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# Culburra Golf Course – Long Bow Point Part Lots 5 and 6 in DP 1065111

**Species Impact Statement** 

August 2015

F Dominic Fanning – Gunninah

with the assistance of SLR Consulting Australia Pty Ltd



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This document and the intellectual material it contains have been prepared by the author (Mr F Dominic Fanning), with the assistance of SLR Consulting Australia Pty Ltd, for the specific purposes described herein.

It has been prepared in cognisance of Division 2 Part 31 of the *Uniform Civil Procedures Rules* (UCPRs) and the *Expert Witness Code of Conduct* contained in Schedule 7 to the UCPRs – as practised *inter alia* in the NSW Land & Environment Court.

Any interpretation of this *Species Impact Statement* or any extraction from it are subject to the approval of the author and the applicant.

# CULBURRA GOLF COURSE – LONG BOW POINT PART LOTS 5 and 6 in DP 1065111

SPECIES IMPACT STATEMENT

August 2015

Declaration

This *Species Impact Statement* has been prepared in accordance with Sections 109, 110 and 111 of the *Threatened Species Conservation Act 1995*, and in accordance with the Director-General's Requirements provided by the Office of Environment & Heritage.

F Dominic Fanning Gunninah

I, Mr Matthew Philpott, of Allen Price & Associates (75 Plunkett Street, Nowra), being the applicant for the proposed Culburra Golf Course on Long Bow Point (*Development Application* DA 11/1728 lodged with Shoalhaven City Council), have read and understood this *Species Impact Statement*. I understand the implications of the recommendations made in the *Statement*, and accept that they may be placed as conditions of consent or concurrence for the proposal.

Matthew Philpott Allen Price & Associates

# CULBURRA GOLF COURSE – LONG BOW POINT PART LOTS 5 and 6 in DP 1065111

#### SPECIES IMPACT STATEMENT

## August 2015

## **EXECUTIVE SUMMARY**

## 1 INFORMATION BASE and BACKGROUND

This *Species Impact Statement* (SIS) has been prepared in respect of a proposal to construct an 18-hole golf course on Long Bow Point, which is located on the periphery of Lake Wollumboola near the township of Culburra Beach - on the south coast of NSW.

The Culburra Golf Course project was the subject of a *Development Application* (DA) submitted to Shoalhaven City Council in 2011. That DA was supported by a detailed *Flora & Fauna Assessment Report* (FFAR), prepared by Environmental InSites (dated July 2011) – which included *Section 5A Assessments of Significance* for relevant or potentially relevant threatened biota. That *Report* concluded that a *Species Impact Statement* (SIS) was not required for the Culburra Golf Course project.

Subsequently, Council determined that a *Species Impact Statement* (SIS) was required for Council to determine the Culburra Golf Course application.

The further analysis of threatened biota contained in this SIS, based *inter alia* on the refinement of the Golf Course design and on an array of further studies, concludes that a "*significant effect*" is **NOT** "*likely*" to be imposed upon any "threatened species, population or ecological community, or its habitat", as a consequence of the proposed Culburra Golf Course.

The author of this SIS maintains that an SIS is not required for the Culburra Golf Course project.

This SIS has been prepared, as is required:

- in accordance with Sections 109, 110 and 111 of the *Threatened Species Conservation Act* 1995 (TSC Act); and
- in accordance with the *Director-General's Requirements* (DGRs) for the SIS (dated 28/11/12) obtained from the then Director-General of the Office of Environment & Heritage (OEH).

The SIS is based on, and documents in detail, the substantial array of investigations which have been conducted on the Culburra Golf Course land (Long Bow Point and the immediately adjoining lands to the north and south), and on other lands in the immediate and general vicinity (particularly the Culburra West land). Flora and fauna investigations have been undertaken on Long Bow Point itself, as well as on other lands in the vicinity, including in and around Lake Wollumboola, over a period of more than two decades.

All of those data are incorporated into this SIS.

In addition, for the specific purposes of this SIS and in accordance with the DGRs, supplementary dedicated surveys have been undertaken (in 2012 and 2013) for an array of threatened biota known or likely to occur, or which may possibly occur, on the Culburra Golf Course site. The recent 'SIS-specific' investigations in 2012, 2013 and 2014 alone involve over 100 person-days of specialist ecologist surveys - including detailed and dedicated searches and surveys for threatened biota known or potentially present at this location.

# 2 VEGETATION and FLORA on LONG BOW POINT

There is an array of vegetation types on the Golf Course land at Long Bow Point - including xeric communities (which characterise most of the subject land) and mesic communities (which occur in the low-lying portions of the subject land - along Downs Creek and Wattle Creek). There is also a Sea Rush/Twig Rush Herbland community around the foreshores of Lake Wollumboola (particularly at the mouth of Downs Creek and Wattle Creek) and the adjoining mudflats - but this ecosystem is located at some considerable distance from the proposed Golf Course.

The majority of the open forest and woodland vegetation to be removed for or to be affected by the Culburra Golf Course consists of xeric forest types or (to a lesser extent) 'ecotone' vegetation (with a mix of xeric and mesic characteristics). Just 5% of the native vegetation to be directly affected by the project (approximately 1.92ha) is of a mesic nature.

None of the vegetation types on the subject land at Culburra are considered by the author of this SIS to constitute any of the "*endangered ecological communities*" (EECs) listed in the TSC Act.

Whilst some of the swamp forest or moist forest communities possess the floristic characteristics of some EECs - Swamp Oak Floodplain Forest (SOFF), River-flat Eucalypt Forest on Coastal Floodplains (REFCF) and/or Swamp Sclerophyll Forest on Coastal Floodplains (SSFCF) - there are no "*coastal floodplains*", either on the subject site or "*associated with*" it. As a consequence, those EECs are not present at Long Bow Point.

