initial weed control	$45,000
maintenance woody weed control	$5,000 /yr

Area E - Ettalong Creek "Billabong" p.48

As noted above, the creek through this area has been essentially isolated from the flows in the remainder of the system, although most parts appear to remain shallowly inundated for much of the time. This riparian vegetation retains much of its natural character with the canopy still supporting many native trees, although there are also introduced willows. Weed infestation of the riparian understorey is severe. There are few opportunities for passive recreational access along the length of this section, other than downstream of Etta Road, due to the steepness and narrowness of the banks.

Retention and rehabilitation of the natural bushland features of this area for their habitat and aesthetic values is the recommended strategy for this area. Weed control techniques would be similar to those suggested for Area D, i.e. an intensive woody weed control program using sensitive mechanical or chemical means, as appropriate. Mature willows should be left due to the potential high cost of removal and consequent disturbance of the creek bank (at least until mature native trees can be established alongside each willow). In open areas where native vegetation is absent after weed removal, Swamp Oak (Casuarina glauca) should be planted at 2 metre centres and in minimum clumps of six. Individual trees of Swamp Mahogany (Eucalyptus robusta) and Broad-leaf Paperbark (Melaleuca quinquenervia) can also be scattered throughout this area.

It is expected that residents adjoining this area will continue to have concerns, real or imagined, regarding dense vegetation in this area with regard to its effect on flooding, fire risk or as a vermin hazard. These potential concerns need to be addressed sympathetically when rehabilitation of this area commences. Continued mowing (mostly by local residents) of existing grass areas immediately adjacent to private properties may be appropriate to provide a break between the bushland and residential properties to allay these concerns.

As this section of the creek is now essentially isolated from the remainder of the creek system, clearing of vegetation from the creek itself may not be necessary for flood mitigation purposes, although such an assessment is not able to be made by this plan.

ESTIMATED COSTS: initial weed control $25,000 maintenance woody weed control $4,000 /yr

Area F - Channels of Ettalong, Iluka and Kahibah Creeks p.49

The vegetation in this area has been substantially modified and generally only comprises scattered trees with a weed understorey. Any rehabilitation of these areas must allow for maintenance clearing of the creeks for flood mitigation purposes. The existing grass tracks along most parts of the creeks provide access for machinery to undertake such clearing. It is proposed that these tracks be retained as part of a walkway system, but it is also necessary that plantings do not block access to the creek channels from these tracks.

A rehabilitation strategy similar to that proposed for Area E is recommended. The bank of the creek opposite the walkway can be densely planted, mainly with Swamp Oak, with Swamp Mahogany and

Broad-leaf Paperbark being planted in lesser numbers. Other species considered suitable for supplementary plantings in these areas include:

Black She-oak	Allocasuarina littoralis
Sydney Golden Wattle	Acacia longifolia
Cheese Tree	Glochidion ferdinandi
Bleeding Heart	Omalanthus populifolius
Creek Sandpaper Fig	Ficus coronata
Coastal Banksia	Banksia integrifolia

The potential for plantings along the walkway side of the channel is limited by the identified need for access for machinery to undertake maintenance works. However, there is considered to be scope for clump plantings along this bank which would still allow access for maintenance clearing. Clump plantings of various shapes and sizes, up to 5 metres diameter, planted at 20 metre centres would be appropriate along this bank, and would allow machinery access to the creek channels.

Patches of bushland associated with cut-off meanders could be regenerated into healthy bushland by sensitive weed control, although it must be emphasised that on-going effort will be required to control weeds in these relatively small patches of bushland, especially given the close proximity of residential properties.

The Kahibah Creek floodplain study recommended vegetation of only grasses in areas subject to higher flood velocities (Willing & Partners, 1991: 23), although scattered trees are unlikely to substantially interfere with flows.

Sections of eroding creek banks are evident within Area F. These sections can be treated by direct revegetation of exposed soil. Grassing and tree planting in various embankment sections along the creeks will be an adequate erosion control measure. Common Couch (Cynodon dactylon) sod or runners (stolons) and Swamp Oak (Casuarina glauca) can be jointly planted to stabilise the exposed bank sections. Common Couch grass (which is a p.50 native species) can tolerate light textured (sandy) soils, requires negligible maintenance and provides a permanent ground cover, thereby assisting in the prevention of streambank erosion. Swamp oak is an aggressive native tree and requires minimal maintenance. Bank stability will be enhanced by integrating Swamp Oak with Common Couch.

All areas requiring revegetation should be fertilised using a complete fertiliser upon sowing and/or planting. Temporary fencing should be installed to protect plantings, including areas planted with grasses.

ESTIMATED COSTS: bank stabilisation works	$6,000
initial weed control	$15,000
tree planting	$4,000
maintenance woody weed control	$4,000 /yr

Area G - Iluka Lagoon

As this wetland is covered by SEPP 14, any rehabilitation works within Iluka Lagoon would be required to be the subject of an environmental impact statement. Accordingly, the need for rehabilitation within the wetland would need to be substantial in order to justify the cost and time of preparation of an EIS. Although the margins of Iluka Lagoon have been disturbed by a number of impacts, the centre of the wetland remains in a relatively healthy condition, making it difficult to justify remedial works within the wetland at this stage. However, it is recommended that funds should be sought from appro-

priate sources (e.g. National Landcare Program) for the preparation of an EIS and undertaking of remedial works as soon as practicable. If an EIS is prepared for remedial works, the opportunity should also be taken to include the installation of a boardwalk in the EIS.

The following management strategy is recommended to limit further damage to the ecology of Iluka Lagoon:

- Strict erosion control measures should be applied to all development within the catchment.
- Sediment and nutrient traps are required on the creeks and drains which enter the lagoon.

Erosion and sediment controls cannot be 100% effective and there will be a need to dredge accumulated sediment from the edges of the lagoon at some time in the future. As is evidenced by the existing extent of sedimentation and consequent weed invasion, failure to remove existing sediment and to control future sedimentation will gradually result in the lose of the wetland character of the area.

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ESTIMATED COSTS: sediment trap upstream	$2,000
weed control & dredging	$15,000
tree planting	$4,000
maintenance woody weed control	$5,000 /yr

Area H - Kahibah Lagoon

The comments made above for Iluka Lagoon also apply to Kahibah Lagoon, although the extent of impact associated with sedimentation is less significant (due to the more recent development of its catchment), and the need for remedial works is less pressing.

ESTIMATED COSTS: sediment trap upstream	$3,000
weed control & dredging	$5,000
maintenance woody weed control	$2,000 /yr

Area I - McEvoy Avenue Bushland

The remnant bushland in this area is in a healthy condition other than for minor weed invasion. Removal of woody weeds physically or by spot spraying is the only rehabilitation works proposed for this area. Limited on-going weed control will also be necessary.

ESTIMATED COSTS: maintenance woody weed control
$1,000 /yr

Area J - Greenhaven Drive Bushland

This area has reasonable quality native vegetation cover, although there has been moderate levels of past disturbance resulting in some thickets of Lantana. Active gully erosion is apparent in this area where natural diffuse runoff from areas above the bushland has been altered into point sources. High fuel levels exist in close proximity to housing.

The recommended treatment for this area is:

- Controlled hazard reduction burning undertaken by experienced personnel in winter.
- Improved access resulting from burning should allow herbicide treatment of regenerating woody weeds once they shoot the following spring.

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- Improved access will also facilitate treatment of eroding gullies. The gullies require reshaping with light earthmoving equipment prior to sowing with a temporary cover crop comprising sterile annual grasses along with Common Couch. Native trees and shrubs will gradually colonise the stabilised soil (although some weed control will be necessary). All areas requiring revegetation should be fertilised using a complete fertiliser upon sowing and/or planting.
- The formal drainage channel and concrete invert leading from Area J to Kahibah Lagoon (Area K) has been badly eroded due to poor original construction, and needs minor repairs.

ESTIMATED COSTS: erosion control works
(including repair of concrete drain) $6,000 initial weed control $2,500 maintenance woody weed control $1,000/yr

Area K - Tuluma Road Bushland

The steep slopes in this area support essentially undisturbed native vegetation which requires no rehabilitation works. However, the lower colluvial slopes, including a sewerage access track are heavily infested with weeds, especially Lantana. The degree of weed infestation would require intensive control using mechanical and/or chemical methods. Once cleared of most of the weeds the slopes could be subject to erosion, and appropriate erosion controls would need to be implemented, possibly including a temporary cover crop of sterile annual grasses which should be sown along with seeds of native shrubs and trees. On-going weed control would be necessary during the establishment phase of replacement vegetation cover.

It is considered that this area could present a high fire hazard risk to adjacent properties, and the need for low intensity hazard reduction burning should be determined in conjunction with Council's fire control officer of fire brigade personnel.