Similarly, as detailed in the SIS:

- the Sea Rush/Twig Rush Herbland around Lake Wollumboola does not constitute the Coastal Saltmarsh EEC because Lake Wollumboola does not satisfy the required 'locational' criterion (there is no relevant "*intertidal zone*"); and
- the small farm dam to the southeast of the subject land (on the southern tributary to Downs Creek) is artificial, and is not located on a "*coastal floodplain*". It therefore does not constitute the Freshwater Wetlands on Coastal Floodplains (FWCF) EEC.

It is noted that, in any case, the mesic vegetation types are located in the low-lying parts of the subject land or along watercourses, and are mostly to be retained and protected. Therefore, even if some of those EECs were present on the Culburra Golf Course site (which is not conceded), it is not *"likely"* that a *"significant effect"* would be imposed upon them.

Only one threatened plant species has been recorded on or adjacent to Long Bow Point – the Roundleafed Wilsonia *Wilsonia rotundifolia*. This species occurs in narrow bands in the Sea Rush/Twig Rush Herbland – at the periphery of Lake Wollumboola. It is distant from, and of no relevance to, the proposed Culburra Golf Course. No other threatened flora species have been recorded on Long Bow Point, despite a plethora of field surveys over a long period, by a number of different ecological consultants. Dedicated searches for threatened flora species listed in the DGRs (particularly for an array of threatened orchids identified in the DGRs) failed to locate any specimens of any of those species on the subject land.

# 3 FAUNA and FAUNA HABITATS and RESOURCES

A number of threatened fauna species have been recorded on Long Bow Point during the current SIS investigations and/or during previous investigations on the land. Relevant threatened fauna species (*ie* threatened fauna species that are likely to be "*affected*" by the proposed Golf Course to some extent – albeit not to a "*significant extent*") include:

- the Powerful Owl, Glossy Black Cockatoo and Square-tailed Kite;
- the Yellow-bellied Glider; and
- a number of threatened microchiropteran bats.

Detailed consideration of those species and of the potential impacts upon them (both direct and indirect) is provided in the SIS. In summary, the Culburra Golf Course proposal will not adversely affect those threatened fauna species to any significant extent – by virtue of:

- the exhaustive and iterative approach which has been adopted to the design of the Golf Course specifically *inter alia* to minimise the extent of clearing required and the number of hollow-bearing trees to be removed;
- the comprehensive design of the stormwater treatment regime to avoid or minimise the potential for indirect impacts on adjoining vegetation and habitats downslope, and particularly on Lake Wollumboola;
- the miniscule area of habitat to be affected on Long Bow Point relative to the very large areas of suitable habitat in the vicinity and locality; and
- the extremely large areas of habitat and resources which are protected in the vicinity, locality and region in various conservation reserves, State Forests, Crown Lands and private land.

Doubtless, there are a number of other threatened fauna species that could theoretically or potentially be present on the subject land at Long Bow Point (on the basis of available habitat and resources), but for which there is no evidence of their occurrence. Potentially relevant species from that list have been considered in some detail in the SIS, but none of those species are regarded as of particular concern with respect to the proposed Culburra Golf Course.

Nevertheless, it is important to note that the potential impacts of the Golf Course on these 'potential' species are substantially the same as, or similar to, those that would apply for the relevant (*ie* the "*affected*") species. It is also the case that the impact amelioration measures proposed for the project would be of similar efficacy for most of these additional potential species.

Resources and habitat features of relevance or potential relevance to threatened fauna that will or might possibly be affected by the Culburra Golf Course include:

• the areas of open forest and woodland to be removed – particularly the tree canopy;

- special feed trees particularly stands of she-oaks for the Glossy Black Cockatoo and (theoretically) food trees for the Yellow-bellied Glider (although no Glider feed trees have been identified within the Golf Course footprint); and
- hollow-bearing trees upon which the Powerful Owl and Glossy Black Cockatoo depend for nesting, and the Yellow-bellied Glider and some of the microchiropteran bats depend for diurnal shelter and/or breeding.

Importantly and most relevantly, the Culburra Golf Course on Long Bow Point has been designed specifically *inter alia* to retain the overwhelming majority of the resources which are, or which could be, of particular relevance and value (*ie* food trees and hollow-bearing trees) and to limit the extent of clearing.

In this regard, the Culburra Golf Course has been designed specifically (by the professional golf course designer and the author of this SIS):

- to minimise impacts only 5 or so known hollow-bearing trees are to be removed (as a
  result of specific walked refinement of the Golf Course layout), avoidance (by re-design of
  relevant elements of the Golf Course) of the known Square-tailed Kite nest tree, and the
  avoidance of relevant or potential food trees and resources; and
- to optimise opportunities for habitat creation (associated with the wetland system) and habitat rehabilitation - as part of the management of the Golf Course and the Long Bow Point Conservation Reserve (weed removal, feral pest eradication, the 'no net loss of hollowbearing trees' policy *etc*).

Because of its proximity to the Culburra Golf Course project, and its status as a haven for wetland and wading birds, Lake Wollumboola and its ecosystems and dependent wildlife have been considered at length in the SIS.

However, no adverse impacts will be imposed upon Lake Wollumboola or its ecosystems and dependent wildlife - because:

- the Golf Course is located at a minimum of 100 metres from the Lake;
- the stormwater treatment regime (as described below and as detailed in Appendix D1 of the SIS) has been designed specifically *inter alia* to avoid any discharge of contaminants or pollutants into Lake Wollumboola or Downs or Wattle Creeks; and
- implementation of the Culburra Golf Course Plan of Management (GCPoM Appendix D2 of the SIS) is also designed inter alia to prevent the discharge of contaminants (including fertilisers, pesticides and other chemicals) into Lake Wollumboola or into Downs or Wattle Creeks, or any of their associated ecosystems.

For those reasons (noting that the 'buffer' between the Golf Course and the Lake involves at least 100m of native open forest and woodland), it is clearly the case that no adverse impacts will be imposed by the Golf Course on Lake Wollumboola itself, or upon any of the threatened and/or migratory birds (and other native wildlife) which utilise or are dependent upon the Lake and its ecosystems.

None of the wetland and wading birds associated with Lake Wollumboola are regarded as relevant ("*affected*") species for the purposes of this SIS – because of the separation of the Golf Course from the Lake, and because of the design and long-term management elements of the Culburra Golf Course project.

It is to be noted that conservation reserves (National Parks and Nature Reserves) are abundant and extensive, both in the immediate locality and throughout the Shoalhaven LGA. There are approximately 229,000ha of National Parks estate in the Shoalhaven LGA, and 52,000ha of State Forests, as well as 31,000ha of Crown Lands (excluding roads). These provide abundant resources for the threatened species identified on the subject land, including all of those addressed in this SIS.

By comparison with the 300,000+ hectares of conserved, or 'functionally conserved', land in the LGA, the proposed Culburra Golf Course will occupy just 27.84ha of existing native vegetation.

# 4 GOLF COURSE DESIGN and ENVIRONMENTAL MANAGEMENT

The proposed Culburra Golf Course has been the subject of a comprehensive and iterative design process, involving the project ecologist, water quality and stormwater expert, and a professional golf course designer. This integrated approach has facilitated the development of a golf course design which minimises the potential for adverse impacts upon the natural environment in general (and upon threatened biota in particular), and which provides some notable environmental benefits.

The proposed Culburra Golf Course has the following characteristics.

- A total footprint of ~35.2 hectares *in toto* (or 17.5% of the subject land at Culburra) of which 7.2 hectares is already cleared and/or consists of regrowth Tick Bush Shrubland.
- The total area of native open forest and woodland which will be removed is 27.84 hectares (or just 13.85% of the subject land and 0.8% of the Lake Wollumboola catchment).
- The creation of 7ha of new habitat and resources (eg ponds, wetlands, native grasslands).
- A minimum separation from Lake Wollumboola of 100 metres.

Relevant measures to be implemented as part of, or which have been incorporated into, the Culburra Golf Course project include the following.

- The careful and specific design of all of the golf holes and fairways, and the golf course infrastructure in order to retain virtually all hollow-bearing trees and other features of biodiversity conservation value.
- The commitment to a 'no net loss of tree-hollows' policy by the salvage and re-deployment of any tree-hollows that must be removed, and supplementation with artificial nest boxes.
- The retention and enhancement or maintenance of native vegetation between golf course fairways and holes.
- The salvage of native vegetation to be cleared for the Golf Course, and its re-use in rehabilitation activities associated with the Golf Course itself and in the surrounding private Conservation Reserve on Long Bow Point.
- The design of a stormwater capture and water quality control management system involving the re-use of stormwater runoff for irrigation purposes and the treatment of all runoff to ensure the highest quality stormwater discharges into Lake Wollumboola.
- Design of stormwater control and treatment features to provide supplementary habitat for native biota (including wetland birds) and (potentially) the Green & Golden Bell Frog. This approach will substantially increase the extent of that habitat type at this general location.

- Implementation of a comprehensive Culburra Golf Course Plan of Management (GCPoM), Golf Course Ecological Management Plan (GCEMP) and a long-term Conservation Reserve Plan of Management (CRPoM) – to ensure the appropriate long-term management of the Golf Course itself, and of retained and rehabilitated vegetation and habitat features throughout Long Bow Point.
- Implementation of a comprehensive weed and feral pest eradication program throughout the Golf Course and the private Long Bow Point Conservation Reserve land – greatly superior to any such program that might be occurring in the vicinity or locality, and at no cost to Council, the OEH or government.
- Commitment to an ongoing monitoring regime to monitor environmental and ecological outcomes, and to ensure the enhancement of biodiversity conservation values around the Golf Course and throughout the Long Bow Point Conservation Reserve.
- Implementation of a monitoring regime with respect to water quality and discharges to
  ensure that no adverse impacts are imposed upon Lake Wollumboola or any other sensitive
  habitats or ecosystems, and to provide a rapid response to any incidents that could
  potentially occur.

It is important to note that the majority of the Lake Wollumboola catchment (of 3,410ha in total), including the body of Lake Wollumboola itself, is contained within the Jervis Bay National Park.

It is also important to note that there is essentially no active treatment of stormwater discharged into Lake Wollumboola from the Culburra Beach township by Shoalhaven City Council. The area of the Culburra Beach township which discharges untreated stormwater into Lake Wollumboola is approximately 80ha (or approximately 2.5 times the area of the proposed Culburra Golf Course), and much of that area consists of paved roads, driveways, buildings, and maintained gardens and lawns. By contrast, the Culburra Golf Course project will discharge NO untreated stormwater into Lake Wollumboola.

It has been a fundamental principle in the design of the Culburra Golf Course project that the natural environment is a significant and valuable asset, rather than a problem or an issue.

The underlying approach by the applicant has been that the Culburra Golf Course is 'a golf course embedded within the natural environment', and that its construction and management will provide supplementary habitats and resources, as well as imposing a very limited and constrained impact on the natural environment on Long Bow Point and on the native (including threatened) biota that us the land.

On the basis of that approach, the Culburra Golf Course project proposes to 'celebrate' the natural environment within which it is located. In addition to the creation of new and valuable habitat (such as the areas of native grassland and the wetland basins), the Golf Course will contain an array of educational signage for golfers and visitors which will:

- highlight and describe areas of particular environmental value;
- illustrate and explain the value of hollow-bearing trees as habitat for native, including threatened, biota;
- illustrate and discuss relevant threatened, and other native, biota and their habitats; and
- promote a sense of enjoyment of the natural environment around the Golf Course.

# 5 SECTION 5A – LIKELIHOOD of a SIGNIFICANT EFFECT

The Culburra Golf Course will require the removal of approximately 27.84 hectares of native forest and woodland vegetation. That loss is addressed in detail in the SIS, and has been determined as not "*likely*" to impose a "*significant effect*" upon any threatened biota. It represents only a minute fraction of the available (and substantially protected) habitat for threatened species in the vicinity and locality, and is not "*likely*" to be of significance for the survival of a "*viable local* population" of any threatened species.