ESTIMATED COSTS: initial weed control (edges & lower slopes) $2,500 maintenance woody weed control $5,000/yr

Area L - Plaving Fields / Parkland p.53

The existing management regime for the playing field at the end of McEvoy Avenue and the parkland at the corner of Greenhaven drive and Brisbane Avenue are considered to be appropriate. However, it is suggested that irregular, peripheral planting around the playing field with native trees would break up the present stark appearance of the field by blending it with adjacent bushland. The trees would also provide some shade for spectators.

ESTIMATED COSTS: shade tree planting $1,500 annual maintenance covered by existing programmes

6.3 DEVELOPMENT AND REHABILITATION PRIORITIES

Council and community groups would be unlikely to have the resources to simultaneously implement the various development and rehabilitation works recommended above. Accordingly, this plan has identified a priority order for the works which will encourage early implementation of the spirit of the plan while allowing for potential staging of the works over several years.

Priority 1

The focus of the proposal is the development of a nature park along the lower reaches of Ettalong Creek. Initial weed control activities in this area and development of the infrastructure of the nature park are therefore given the highest priority. Early development of this area will raise community interest in the project, providing momentum for implementation of the remainder of the plan.

The sediment traps to protect Iluka and Kahibah Lagoons are also considered to have a high priority, as are all erosion control measures. Provision of interpretive signs and seating at these two wetlands would assist in raising public awareness of the project.

Implementation of erosion controls in the Greenhaven Bushland (Area J) will need to be associated with revegetation works.

Priority 2

Once the Ettalong Creek Nature Park is substantially commenced (development of the park will be an on-going community project), efforts should be directed into development of the creek-side walking trail system and associated vegetation rehabilitation. This would be a relatively low cost development, and would link the remainder of the project and its surrounding community to the focal point nature park.

Priority 3 p.54

Weed control and plantings along the Ettalong Creek Billabong (Area E) should be given next priority. These rehabilitation works are important for wildlife habitat and aesthetic reasons but will be costly and time consuming, the reason for their lower priority.

Priority 4

Weed control in the McEvoy Avenue and Tuluma Road Bushland areas (Areas I & K) are considered to have a relatively low priority as these areas are currently in a mostly healthy condition.

Priority 5

Remedial dredging works in Iluka and Kahibah Lagoons are given a low priority mainly because of the need to fund and prepare environmental impact statements. Implementation of sedimentation controls, recommended for Priority 1, should limit further sedimentation in the lagoons, providing breathing space to prepare sound proposals for remedial works.

6.4 REVIEW

No management plan for a natural area should be considered to be definitive, but should be reviewed on a regular basis to ensure that it is meeting its objectives, and to take account of any changing circumstances. It is suggested that a suitable time frame for the review of this Rehabilitation and Management Plan would be five yearly intervals.

By the time of the first review (due for 1999), it is unlikely that the recommendations of this plan would be fully implemented, and it is suggested that this review need only comprise an overview of the plan's implementation, along with identification of any areas where the plan's recommendations may need modification.

It is expected that the recommendations of the plan should be substantially, if not fully implemented by the time of the second review (due for 2004), and it is recommended that this review should comprise a complete rewrite of the plan. This second version of the plan should reassess the very core of the plan (the objectives and issues) and should emphasise ongoing maintenance requirements.

7. IMPLEMENTATION p.55

7.1 COMMUNITY PARTICIPATION

As mentioned in number of times throughout this plan, it is considered that the plan's successful implementation will be dependent on enthusiastic support and assistance from the broader community. The forms of potential community participation include:

- Formation of one or more Landcare or similar groups to actively carry out weed control and replanting activities. Landcare groups can attract grant funding for such projects under the Commonwealth Government's National Landcare Program.
- Involvement of service groups in rehabilitation activities.
- Advice from community groups with special expertise, such as the Central Coast Group of the Society for Growing Australian Plants.
- General community support through the changing of attitudes in relation to issues such as dumping of garden refuse and illegal clearing of vegetation.

All of these potential forms of support depend upon general community acceptance of the plan and its proposals. This acceptance must come from an understanding of the ecological value of the creeks system, as well as an understanding of the rehabilitation proposals, which will require an on-going effort from those sectors of the community already committed to rehabilitation of the creeks.

To assist with this process, the study team has prepared two interpretive signs which can be placed in strategic locations as rehabilitation proceeds (reduced copies of the signs are presented in Appendix 3). Two promotional brochures have also been prepared to explain the project to local residents (copies are presented in Appendix 4).

7.2 TECHNICAL SUPPORT

A plan of this character is unable to address in full detail all of the matters likely to be encountered by a community group implementing such an ambitious rehabilitation and management project. As a consequence, the group would, on occasions, need access to technical advice to clarify or expand on various matters. Several Government agencies, in addition to Gosford City Council, could provide such advice:

p.56 Soil Conservation Service
40 Mann St
GOSFORD

NSW Agriculture
Research Rd
NARARA

National Parks & Wildlife
207 Albany St
GOSFORD

National Landcare Program
Locked Bag 5320
PARRAMATTA

Environment Protection Auth.
Pacific Highway
CHATSWOOD

- streambank stabilisation / erosion control
- dune planting and stabilisation
- weed control
- herbicide use
- advice on native fauna
- Landcare funding
- Environmental Trust Grants funding

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p.58 Willing & Partners (1991) Kahibah Creek floodplain management study. Prepared for Gosford City Council.

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APPENDIX 1 - Flora List p.59

The following list includes all species of vascular plants observed within the study area during field investigations for this plan. It should be noted that such a list cannot be considered to be comprehensive, but rather indicative of the flora. It can take many years of flora surveys to record all of the plant species occurring within any area, especially plant species that are only apparent in some seasons, such as orchids. Lists compiled as part of earlier surveys (e.g. Payne, 1989) have not been incorporated into the present list, and include a number of species not listed here.

Plant species cannot always be accurately identified during a brief survey, generally due to the lack of suitable flowering and/or fruiting material. Any such species are identified as accurately as possible, and are indicated in the list thus:

- Specimens which could only be identified to genus level are indicated by the generic name followed by the abbreviation “sp.”, indicating an unidentified species of that genus.
- Specimens which could be accurately identified to genus level but could be identified to species level with only a limited degree of certainty are indicated by a question mark (“?”) placed in front of the specific epithet.

Authorities for the scientific names are not provided in the list. These follow Hnatiuk (1990). Names of families and higher taxa follow a modified Cronquist system. Introduced species are indicated by an asterisk (“*”).

The following standard abbreviations are used to indicate subspecific taxa:
subsp. subspecies var. variety x hybrid between the two indicated species

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
DIVISION POLYPODIOPHYTA	ferns												
ADIANTACEAE													
Adiantum aethiopicum	Common Maidenhair Fern												
ASPIDIACEAE													
Polystichum australiense	Austral Shield-fern												
AZOLLACEAE													
Azolla filiculoides	Pacific Azolla				D		F						
BLECHNACEAE													
Blechnum cartilagineum	Gristle Fern												
Blechnum indicum													
Doodia aspera	Hard Water Fern Rasp Fern												
CYATHACEAE													
Cyathaea cooperi	Paper Tree Fern												
DAVALLIACEAE													
**Nephrolepis cordifolia (cv.)*	Fishbone Fern												
DENNSTAEDTIACEAE													
Calochaena dubia	Rainbow Fern												
Hypolepis muelleri													
Pteridum esculentum	Bracken												
GLEICHENIACEAE													

FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
Gleichenia dicarpa	Pouched Coral fern												

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
THELYPTERIDACEAE													
Cyclosorus interruptus	Cyclosorus					E							
DIVISION CYCADOPHYTA	cycads												
ZAMIACEAE													
Macrozamia communis	Burrawang			C ✓			F			I			
DIVISION PINOPHYTA	conifers & allies												
PINACEAE													
**Pinus sp.*	pine		B										
PODOCARPACEAE													
Podocarpus spinulosus	Shrub Plum-pine												
DIVISION MAGNOLIOPHYTA	flowering plants												
Class Magnoliopsida	dicotyledons												
ACANTHACEAE													
**Pseuderthemum variabile*	Pseuderanthemum												
**Thunbergia alata*	Black-eyed Susan				D		F					K	
AIZOACEAE													
Tetragonia tetragonoides	New Zealand Spinach												

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
AMARATHACEAE													
**Alternanthera philoxeroides*	Alligator Weed				D								
**Amaranthus viridus*	Green Amaranth				D								
ANACARDIACEAE													
**Rhus secunda*	Rhus						F						
APIACEAE													
Actinotus helanthi	Flannel Flower									I			
Centella asiatica	Centella										J	K	
**Hydrocotyle bonariensis*	Pennywort				D	E	F	G					
Hydrocotyle laxiflora	Stinking Pennywort				D						J	K	
Platysace lanceolata	Lance-leaf Platysace			C			F			I	J	K	
APOCYNACEAE													
Parsonsia straminea	Common Silk Pod					E	F			I		K	
ARALIACEAE													
Astrotricha latifolia	Broad-leaf Star-hair											K	
**Hedera helix*	English Ivy					E							
ASCLEPIADACEAE													
**Gomphocarpus physocarpus*	Milkweed					E							
Marsdenia suaveolens	Scented Marsdenia												