This SIS contains a supplementary consideration of the relevant (and other) threatened biota of potential relevance to the Culburra Golf Course, pursuant to Section 5A of the *Environmental Planning & Assessment Act 1979* (EP&A Act), as required by the DGRs. As detailed at length in the SIS, the application of Section 5A concludes that there is not *"likely"* to be a *"significant effect"* imposed upon any of the threatened species known, or even likely, to occur on the subject land at Long Bow Point.

That conclusion is based inter alia on:

- the careful and refined design of the 18-hole golf course (involving both the project ecologist and a professional golf course designer) – to avoid areas of potential significance and to retain virtually all hollow-bearing trees;
- the substantial extent of suitable habitat and resources for relevant or potentially relevant threatened biota on the subject land itself and in the surrounding lands (some of which is to be dedicated for biodiversity conservation purposes);
- the distribution and generally wide-ranging habits of the relevant and/or potentially relevant threatened fauna species;
- the very considerable extent of suitable habitats and resources in the vicinity and general locality – including in the very extensive conservation reserves (National Parks and State Forests) and other vegetated lands (Crown Lands and private lands) throughout the Shoalhaven LGA; and
- the implementation of an array of impact amelioration and environmental management measures as integral elements of the Culburra Golf Course project.

The SIS has also considered, at length, the potential for a "*significant effect*" to be imposed upon any threatened, and indeed non-threatened, wetland and wading birds associated with Lake Wollumboola.

That consideration has taken into account the specific details of the Golf Course design, as well as the comprehensive impact amelioration and environmental management measures – including the hydrologic and stormwater management regime for the Golf Course, and the long-term management of the Golf Course through a dedicated *Culburra Golf Course Plan of Management* (GCPoM). In particular, there are stringent management measures to be imposed with respect to the storage and use of fertilisers, pesticides and other chemicals – to avoid any adverse impacts on Lake Wollumboola.

As a consequence of those considerations, it is the conclusion of this SIS that the Culburra Golf Course as proposed, including the integrated management regime for the project, is not *"likely"* to result in the imposition of a *"significant effect"* (if indeed any adverse impact at all) upon any of the threatened biota associated with Lake Wollumboola, or their habitats.

It is the conclusion of this SIS, on the basis of the application of Section 5A of the EP&A Act to all of the relevant, and potentially relevant, threatened biota, that:

- there is **no** likelihood of the Culburra Golf Course imposing a "significant effect" on any "threatened species, populations or ecological communities, or their habitats"; and
- there is **no** requirement for the preparation of an SIS for the proposed Culburra Golf Course on Long Bow Point.

# 6 ENVIRONMENTAL OFFSETS STRATEGY

In addition to the detailed and careful design of the Culburra Golf Course, and the implementation of integrated impact amelioration and environmental management measures (as detailed in the SIS), the Culburra Golf Course project includes the application of a comprehensive *Environmental Offsets Strategy*.

This approach satisfies a key principle of the OEH regarding biodiversity or conservation offsets:

- first avoid impacts achieved by the Golf Course design
- second ameliorate impacts achieved by the impact amelioration and environmental management measures described above
- third offset impacts achieved through the *Environmental Offsets Strategy*.

The loss of a small area (27.84ha) of open forest and woodland vegetation from Long Bow Point for the Culburra Golf Course will be offset *inter alia* by the dedication of other lands in the general vicinity and locality. The proposed *Environmental Offsets Strategy* is the subject of ongoing negotiations between the landowner, the OEH, Council and other relevant government agencies.

The Culburra Golf Course Environmental Offsets Strategy contains several elements.

- The long-term management of retained vegetation in and around the Golf Course as habitat for native, including threatened, species.
- The creation and ongoing maintenance of freshwater wetlands around the Golf Course providing a habitat type that is currently not present on Long Bow Point.
- The dedication of land on Long Bow Point as a private Conservation Reserve to be retained for biodiversity conservation purposes (a total of 113ha).
- The long-term management of the Long Bow Point Conservation Reserve subject to a dedicated *Plan of Management*.
- The dedication of Lot 1 in DP 614607 East Crescent, Culburra Beach (approximately 1km to the northeast of Long Bow Point) to Shoalhaven City Council containing approximately 2ha of the Bangalay Sand Forest EEC.
- The dedication of Lot 1 and Lot 2 in DP 109714 Worrowing Heights (near Vincentia) to the OEH containing approximately 6.1ha of shrubland and woodland vegetation, including habitat for several threatened species.

# 7 CONCLUSIONS

The Culburra Golf Course project will provide a valuable social amenity for the township of Culburra Beach, with a 'charter' for environmental sensitivity and sustainability. The Golf Course has been designed specifically to 'celebrate' its location in a bushland setting, and will be managed in the long-term to avoid adverse impacts on Lake Wollumboola and on the surrounding open forest and woodland around the Golf Course and within which it is embedded.

The specific conclusions of this *Species Impact Statement* (SIS) with respect to threatened biota are as follows.

- 1 It is **NOT** "*likely*" that a "*significant effect*" would be imposed upon any "*threatened species, populations or ecological communities, or their habitats*" as a consequence of the development and operation of the Culburra Golf Course.
- 2 There is **NO** requirement for the preparation of an SIS for the Culburra Golf Course.

F Dominic Fanning Gunninah

# CULBURRA GOLF COURSE – LONG BOW POINT PART LOTS 5 and 6 in DP 1065111

# SPECIES IMPACT STATEMENT

# August 2015

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# CULBURRA GOLF COURSE – LONG BOW POINT PART LOTS 5 and 6 in DP 1065111

SPECIES IMPACT STATEMENT

August 2015

# 1 INTRODUCTION

#### 1.1 Background

# 1.1.1 Project Background

The land which is the subject of this *Species Impact Statement* (SIS) is located to the immediate southwest of the township of Culburra Beach (also known as Culburra), on the south coast of New South Wales (Figure 1).

Culburra Beach is located on the southern side of the estuary of the Shoalhaven and Crookhaven Rivers, approximately 15km to the southeast of the town of Nowra. The township is also located on the northern shores of Lake Wollumboola, which is now part of the Jervis Bay National Park (Figure 2) - with approximately 80 hectares of the Culburra Beach township draining into the Lake.

The "*subject land*" (to which this SIS applies) is located on and adjacent to Long Bow Point - to the immediate northwest of Lake Wollumboola, and to the immediate southeast of the Culburra Beach township (Figure 2). The total area of the "*subject land*" is approximately 201 hectares.

The proposal is for the construction of an 18-hole championship golf course on Long Bow Point and on land to its immediate south (Figures 3A and 3B), with the retention and rehabilitation of substantial areas of land (approximately 113ha or 56% of the subject land) – including a minimum 100m buffer to Lake Wollumboola. The Culburra Golf Course itself, including ancillary features such as the driving range, access road and (ultimately, and subject to a separate DA) a club house, will only occupy approximately 35.2 hectares – including all areas to be affected by cleating and earthworks for the Golf Course project.

A *Development Application* (DA 11/1728) for the 18-hole golf course was lodged with Shoalhaven City Council (SCC) in 2011, accompanied *inter alia* by a detailed *Ecological & Riparian Assessment Report* (dated 24 June 2011) - prepared by Environmental InSites. A *Supplementary Ecological Assessment Report* (SLR Ecology 2012) was subsequently provided – in an attempt to address a number of issues raised by the Office of Environment & Heritage (OEH) and/or officers of Shoalhaven City Council.

The author of those *Reports* (Mr F Dominic Fanning) was previously (relevantly) the Director of Environmental Services at InSites, and the Technical Director – Ecology at SLR Consulting Australia Pty Ltd. Mr F Dominic Fanning is the author of this SIS.

# 1.1.2 Authorship of This SIS

As noted above, Mr F Dominic Fanning is the author of this SIS - and is responsible for its content and the opinions expressed herein.

A previous version of the SIS for the Culburra Golf Course (dated May 2014) had been authored and authorised by Mr Fanning - while the Technical Director of Ecology at SLR Consulting Australia Pty Ltd. That version of the SIS has been the subject of review and comment by officers at Shoalhaven City Council (SCC), and the subject of a discussion between SCC, the author and the applicant in Nowra (on 19 February 2015).

This SIS has been prepared *inter alia* using the information and data collected by SLR Consulting – at the direction of the author. The ecology team at SLR Consulting has also provided technical assistance in the revisions contained within this SIS (dated August 2015).

This SIS has been prepared by the author (Mr F Dominic Fanning) in an objective and independent manner. It has been prepared in cognisance of the requirements of the *Uniform Civil Procedures Rules* (UCPRs) with respect to the behaviour and obligations of expert witnesses in the NSW Land & Environment Court.

# 1.1.3 Primacy of This SIS

This *Species Impact Statement* (dated August 2015) – prepared by Gunninah (with the technical assistance of SLR Consulting Australia Pty Ltd) – supercedes and replaces any and all previous versions of the SIS for the Culburra Golf Course project.

It includes material and information prepared or provided specifically *inter alia* for the purposes of addressing issues and matters raised by SSC - as discussed in February 2015.

## 1.2 The Subject Land

The land which is the subject of this SIS, and within which the proposed Culburra Golf Course is to be located, consists of a substantial tract of privately owned land to the south of Culburra Road - immediately southwest of the existing Culburra Beach township (Figures 1 and 2).

The "subject land" for the Golf Course occupies a total of approximately 201ha (Figure 2), and includes:

- most of the southern part of Lot 5 in DP 1065111 the eastern part of the "subject land"
- most of the southern part of Lot 6 in DP 1065111 (excluding the southwestern corner) which comprises the western part of the "*subject land*".

The subject land is mostly naturally vegetated, with significant disturbance being limited to the central parts of Long Bow Point (Figure 2) – which has been cleared for grazing purposes for some considerable time (see Chapter 4.3). Other clearing and land modification has taken place throughout the subject site - for access tracks, fencing and maintenance. In addition, the land had been the subject of previous timber harvesting and partial clearing for grazing purposes over a long period (Chapter 4.3).

The subject land is zoned for a variety of purposes (Figure 4), pursuant to the Shoalhaven City Council *Local Environmental Plan 1985* (LEP 1985):

- 1(d) General Rural
- 2(c) Residential (New Living Areas)
- 5(c) Special Uses (Reservation)
- 6(c) Open Space (Proposed Recreation)
- 7(a) Environmental Protection (Wetlands).

# 1.3 Legislative Framework

# 1.3.1 The General Statutory Basis of an SIS

The *Threatened Species Conservation Act 1995* (TSC Act) requires that the planning and development approval process for developments and activities in New South Wales have regard to the potential for adverse impacts to be imposed upon threatened biota, and their habitats.

The TSC Act modified the *Environmental Planning & Assessment Act 1979* (EP&A Act) by, *inter alia*, including a requirement in Section 78A(8)(b) of the EP&A Act to determine whether the proposal:

- is "on land that is, or is part of, critical habitat"; or
- is "likely to significantly affect threatened species, populations or ecological communities, or their habitats".

Section 5A of the EP&A Act is employed to determine "whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats" – in order to answer Section 78A(8)(b) of the Act. The relevant factors of Section 5A of the EP&A Act (inter alia) "must be taken into account" by a consent or determining authority when considering a development proposal or Development Application (DA), particularly in administering Sections 78, 79C and 112 of the Act.

Section 5A of the EP&A Act was modified by the *Threatened Species Amendment Act 2003* (TSAA Act). The original eight factors of Section 5A have been replaced by seven new factors - which have a local, rather than a regional, focus when assessing the likelihood of "*a significant effect*" being imposed upon threatened biota.