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
ASTERACEAE													

FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
**Ageratina adenophora*	Crofton Weed				D		F	G	H		J		
**Bidens pilosa*	Cobblers Peg				D	E	F	G					
**Chrysanthemoides monilifera*	Bitou Bush			C							J		
**Conyza bonariensis*	Fleabane	A			D		F						
**Conyza canadiensis*	Tall Fleabane			C	D	E	F		H		J	K	
**Coreopsis lanceolata*	Railway Daisy			C			F			I			L
Cotula longipes	Large Creeping Cotula				D								
**Deliarea odorata*	Climbing Daisy				D	E	F						
Enydra fluctuans	Enydra					E							
**Erechites valerianifolia*	Brazilian Fireweed								H				
**Gazania splendens*	Gazania	A											
**Gnaphalium sp.*	cudweed		B										
**Hypocherosis radicata*	Flat Weed	A	B	C			F		H	I	J	K	
**Senecio madagascariensis*	Fireweed						F						
**Sigesbeckia orientalis*	Indian Weed				D								
**Sonchus asper*	Rough Sow Thistle					E							
**Sonchus oleraceus*	Common Sow Thistle	A				E	F		H				
**Xanthium strumarium*	Noogoora Burr					E							
BALSAMINACEAE													
**Impatiens walleriana*	Impatience				D	E	F						
BIGNONIACEAE													
**Campsis chinensis*	Chinese Trumpet Creeper						F						
**Jacaranda mimosifolia*	Jacaranda				D								L
Pandorea pandorana	Wonga Vine			C						I		K	

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
BRASSICACEAE													
**Cakile edulenta*	Cakile	A											
**Coronopus didymus*	Lesser Swinecress		B				F						
CAESALPINIACEAE													
**Senna pendula var. glabrata*	Cassia				D	E	F						
CAMPANULACEAE													
Wahlenbergia communis	Native Bluebell ✓			C									
CASUARINACEAE													
Allocasuarina littoralis	Black She-oak			C ✓			F			I			
Allocasuarina torulosa	Forest Oak										J	K	
Casuarina glauca	Swamp Oak				D	E	F						
CONVOLVULACEAE													
**Ipomoea cairica*	Five-leaf Morning Glory					E							
**Ipomoea indica*	Morning Glory				D	E	F						
CUNOCIACEAE													
Ceratopetalum gummiferum	Christmas Bush											K	
DILLENIACEAE													
Hibbertia dentata	Twining Guinea Flower											K	
Hibbertia scandens	Creeping Guinea Flower				D								
ELAEOCARPACEAE													
Elaeocarpus reticulatus	Blueberry Ash									I		K	

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
EPACRIDACEAE													
Monotoca elliptica	Tree Broom-heath			C ✓						I			
EUPHORBIACEAE													
Breynia oblongifolia	Dwarfs Apple			C ✓	D		F			I			
**Euphorbia pepus*	Petty Spurge					E							
**Euphorbia pulcherrima*	Poinsettia				D								
Glochidion ferdinandi	Cheese Tree			C ✓	D	E	F				J	K	
Omalanthus populifolius	Bleeding Heart			C ✓	D	E	F						
**Ricinis communis*	Castor Oil			C ✓	D	E							
FABACEAE													
Bossiaea heterophylla	Variable-leaf Bossiaca			C ✓									
**Erythrine crus-galli*	Coral Tree						F						
**Erythrina x sykesii*	Coral Tree		B			E	F						
Glycine clandestina	Twining Glycine			C ✓							J		
Gompholobium latifolium	Broad-leaf Wedge-pea									I			
Indigofera australis	Natible Indigo									I	J		
Platylobium formosum	Handsome Flat-pea						F					K	
Pultanaea euchila	bush-pea											K	
Pultanaea flexilis	bush-pea										J	K	
**Trifolium repens*	White Clover		B									K	
GERANIACEAE													
Geranium solanderi	Australian Cranesbill				D								
GOODENIACEAE	Hop Goodenia										J		
Goodenia ovata													

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
HALORAGACEAE													
**Myriophyllum aquaticum*	Parrots Feather				D	E	F						
LAMIACEAE													
**Leonotis leonurus*	Lions Paw				D								
Lycopus australis	Lycopus				D	E							
Westringia longifolia	Long-leaf Westringia												
LAURACEAE													
**Cinnamomum camphora*	Camphor Laurel			C			F		H				
LOBELIACEAE													
Lobelia alata	Angled Lobelia				D								
Pratia purpurescens	Lobelia Pratia												
MALVACEAE													
Hibiscus diversifolius	native hibiscus				D								
Hibiscus trinonum	native hibiscus				D								
**Lagunaria patersonii*	Norfolk Island Hibiscus												
**Sida rhombifolia*	Paddys Lucerne			B		E	F					K	L
MELIACEAE													
Synoum glandulosum	Scentless Rosewood												
MENISPERMACEAE												K	
Stephania japonica var. discolor	Stephania			C	D	E							

FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
MENY ANTHACEAE													
Villarsia exaltata	Yellow Marsh Flower								H				

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
MIMOSACEAE													
Acacia implexa	Hickory									I			
Acacia longifolia	Sydney Golden Wattle	A	B								J		
Acacia sophorae	Prostrate Golden Wattle	A											
Acacia stricta	Staight Wattle										J		
Acacia suaveolens	Sweet-scented Wattle			C ✓									
Acacia terminalis	Sunshine Wattle						F				J	K	
MORACEAE													
Ficus coronata	Creek Sandpaper Fig				D								
Ficus rubiginosa	Port Jackson Fig						F						
**Morus alba*	Mulberry				D		F						
MYRTACEAE													
**Agonis flexuosa*	Weeping Myrtle												L
Angophora costata	Smooth-barked Apple			C ✓			F					K	
Angophora floribunda	Rough-barked Apple									I	J	K	L
**Callistemon viminalis (CV)*	bottlebrush												L
Eucalyptus botryoides	Bangalay		B	C ✓	D	E	F			I	J	K	L
Eucalyptus maculata	Spotted Gum										J		
Eucalyptus paniculata	Grey Ironbark										J	K	
Eucalyptus robusta	Swamp Mahogany				D		F	G	H				
Leptospermum laevigatum	Coastal Tea-tree	A											
Leptospermum polygalifolium													
subsp. polygalifolium	Yellow Teatree								H				
**Lophostemon confertus*	Brush Box												L
Melaleuca linariifolia	Narrow-leaf Paperbark					E							
Melaleuca quinquenervia	Broad-leaf Paperbark				D	E	F	G	H				
Syncarpia glomulifera	Turpentine											K	

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
NYMPHA EACEAE													
Nymphaea capensis	Cape Waterlily						F						
Nymphaea mexicana	Yellow Waterlily				D		F						
OCHNACEAE													
**Ochna serrulata*	Ochna					E	F						
OLEACEAE													
**Jasminum polyanthum*	Jasmine				D								
**Ligustrum sinsense*	Small-leaf Privet				D								
Notelaea longifolia	Long-leaf Mock Olive									I		K	
ONAGRACEAE													
Ludwigia peploides	Water Primrose					E	F	G	H				
**Oenothera indecora*	Small Evening Primrose	A		C			F						L
OXALIDACEAE													

FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
Oxalis corniculatum	Yellow Oxalis		B										
PAPAVERACEAE													
**Argemone ochroleuca*	Mexican Poppy	A											
PITTOSPORACEAE													
Pittosporum undulatum	Native Daphne					E	F			I			
PLANTAGINACEAE													
**Plantago lanceolata*	Ribwort		B		D								L
**Plantago major*	Large-leaf Plantain				D								

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
POLYGONACEAE													
**Acetosa sagittata*	Potato Vime				D	E							
Persicaria decipiens	Slender Knotweed					E	F	G					
Persicaria strigosa	Spotted Knotweed					E	F	G	H				
Rumex brownii	Swamp Dock				D								
PRIMULACEAE													
**Anagalis arvensis*	Scarlet Pimpernell				D								
PROTEACEAE													
Banksia integrifolia	Coast Banksia	A	B	C ✓	D								L
Banksia serrata	Old Man Banksia			C ✓			F			I			
Persoonia levis	Large-leaf Geebung									I			
Persoonia pinifolius	Pine-leaf Geebung											K	
RANUNCULACEAE													
Ranunculus inundatus	Swamp Buttercup							G					
Ranunculus plebius	Hairy Buttercup				D	E							
ROSACEAE													
**Eriobotrya japonica*	Loquat					E							
**Prunus sp.*	Peach			C									
**Rubus ? discolor*	Blackberry				D		F		H		J	K	
Rubus hillii	Native Raspberry										J		
**Rubus ulmifolius x ? discolor*	Blackberry										J		
RUBIACEAE													
Pomax umbellata	Pomax									I			