If it is determined on the basis of Section 5A of the EP&A Act that a proposed development or activity (such as the Culburra Golf Course) is "on land that is, or is part of, critical habitat or is likely to significantly affect threatened species, populations or ecological communities, or their habitats", then a Species Impact Statement (SIS) must be prepared, and must accompany the proposal – pursuant to Section 78A(8)(b) of the EP&A Act.

The SIS prepared in those circumstances would accompany, or be part of, an *Environmental Impact Statement* (EIS), *Statement of Environmental Effects* (SEE) or DA, or other impact assessment documents prepared for a proposed development, as relevant in the circumstances. In this instance, this SIS accompanies an amended *Statement of Environmental Effects* (SoEE) - which has been prepared for the refined Culburra Golf Course (APA 2015).

# 1.3.2 Justification for the SIS

It is to be noted that the conclusions of the original *Section 5A Assessments of Significance* for the Culburra Golf Course proposal (Environmental Insites 2011) were that it was **not** *"likely"* that a *"significant effect"* would be imposed upon any *"threatened species, population or ecological community, or its habitat"*.

That *Ecological & Riparian Assessment Report* (Environmental InSites 2011), and a subsequent *Response Report* (SLR Ecology 2012), concluded *inter alia* that:

• an SIS was **NOT** required for the Culburra Golf Course project.

Subsequent discussions with representatives of the Office of Environment & Heritage (OEH) and of Shoalhaven City Council (SCC) have established that SCC (as the *consent authority*) was intending to request the preparation of an SIS (based *inter alia* on a separate '*Peer Review*' of the FFAR) – in order for Council to determine the DA.

This Species Impact Statement (SIS) has been prepared on the basis of that requirement by Council.

The preparation of this SIS does not, however, constitute an admission by the author (Mr F Dominic Fanning) that an SIS was, or is, in fact justified. As documented in Chapter 10.8 of this SIS, the reapplication of Section 5A of the EP&A Act to each of the relevant threatened biota and their habitats (as required by the OEH – see Appendix A) reiterates the original conclusions (Environmental InSites 2011; SLR Ecology 2012) that:

- it is **not** "*likely*" that a "*significant* effect" would be imposed upon any such biota or their habitats as consequence of the Culburra Golf Course; and
- this SIS is **not** required for the Culburra Golf Course project.

## 1.4 SIS Structure and Compliance

This SIS has been prepared in accordance with:

- the requirements of Sections 109, 110 and 111 of the TSC Act; and
- the *Director-General's Requirements* (DGRs) which were obtained for its preparation from the Director-General of the Office of Environment & Heritage (OEH), as required pursuant to Section 111(1) of the TSC Act (Appendix A).

Details of the compliance of the SIS with the relevant Sections of the Act, and with the DGRs (Appendix A), are provided in Appendix B of this SIS.

As required by Section 109(2) of the TSC Act, the SIS has been signed by:

- the author (Mr F Dominic Fanning Gunninah); and
- "the proponent of the activity" (see Declaration at the front of this document).

The SIS has been structured according to Section 110 of the TSC Act - which details the "form" of an SIS (Table 1.1) - and by reference to the *Director-General's Requirements* (DGRs).

Table 1.1	Structure of the SIS pursuant to Sections 110 and 111 of the TSC Act, and the DGRs
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Chapter	Description		
1	Background and introductory information regarding the proposal, and the statutory basis for and the structure of the SIS		
2	Contextual Information (DGRs Item 2) and a " <i>full description of the action proposed</i> " - Section 110(1)		
3	Details of survey methods and investigations, and databases, on which the SIS is based, pursuant to Item 4 of the DGRs (Section 111 of the Act)		
4, 5 and 6	<ul> <li>A general description of the subject land</li> <li>A "general description of the threatened species or populations known or likely to be present in the area" - Section 110(2)(a) of the TSC Act</li> <li>A "general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action" - Section 110(3)(a)</li> </ul>		
7	Discussion of the " <i>subject species, populations and ecological communities</i> " – those known to occur in the " <i>locality</i> " which could <b>potentially</b> be present on or adjacent to the " <i>subject land</i> " – including all of those listed in the DGRs		
8	Consideration of those "threatened species, populations and endangered ecological communities" which are " <b>likely to be affected</b> by the action" - Section 110(2)(b)		
9	<ul> <li>A detailed description of the relevant ("affected") species and populations - as required by Section 110(2)(c), Section 110(2)(d) and Section 110(2)(f) of the TSC Act</li> <li>A detailed discussion of the allegedly relevant ("affected") "endangered ecological communities" - as required by Section 110(3)(b) and Section 110(3)(c)</li> </ul>		
10	An assessment of the likely impacts of the proposed development on relevant ("affected") threatened species and endangered ecological communities - pursuant to Items 5 and 6 of the DGRs		
11	Information regarding " <i>feasible alternatives to the action</i> " - Section 110(2)(h) and Section 110(3)(e) of the TSC Act		
12	The impact amelioration and environmental management measures proposed as part of the activity – Section 110(2)(i) and Section 110(3)(f) of the TSC Act		
13	<ul> <li>Additional information regarding other approvals and licensing requirements which are required – Section 110(2)(j) and Section 110(3)(g) of the TSC Act</li> <li>The "qualifications and experience" of the author of this SIS, and other relevant persons – Section 110(4) of the TSC Act</li> </ul>		

Given the time lapse between the provision of the original SIS by SLR in May 2014 (and the provision of the DGRs – dated 28 November 2012) and the discussions with SCC (in February 2015), an updated search of the TSC Act and EPBC Act listings, and of the OEH Wildlife Atlas and the Commonwealth EPBC Act database, has been undertaken for this Gunninah SIS (August 2015)– to identify any additional biota and/or other matters (see Chapter 1.5) that have been listed in that period.

This SIS has been updated to address the relevant listings as at August 2015.

#### 1.5 Matters Which Have Been Limited or Modified

The DGRs for this SIS (Appendix A) identify a range of matters which are identified in Section 110 of the TSC Act that "need only be addressed where relevant". These include inter alia matters relating to *Threat Abatement Plans, Recovery Plans, Key Threatening Processes* and *Critical Habitat.* 

## 1.5.1 Threat Abatement Plans

The DGRs (Appendix A) state that "*There are no threat abatement plans relevant to the key threatening processes associated with the proposal*", and there are no additional *Threat Abatement Plans* listed in the TSC Act since 2012 that are of any relevance to this SIS.

However, two *Threat Abatement Plans* that could potentially be of relevance are those for Bitou Bush infestation and predation by the Red Fox.

As discussed below (Table 1.2), the Culburra Golf Course project will implement measures to significantly reduce the effects of these two *Key Threatening Processes* (KTPs) on Long Bow Point in the long-term – notwithstanding the fact that neither KTP is considered to be of any relevance to any of the relevant threatened biota on the subject land.

## 1.5.2 Recovery Plans

The DGRs (Appendix A) state that:

- there are "approved and draft recovery plans relevant to the subject species listed in Tables 1 and 2 and the subject ecological community listed in Section 3.2 of these DGRs";
- "if other entities should be deemed as subject species, populations or ecological communities by analysis in accordance with these DGRs, then any relevant recovery plans pertaining to these entities will need to be addressed in the SIS".

No additional Recovery Plans listed in the TSC Act since 2012 are of any relevance to this SIS.

The *Recovery Plans* for relevant and/or potentially relevant threatened biota are addressed in Chapters 9 and 10 of this SIS, and include -

- the approved Recovery Plan for the Yellow-bellied Glider (NPWS 2003)
- the approved Recovery Plan for Large Forest Owls (DECC 2006)
- the Management Plan for the Green & Golden Bell Frog Key Population Within the Crookhaven River Floodplain (DECC 2007).

## 1.5.3 Key Threatening Processes

The DGRs state that "Only the following key threatening processes are relevant to this proposal" -

- · Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands
- Bushrock removal

- Clearing of native vegetation
- Infection of native plants by Phytophthora cinnamomi
- Invasion of native plant communities by exotic perennial grasses
- Loss of hollow-bearing trees
- Removal of dead wood and dead trees.

Three additional *"key threatening processes"* (KTPs), which were not identified by the OEH in the DGRs, are considered by the author of this SIS to be potentially relevant:

- invasion by Lantana Lantana camara
- invasion by the Bitou Bush
- aggressive exclusion of other birds by the Noisy Miner.

Several further KTPs are also theoretically relevant (although not identified by the OEH in the DGRs) - although these are considered not likely to be of concern for any of the relevant ("*affected*") threatened species nor would be imposed or exacerbated by the proposal:

- predation by the Feral Cat
- predation by the European Red Fox
- competition from the European Rabbit
- High frequency fire regimes.

No additional KTPs listed in the TSC Act since 2012 are of any relevance to this SIS.

The relevance (or otherwise) of those KTPs is considered in general terms in Table 1.2 (below), and with respect to relevant, or potentially relevant, threatened biota in Chapter 10 of the SIS.

The DGRs further state that for each "subject species, population or ecological community likely to be affected by any of these key threatening processes, the SIS shall address whether the action will increase this threat, and shall describe proposed measures to ameliorate such threats".

The potential or likely imposition and/or exacerbation of any "*key threatening processes*" on any of the relevant threatened biota is addressed in Chapter 10 of this SIS. The "*proposed measures to ameliorate such threats*" are addressed in Chapter 12 of this SIS.

## 1.5.4 Critical Habitat

At the time of preparation of this SIS, there are no areas of declared "*critical habitat*" for any threatened biota which are of any relevance, or potential relevance, to this proposal.

No additional Critical Habitat listed in the TSC Act since 2012 is of any relevance to this SIS.

Key Threatening Process	Considerations	Relevance
Aggressive exclusion of birds from forest and woodland habitat by abundant Noisy Miners	<ul> <li>The Culburra Golf Course is not likely to exacerbate this KTP – given the surrounding retained bushland</li> <li>Ongoing monitoring would identify any increase in Noisy Miners, and management measures implemented</li> </ul>	<ul> <li>None of the relevant (<i>"affected"</i>) threatened biota would be adversely affected by Noisy Miners, in any case</li> <li>This species can be managed if it becomes a problem - which is not considered likely</li> </ul>
Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands	<ul> <li>There will be no relevant "alteration to the natural flow regimes" on or adjoining the Golf Course – because of the stormwater management regime (Martens 2015)</li> <li>The Golf Course occupies only a minute proportion (~1%) of the Lake Wollumboola catchment (less than half of the area covered by urban development in Culburra Beach)</li> </ul>	<ul> <li>The potential for impacts has been avoided and/or minimised (Martens 2015; Golf by Design 2015)</li> <li>No likely impacts on Lake Wollumboola – in terms of water quality or quantity</li> <li>No likelihood of any significant (if any) impacts on any relevant ("affected") threatened biota</li> </ul>
Bushrock removal	<ul> <li>There is no "bushrock" on Long Bow Point</li> <li>The Culburra Golf Course project will not remove any "bushrock"</li> </ul>	<ul> <li>There are no threatened biota which would be dependent upon <i>"bushrock"</i>, in any case</li> <li>No relevant impacts</li> </ul>
Clearing of native vegetation	The project will involve the <i>"clearing"</i> of approximately 27.84ha of open forest and woodland vegetation	<ul> <li>The potential for impacts to arise on relevant ("affected") threatened species is addressed in detail in Chapter 10 of this SIS</li> </ul>
	<ul> <li>That process will remove foraging habitat for several threatened species</li> <li>However, the Golf Course has been designed specifically <i>inter alia</i> to limit the extent of "<i>clearing of native vegetation</i>"</li> <li>There are substantial areas of similar and identical habitat and resources in the immediate vicinity, locality and region</li> </ul>	<ul> <li>It is not <i>"likely"</i> that the imposition of that KTP would result in the imposition of a <i>"significant effect"</i> on any threatened biota (see Chapter 10)</li> <li>Importantly, it is <b>not</b> <i>"likely"</i> that any threatened biota would be <i>"placed at risk of extinction"</i> by that KTP</li> </ul>
Competition and grazing by the feral European Rabbit	<ul> <li>European Rabbits are not common on Long Bow Point, and none of the relevant (<i>"affected"</i>) threatened biota would be affected by competition from the European Rabbit</li> <li>Implementation of the relevant <i>Plans of Management</i> on Long Bow Point will reduce or eliminate this KTP</li> </ul>	<ul> <li>Competition from the European Rabbit is not a relevant KTP for any of the threatened biota which will or may be affected by the Culburra Golf Course</li> <li>In any case, the Culburra Golf Course project will reduce any levels of such competition</li> </ul>