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
RUTACEAE													
Zieria smithii	Sandfly Bush										J		
SALICACEAE	White Willow												
**Salix alba*	Weeping Willow					E	F	G					
SANTALACEAE													
Exocarpus strictus	Pale Ballart			C									
SCROPHULARIACEAE													
Bacopa monnieri	Bacopa				D								
SOLANACEAE	Corkwood												
Duboisia myoporoides	Tobacco Bush									I		K	

FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
**Nicotiana glauca*	Gooseberry				D								
**Physalis peruviana*	Wild Tobacco Tree						F						
**Solanum mauritianum*	Black Nightshade				D	E							
**Solanum nigrum*													
TROPAEOLACEAE													
**Tropaeolum majus*	Nasturtium				D		F						
ULMACEAE													
Trema aspera	Native Peach				D								

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
VERBENACEAE													
Clerodendrum tomentosum	Hairy Clerodenum			C	D								
**Lantana camara*	Lantana			C	D	E	F						
**Verbena bonariensis*	Purple Top			C	D	E							
VIOLACEAE													
Viola hederacea	Ivy-leaf Violet				D	E			H		J	K	
VITACEAE													
Cayratia clematidea	Slender Grape				D								
Tetrastigma nitens	Three-leaf water Vine												
Class Liliopsida	monocotyledons												
ALISMATACEAE													
**Sagittaria graminea var. platyphylla*	Sagittaria						F						
ARACEAE													
**Colocasia esculenta*	Taro				D	E	F						
Gymnostachys anceps	Caterpillar Flower												
**Philodendrum selloana*	Philodendrum				D		F				J		
ARECACEAE													
Livistona australis	Cabbage Tree Palm				D	E					J	K	
ASPARAGACEAE													
**Protasparagus densiflorus*	Asparagus Fern			C	D	E	F						

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
CANNACEAE													
**Canna indica*	Canna Lily				D	E							
COMMELINACEAE													
Commelina cynea	Wandering Sailor			C ✓		E	F						
**Tradescantia alba*	Wandering Jew				D	E	F						
CYPERACEAE													
Baumea articulata	Jointed Twig-rush								H				
Baumea rubiginosa	Soft Twig-rush								H				
Carex appressa	Tussock Carex				D								
Carex fascicularis	Tassel Carex					E	F						
Cladium procerum	Cladium				D	E							
**Cyperus eragrostis*	Umbrella Sedge				D								
Cyperus flaccidus	sedge				D								

FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
Cyperus leiocaulon	sedge				D								
Cyperus polystachyos	sedge				D								
Eleocharis gracilis	Slender Spike-rush								H				
Eleocharis sphacelata	Tall Spike-rush						F		H				
Gahnia clarkei	Clarks Saw-sedge										J		
Gahnia ? erythrocarpa	Red-fruited Saw-sedge											K	
Isolepis nodosa	Knobby Club-rush			C ✓	D								
**Isolepis proliferatioras*	Sprouting Club-rush						F	G					
Lepidosperma elatius	Tall Saw-sedge											K	
Lepironia articulata	Lepironia							G					
Schoenoplectus validus	River Club-rush				D	E	F	G					
Schoenus melanostachys	Black Bog-rush											K	

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
DASYPOGONACEAE													
Lomandra longifolia	Spiny Mat-rush	A		C ✓			F			I	J	K	
HYDROCHARITACEAE													
Vallisneria gigantea	Ribbonweed						F						
IRIDACEAE													
**Crocosmia ✓ crocosmiifolia*	Crocosmia				D		F						
JUNCACEAE													
Juncus usitatis	Common Rush						F						
JUNCAGINACEAE													
Maundia triglochinoides	Maundia						F						
LEMINACEAE													
Lemna minor	duckweed				D								
LILIACEAE													
**Astroemeria pulchella*	Alstroemeria				D								
Caesia parviflora var. vittata	Blue Grass-lily			C ✓	D								
Crinum pedunculatum	Swamp Lily												
Dianella caerulea	Flax Lily			C ✓	D								
**Nothoscordum inodorum*	Onion Weed	A					F			I	J	K	
**Yucca filamentosa*	Yucca												
MUSACEAE													
**Musa paradisica*	Bannana					E	F						

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
ORCHIDACEAE													
*Dipodium punctatum *Epidendrum ? ibaguense*	Christmas Orchid Crucifix Orchid			C									
PHILESIACEAE													
Eustrephus latifolus	Wombat Berry										J	K	
PHILYDRACEAE													
Philydrum languinosum	Frogsmouth							F		H			
POACEAE													
**Andropogon virginicus*	Whisky Grass										J		

FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
**Arundo donax*	Spanish Reed				D								
**Brixia maxima*	Quaking Grass			C							J	K	
**Cortadieria selloana*	Pampas Grass							G	H				
Cynodon dactylon	Common Couch	A	B		D		F						L
Dichelachne crinita	Long-hair Plume Grass			C									
Dichelachne micrantha	Short-hair Plume Grass			C			F			I			
**Echinochloa crus-galli*	Barnyard Grass				D	E							
**Ehrharta erecta*	Panic Veldt Grass				D								
Entolasia marginata	Margined Panic					E		G				K	
Imperata cylindrica	Blady grass			C	D		F			I	J		L
Isachne globosa	Swamp Millet							G	H				
**Lagurus ovatus*	Harestail Grass		B	C									
Optimemus aemulus	Broad-leaf Beard-grass				D								
**Panicum maximum*	Guinea Grass			C	D		F						
**Paspalum dilatatum*	Paspalum				D		F						L
Paspalum distichum	Water Couch						F						
**Paspalum urvillei*	Vasey Grass				D	E	F	G	H		J	K	

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FAMILY / Scientific name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L
POACEAE (cont'd)													
**Pennisetum clandestinum*	Kikuyu	A	B		D		F	G					L
Phragmites australis	Common Reed				D	E	F		H				
**Phyllostachys aurea*	Bamboo				D	E							
Poa labillardieri	Tussock Grass										J	K	
**Setaria gracilis*	Slender Pigeon Grass				D		F						L
Spinifex sericeus	Hairy Spinifex	A											
**Sporobolus indicus var. africanus*	Parramatta Grass		B	C	D		F						L
Sporobolus virginicus	Salt Couch				D								
**Stenotaphrum secundatum*	Buffalo Grass		B										L
Themeda australis	Kangaroo Grass			C									
POTAMOGETONACEAE													
Potamogeton ochreatus	Blunt Pondweed				D								
RESTIONACEAE													
Restio tetraphyllus	Tassel Cord-rush						F		H				
SMILACACEAE													
Smilax glyciphylla	Sweet Sarsparilla						F					K	
TYPHACEAE													
Typha orientalis	Broad-leaf Cumbungi				D	E	F	G	H				
XANTHORRHOACEAE													
Xanthorrhoea media subsp. latifolia	grass-tree											K	

APPENDIX 2 - Fauna List p.76

The following list includes all species of birds, reptiles, amphibians and mammals observed within the study area during field investigations for this plan, as well as vertebrate fauna recorded by previous surveys.

The source of the record for each species is indicated thus:
1 Payne (1989)
2 Laxton & Duell (1991)
3 this survey

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FAMILY / Scientific Name	Common Name	Records
Class Ichthys	Fish	
AMBASSIDAE		
Ambassis jacksoniensis	glassfish	2
ANGUILLIDAE		
Anguilla australis	Short-finned Eel	2
Anguilla reinhardtii	Long-finned Eel	2
ELEOTRIDDAE		
Gobiomorphus australis	Striped Gudgeon	2
MUGILIDAE		
Mugil cephalus	Sea Mullet	2
PERCICHTHYIDAE		
Macquaria novaemaculata	Australian Bass	2
POECILIIDAE		
* *Gambusia affinis*	Mosquitofish	2
Class Amphibia	Frogs	
HYLIDAE		
Litoria fallax	Eastern Dwarf Tree Frog	3
Litoria phyllochroa	Leaf-green Tree-frog	3
MYOBATRACHIDAE		
Crinia signifera	Common Eastern Frogle	3
Limnodynastes peronii	Brown Striped Frog	1, 3
Class Reptilia	Reptiles	
CHELIDAE		
Chelodina longicollis	Eastern Snake-necked Turtle	1, 2
ELAPIDAE		
Demansia psammophis	Yellow-faced Whipsnake	1
Hemiaspis signata	Marsh Snake	2
Pseudechis porphyriacus	Red-bellied Black Snake	1, 2
SCINCIDAE		
Ctenotus taeniolatus	Copper-tailed Skink	3
Eulamprus quoyii	Eastern Water Skink	1, 2, 3
Lamropholis guichenoti	Pale Garden Skink	1
Saproscinus mustelinus	Weasel Skink	2
Tiliqua scincoides	Eastern Blue-Tongued Lizard	2

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FAMILY / Scientific Name	Common Name	Records
Class Aves	Birds	
ACANTHIZIDAE		
Acanthiza nana	Yellow Thornbill	2
Sericornis frontalis	White-browed Scrubwren	2
ACCIPITRIDAE		
Accipiter cirrhocephalus	Collared Sparrowhawk	2
Circus aeruginosus	Marsh Harrier	2
Haliastur sphenurus	Whistling Kite	3
ALCEDINIDAE		
Ceyx azurea	Azure Kingfisher	2
Dacelo novaeguineae	Laughing Kookaburra	1, 2, 3
Halcyon sancta	Sacred Kingfisher	1, 2, 3
ANATIDAE		
Anas superciliosa	Black Duck	1, 2, 3
** Anser anser (cv)*	Domestic Goose	1, 2, 3
** Cairina moschata (cv)*	Domestic Muscovy Duck	3
Chenonetta jubata	Maned Duck	1, 2, 3
** Anas sp. (cv)*	Pekin Duck	3
ARDEIDAE		
Ardea novaehollandiae	White-faced Heron	1, 3
Egretta alba	Great Egret	2
ARTAMIDAE		
Artamus cyanopterus	Dusky Woodswallow	3
CACATUIDAE		
Cacatua galerita	Sulphur-crested Cockatoo	1, 2, 3
Cacana roseicapilla	Galah	1, 2, 3
Cacatua tenuirostris	Long-billed Corella	3
CAMPEPHAGIDAE		
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1, 2, 3
CHARADRIIDAE		
Vanellus miles	Masked Lapwing	1, 2, 3
COLUMBIDAE		
Columba leucomela	White-headed Pigeon	2
Columba livia	Feral Pigeon	3
Geophelia placida	Peaceful Dove	1, 2
Leucosarcia melanoleuca	Wonga Pigeon	1
Ocyphaps lophotes	Crested Pigeon	1, 2, 3
Streptopelia chinensis	Spotted Turtle-Dove	3

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FAMILY / Scientific Name	Common Name	Records
CORACIIDAE		
Eurystomus orientalis	Dollarbird	1, 2, 3
CORVIDAE		
Corvus coronoides		1, 2, 3
CRACTICIDAE		

FAMILY / Scientific Name	Common Name	Records
Cracticus nigrogularis	Pied Butcherbird	3
Cracticus torquatus	Grey Butcherbird	1, 2
Gymnorhina tibicen	Australian Magpie	1, 2, 3
Strepera graculina	Pied Currawong	1, 3
CUCULIDAE		
Centropus phasianinus	Pheasant Coucal	1, 2
Cuculus pallidus	Pallid Cuckoo	2
Eudynamis scolopacea	Common Koel	1, 2
Scythrops novaehollandiae	Channel-billed Cuckoo	1
FALCONIDAE		
Falco berigora	Brown Falcon	1
GRALLINIDAE		
Grallina cyanoleuca		1, 3
HIRUNDINIDAE		
Hirundo neoxena	Australian Magpie-lark	
LARIDAE		
Larus novaehollandiae	Welcome Swallow	1, 2, 3
LORIDAE		
Trichoglossus haematodus	Silver Gull	1
Trichoglossus chlorolepidotus		1, 2, 3
MALURIDAE		
Malurus cyaneus	Superb Fairy-wren	1, 2, 3
MEGAPODIIDAE		
Alectura lathami		1
MELIPHAGIDAE		
Acanthorhynchus tenuirostris	Eastern Spinebill	1, 2
Anthochaera carunculata	Red Wattlebird	1, 2
Anthochaera chrysoptera	Brush Wattlebird	3
Anthochaera lunulata	Little Wattlebird	1, 3
Manorina melanocephala	Noisy Miner	1, 2, 3
Meliphaga lewinii	Lewin's Honeywater	1, 2
Philemon corniculatus	Noisy Friarbird	1, 2, 3

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FAMILY / Scientific Name	Common Name	Records
MOTACILLIDAE		
Anthus novaeseelandiae	Richard's Pipit	1, 2
MUSCICAPIDAE		
Colluricincla harmonica	Grey Shrike-thrush	2
Eopsaltria australis	Eastern Yellow Robin	2
Microeca leucophaea	Jacky Winter	2
Pachycephala pectoralis	Golden Whistler	2
Petroica phoenicea	Flame Robin	1
Rhipidura fuliginosa	Grey Fantail	2, 3
Rhipidura leucophrys	Willie Wagtail	1, 2, 3
Rhipidura rufifrons	Rufous Fantail	1
Zoothera lunulata	White's Thrush	1
ORTHONYCHIDAE		

FAMILY / Scientific Name	Common Name	Records
Psophodes olivaceus	Eastern Whipbird	1, 3
PARADISAEIDAE		
Ailuroedus crassirostris	Green Catbird	1
Ptilonorhynchus violaceus	Satin Bowerbird	1, 3
PARDALOTIDAE		
Pardalotus punctatus	Spotted Pardalote	1, 2, 3
PASSERIDAE		
* *Passer domesticus*	House Sparrow	1, 2, 3
PHALACROCORACIDAE		
Phalacrocorax carbo	Great Cormorant	1
Phalacrocorax sulcirostris	Little Black Cormorant	3
PLATALEIDAE		
Platalea regia	Royal Spoonbill	3
Threskiornis aethiopica	Sacred Ibis	2
Threskiornis spinicollis	Straw-necked Ibis	1
PLATYCERCIDAE		
Platycercus eximius	Eastern Rosella	1, 2, 3
PLOCEIDAE		
Emblema temporalis	Red-browed Firetail	2, 3
PODARGIDAE		
Podargus strigoides	Tawny Frogmouth	1, 2
POLYTELITIDAE		1, 2
Alisterus scapularis	Australian King Parrot	

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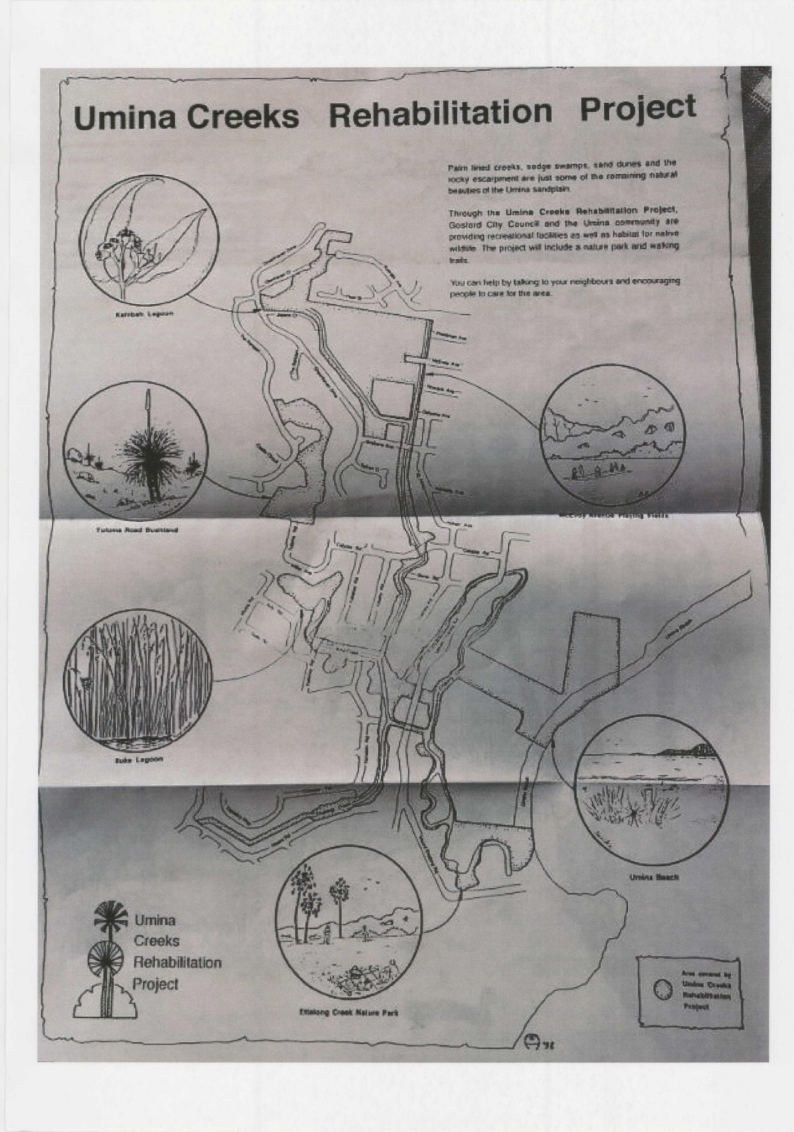
FAMILY / Scientific Name	Common Name	Records
PYCNONOTIDAE		
* *Pyconotus jocosus*	Red-whiskered Bulbul	1, 2, 3
RALLIDAE		
Gallinula tenebrosa	Dusky Moorhen	1, 2, 3
Porphyrio porphyrio	Purple Swamphen	1, 2, 3
Rallus philippensis	Buff-banded Rail	1
STRIGIDAE		
Ninox novaehollandiae	Southern Boobook	1, 3
STURNIDAE		
* *Acridotheres tristis*	Common Mynah	1, 2, 3
* *Sturnus vulgaris*	Common Starling	1, 2, 3
ZOSTEROPIDAE		
Zosterops lateralis	Silvereye	2, 3
Class Mammalia	Mammals	
CANIDAE		
* *Canis familiaris*	Domestic Dog	3
FELIDAE		
* *Felis catus*	Domestic Cat	1
PERAMELIDAE		
Perameles nasuta	Long-nosed Bandicoot	2
PETAURIDAE		

FAMILY / Scientific Name	Common Name	Records
Pseudocheirus peregrinus	Common Ringtail Possum	3
Petaurus breviceps	Sugar Glider	1
PHALANGERIDAE		
Trichosurus vulpecula	Common Brushtail Possum	1, 2, 3
PTEROPODIDAE		
Pteropus poliocephalus	Grey-headed Flying Fox	1

APPENDIX 3 - Interpretive Signs p.82

Two interpretive signs were prepared as part of the study to assist with promotion of the project amongst the Umina community. Reduced copies of these two signs are presented here.



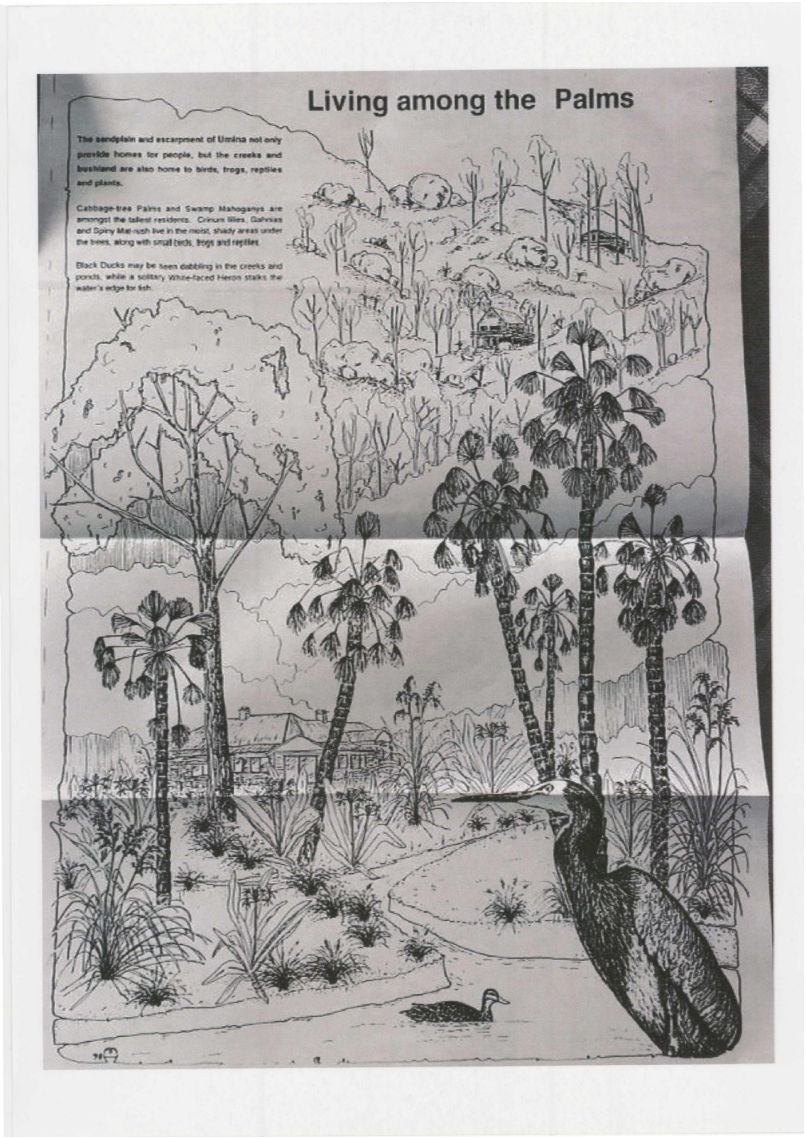
p.83

Palm lined creeks, sedge swamps, sand dunes and the rocky escarpment are just some of the remaining natural beauties of the Umina sandplain.

Through the Umina Creeks Rehabilitation Project, Gosford City Council and the Umina community are providing recreational facilities as well as habitat for native wildlife. The project will include a nature park and walking trails.

You can help by talking to your neighbours and encouraging people to care for the area.

Map labels: Kahibah Lagoon, Tuluma Road Bushland, Iluka Lagoon, McEvoy Avenue Playing Fields, Umina Beach, Ettalong Creek Nature Park



p.84

The sandplain and escarpment of Umina not only provide homes for people, but the creeks and bushland are also home to birds, frogs, reptiles and plants.

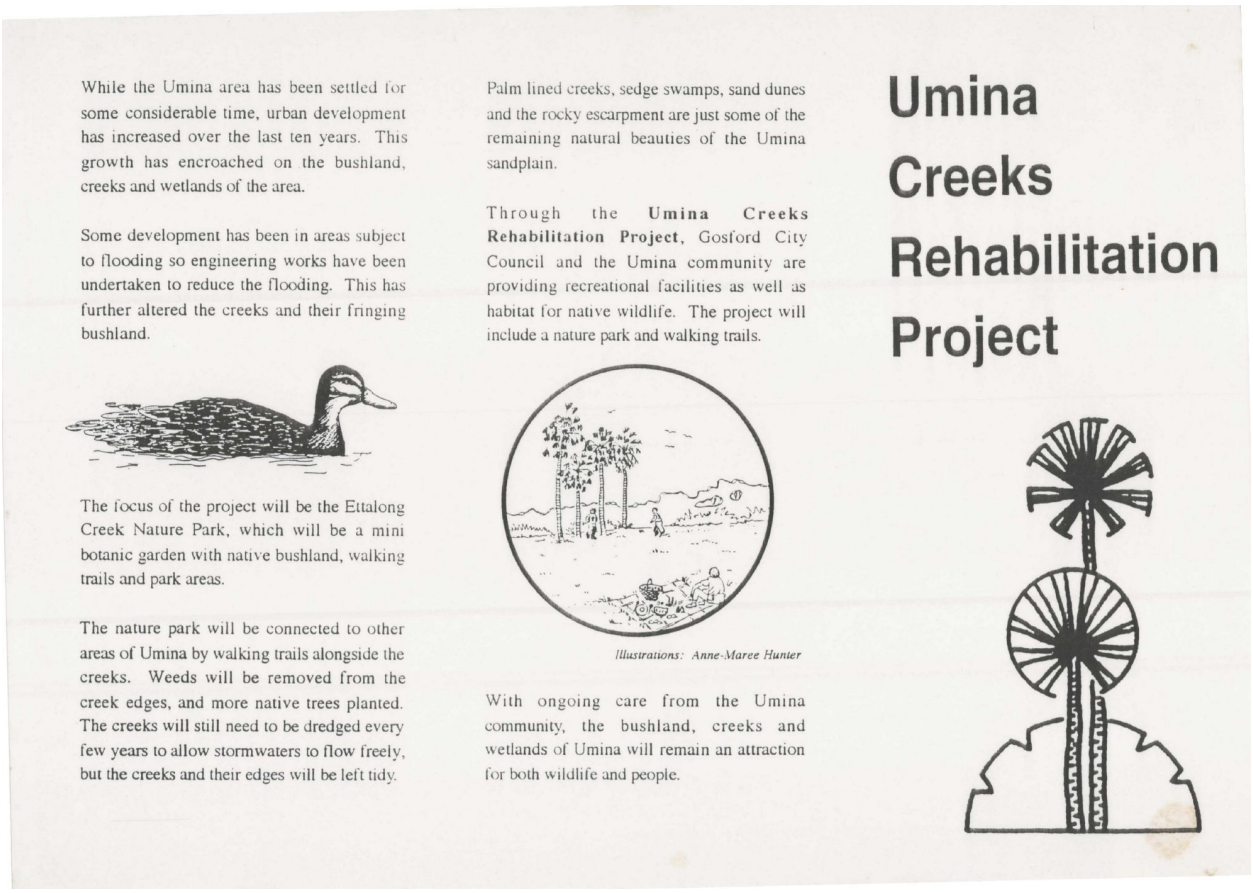
Cabbage-tree Palms and Swamp Mahoganys are amongst the tallest residents. Crinum lilies, Gahnias and Spiny Mat-rush live in the moist, shady areas under the trees, along with small birds, frogs and reptiles.

Black Ducks may be seen dabbling in the creeks and ponds, while a solitary White-faced Heron stalks the water's edge for fish.

APPENDIX 4 - Promotional Pamphlets p.85

Two pamphlets were prepared as part of the study to assist with promotion of the project amongst the Umina community. Copies of these two pamphlets are presented here.

p.86



While the Umina area has been settled for some considerable time, urban development has increased over the last ten years. This growth has encroached on the bushland, creeks and wetlands of the area.

Some development has been in areas subject to flooding so engineering works have been undertaken to reduce the flooding. This has further altered the creeks and their fringing bushland.

The focus of the project will be the Ettalong Creek Nature Park, which will be a mini botanic garden with native bushland, walking trails and park areas.

The nature park will be connected to other areas of Umina by walking trails alongside the creeks. Weeds will be removed from the creek edges, and more native trees planted. The creeks will still need to be dredged every few years to allow stormwaters to flow freely, but the creeks and their edges will be left tidy.

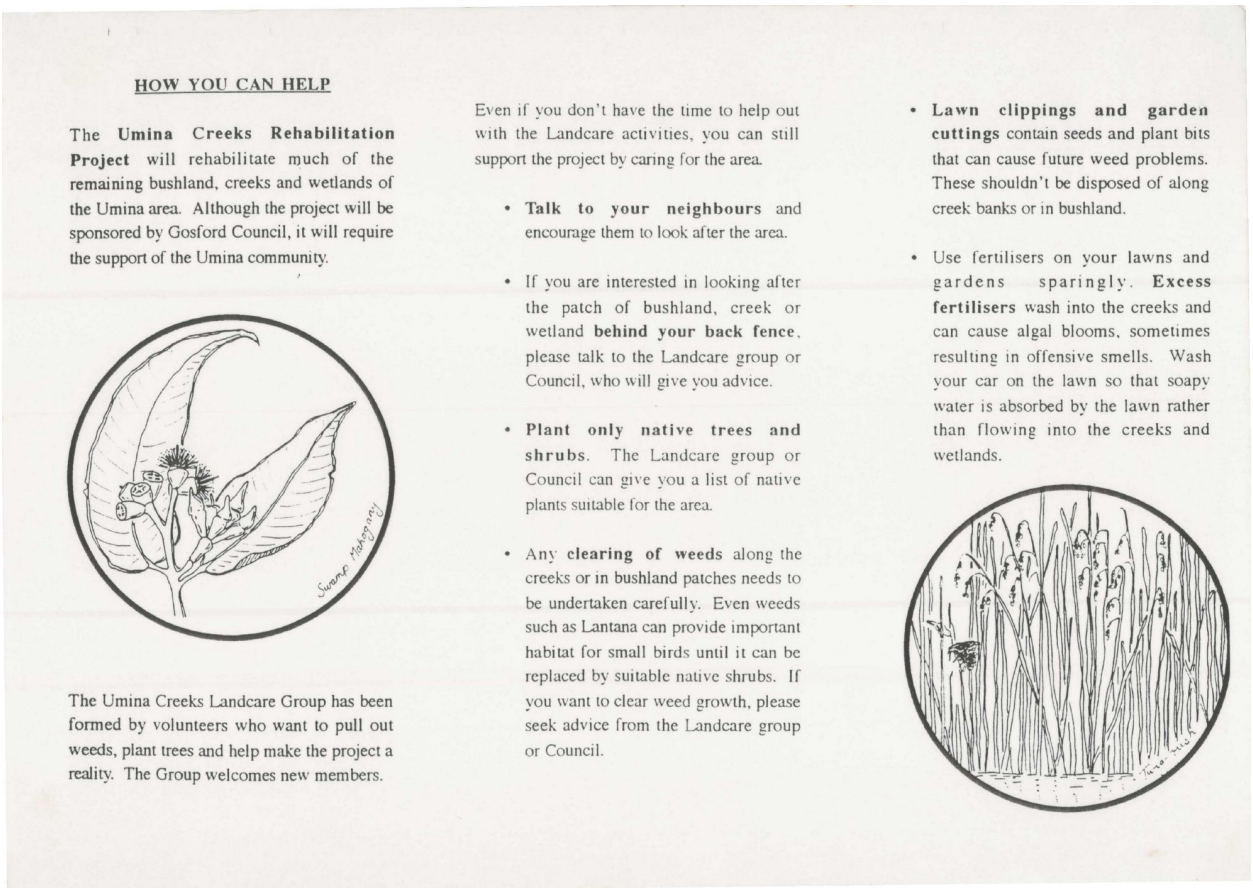
Palm lined creeks, sedge swamps, sand dunes and the rocky escarpment are just some of the remaining natural beauties of the Umina sandplain.

Through the Umina Creeks Rehabilitation Project, Gosford City Council and the Umina community are providing recreational facilities as well as habitat for native wildlife. The project will include a nature park and walking trails.

With ongoing care from the Umina community, the bushland, creeks and wetlands of Umina will remain an attraction for both wildlife and people.

Umina
Rehabilitation Project

p.87



HOW YOU CAN HELP

The **Umina Creeks Rehabilitation Project** will rehabilitate much of the remaining bushland, creeks and wetlands of the Umina area. Although the project will be sponsored by Gosford Council, it will require the support of the Umina community.

The Umina Creeks Landcare Group has been formed by volunteers who want to pull out weeds, plant trees and help make the project a reality. The Group welcomes new members.

Even if you don't have the time to help out with the Landcare activities, you can still support the project by caring for the area.

- **Talk to your neighbours** and encourage them to look after the area.
- If you are interested in looking after the patch of bushland, creek or wetland **behind your back fence**, please talk to the Landcare group or Council, who will give you advice.
- **Plant only native trees and shrubs.** The Landcare group or Council can give you a list of native plants suitable for the area.
- Any **clearing of weeds** along the creeks or in bushland patches needs to be undertaken carefully. Even weeds such as Lantana can provide important habitat for small birds until it can be replaced by suitable native shrubs. If you want to clear weed growth, please seek advice from the Landcare group or Council.
- **Lawn clippings and garden cuttings** contain seeds and plant bits that can cause future weed problems. These shouldn't be disposed of along creek banks or in bushland.
- Use fertilisers on your lawns and gardens sparingly. **Excess fertilisers** wash into the creeks and can cause algal blooms, sometimes resulting in offensive smells. Wash your car on the lawn so that soapy water is absorbed by the lawn rather than flowing into the creeks and wetlands.

The Umina Creeks Rehabilitation Project will rehabilitate much of the remaining bushland, creeks and wetlands of the Umina area. Although the project will be sponsored by Gosford Council, it will require the support of the Umina community.

Even if you don't have the time to help out with the Landcare activities, you can still support the project by caring for the area.

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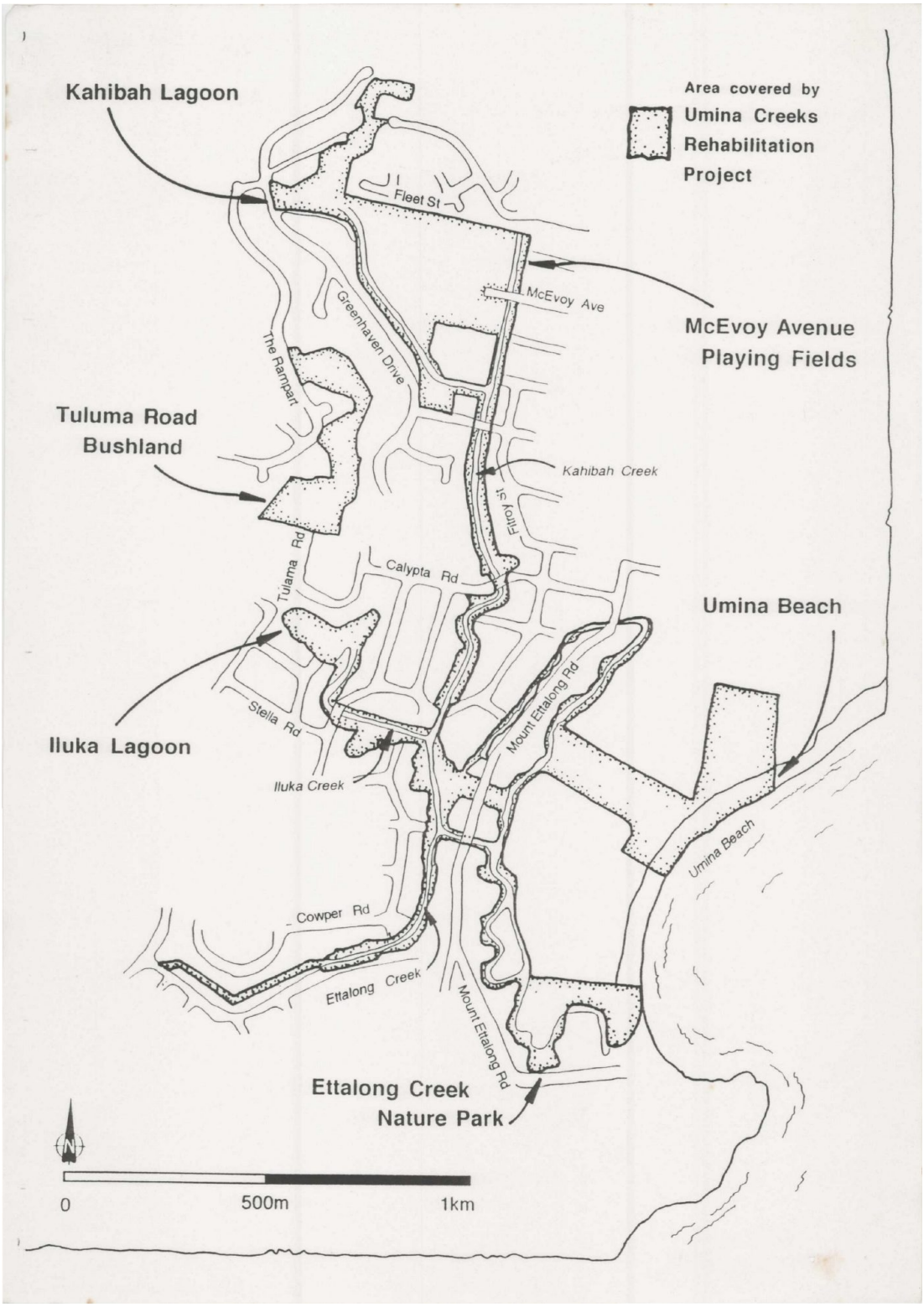
Kahibah Lagoon
Area covered by
Umina Creeks
Rehabilitation
Project
Fleet St
McEvoy Ave
McEvoy Avenue
Playing Fields
Greenhaven Drive
The Rampart
Tuluma Road
Bushland
Kahibah Creek
Fitroy St
Tulama Rd
Calypta Rd
Umina Beach
Mount Ettalong Rd
Stella Rd
Iluka Lagoon
Iluka Creek
Umina Beach
Cowper Rd
Ettalong Creek
Mount Ettalong Rd
Ettalong Creek
Nature Park
N
0
500m
1km

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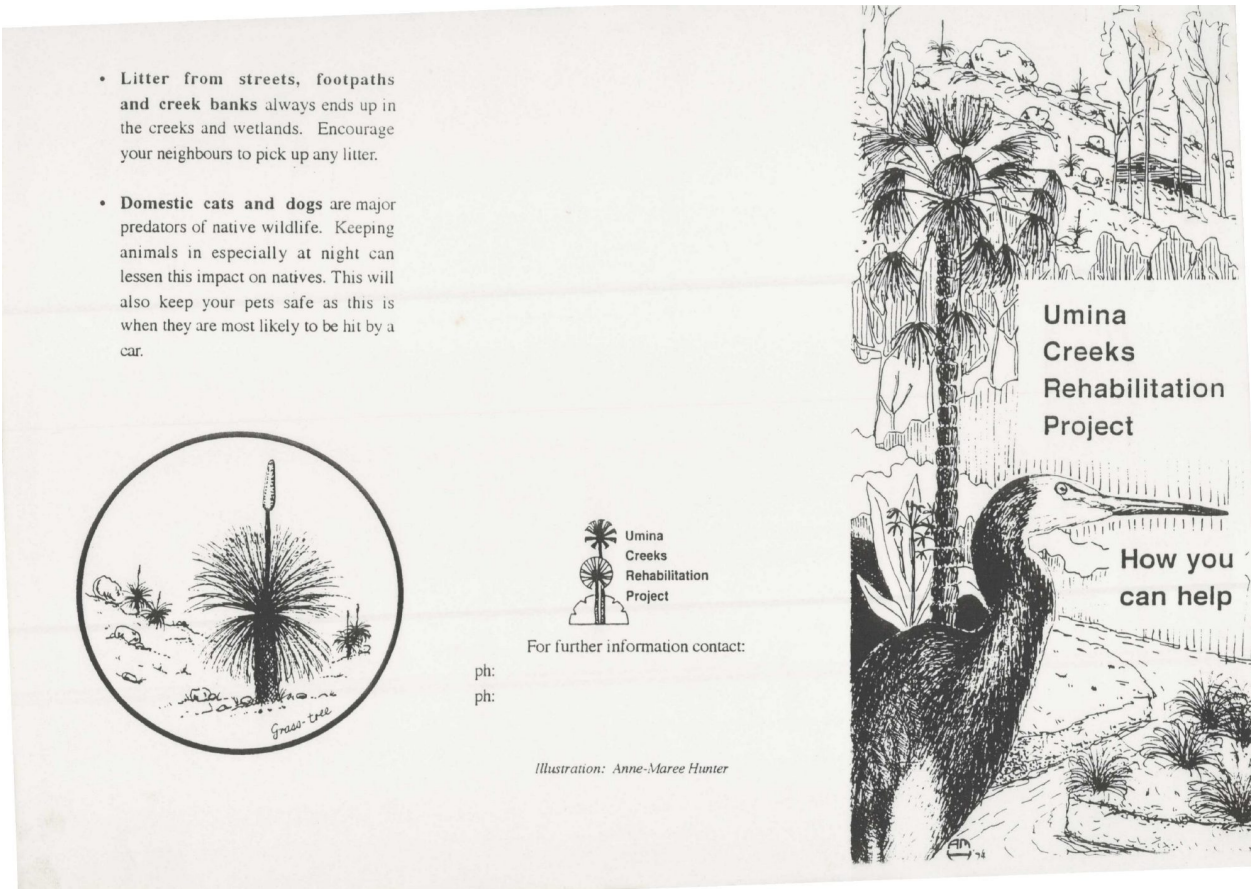
p.89



- Litter from streets, footpaths and creek banks always ends up in the creeks and wetlands. Encourage your neighbours to pick up any litter.
- Domestic cats and dogs are major predators of native wildlife. Keeping animals in especially at night can lessen this impact on natives. This will also keep your pets safe as this is when they are most likely to be hit by a car.

For further information contact:
Illustration: Anne-Maree Hunter

How you can help

> *Pages 90 to 92 of the scan repeat Appendix 3 (pages 82 to 84) and are omitted.*

APPENDIX 5 - Public Comment p.93

A number of comments on the draft report were received, mainly from members of the section 377 Committee. Where possible, amendments were made to the plan to take account of these comments, especially in the case of largely editorial comments. The major comments of the respondents are summarised below, along with responses (in italics), where appropriate:

Respondent Algis Sutas, Soil Conservation Service

Comments

- Acid sulphate soils have previously been identified in the Ettalong Creek area. SCS available for advice if required.
- Recommended that SCS Coastal Dune Management Manual be followed in all dune areas.

  Recommendations of plan for Umina dunes are in accordance with these guidelines.
- Strong support for strict erosion control within Kahibah and Iluka Creeks catchments. SCS available for advice if required.

Respondent Robert Payne, Umina Beach

Comments

- Madiera Vine (*Anredera cordifolia*) has become established in parts of the lower Ettalong Creek area, and could become a serious problem.
- Suggested a right of access be negotiated through private property alongside McLaurin Road channel to provide better access to proposed Ettalong Creek Nature Park.

  In the plan, access is only provided from Etta Road. Additional access alongside McLaurin Road would not be in conflict with the plan, but is not considered essential.
- Suggested that responsibility for maintenance of the study be vested with one council officer to ensure continuity of implementation of the plan.

Respondent Brian Ellis, Umina

Comments

- Current flood mitigation practices, i.e. periodic clearing of aquatic vegetation from creeks, are inappropriate. Dredging of entire creeks/channels should be unnecessary, and provision should not need to be made for access by machinery to creeks.

  Re-evaluation of flood mitigation developments and practices was outside of the brief for this study, and the plan was, by necessity, written to allow for continuation of existing management practices.
- 'Existing Conditions' section should be deleted from report as largely repetitive of previous reports.

  The plan was written as a stand alone document, and the description of existing conditions provides essential background information.