Key Threatening Process	Considerations	Relevance	
High frequency fire	<ul> <li>The Culburra Golf Course project will not modify bushfire regimes on Long Bow Point</li> </ul>	• None of the relevant ("affected") threatened biota would be affected by any "alterations to fire regimes"	
		<ul> <li>A modified bushfire regime could be imposed on Long Bow Point - if deemed appropriate by OEH</li> </ul>	
Infection of native plants by <i>Phytophthora</i> <i>cinnamomi</i>	• Specific measures are included in the proposed management regime for the Culburra Golf Course to prevent the introduction of <i>P. cinnamomi</i> (see Chapter 12)	• There are no relevant ("affected") threatened species which would be affected by this KTP, in any case	
Invasion, establishment and spread of Lantana <i>Lantana camara</i>	<ul> <li>There are existing areas of Lantana infestation on Long Bow Point</li> <li>The proposed Culburra Golf Course project – including its construction</li> </ul>	<ul> <li>None of the relevant ("affected") or potentially relevant threatened biota would be affected by Lantana</li> </ul>	
	and operation – will reduce the extent of Lantana on Long Bow Point	Appropriate management of Long Bow Point and the Culburra Golf Course will, in fact, reduce the extent of Lantana on Long Bow Point	
Invasion by the Bitou Bush	<ul> <li>There are existing areas of Bitou Bush infestation on Long Bow Point</li> <li>The proposed Culburra Golf Course project – including its construction and operation – will reduce the extent of Bitou Bush on Long Bow Point</li> </ul>	<ul> <li>None of the relevant ("affected") or potentially relevant threatened biota would be affected by Bitou Bush, in any case</li> <li>Appropriate management of Long Bow Point and the Culburra Golf Course will, in fact, reduce the extent of Bitou Bush on Long Bow Point</li> </ul>	
Invasion of native plant communities by exotic perennial grasses	• There is no evidence of any significant (or any) such " <i>invasion</i> " on Long Bow Point at present	There are no relevant ("affected") threatened species which would be affected by this KTP, in any case	
	<ul> <li>Management of the Golf Course will avoid any such potential (Chapter 12)</li> </ul>	<ul> <li>No further consideration of this KTP is warranted</li> </ul>	
Loss of hollow-bearing trees	<ul> <li>This is a potential issue for most of the relevant ("affected") threatened species on Long Bow Point</li> </ul>	The Culburra Golf Course has been specifically designed, in an exhaustive and iterative	
	<ul> <li>Tree-hollows are necessary for all of the relevant threatened fauna species, except the Square-tailed</li> </ul>	of hollow-bearing trees that require removal	
	<ul> <li>Kite</li> <li>There are abundant hollow-bearing trees and tree-hollows on the</li> </ul>	<ul> <li>Only about 5 known significant hollow-bearing trees in total will be removed for the project</li> </ul>	
	subject land (almost all of which will be retained), and throughout the very extensive forests in the vicinity, locality and region at Culburra	• Implementation of the <i>Hollow-Bearing Tree Protocol</i> will ensure that there is no nett loss of tree-hollows on Long Bow Point	

Key Threatening Process	Considerations	Relevance
Predation by the European Red Fox	<ul> <li>The Culburra Golf Course project will not increase any levels of predation by the Red Fox</li> <li>Implementation of the relevant <i>Plans of Management</i> for the Golf Course and <i>Conservation Reserve</i> will reduce the impacts of the Red Fox on Long Bow Point</li> </ul>	<ul> <li>The Culburra Golf Course project will reduce predation by the Red Fox on Long Bow Point – through a dedicated pest eradication program</li> </ul>
Predation by the Feral Cat	<ul> <li>The Culburra Golf Course project will not increase any levels of predation by the Feral Cat</li> <li>Implementation of the relevant <i>Plans of Management</i> for the Golf Course and <i>Conservation Reserve</i> will reduce the impact of Feral Cats on Long Bow Point</li> </ul>	<ul> <li>The Culburra Golf Course project will reduce predation by the Feral Cat on Long Bow Point – through a dedicated pest eradication program</li> </ul>
Removal of dead wood and dead trees	<ul> <li>As is the case with hollow-bearing trees, the Culburra Golf Course has been designed specifically to minimise the removal of this resource</li> <li>The most significant and relevant element (tree-hollows) has been dealt with above</li> <li>As for hollow-bearing trees, "dead wood and dead trees" will be salvaged (where they cannot be retained) and re-deployed in the <i>Conservation Reserve</i> on Long Bow Point</li> </ul>	<ul> <li>None of the relevant ("affected") threatened biota are dependent upon "dead wood and dead trees" per se</li> <li>In any case, such resources are to be preferentially retained and/or salvaged and re-deployed on Long Bow Point</li> <li>The imposition of this KTP is not "likely" to impose a "significant effect" upon any threatened biota</li> </ul>

# 1.5.5 Relevant Definitions

The DGRs provide definitions for a range of terms of relevance for this SIS (Appendix A), the most important of which are repeated below. For the purposes of this SIS, five specific areas at Culburra (the *"subject site"*, *"subject land"*, *"study area"*, *"survey area"* and *"locality"*) have been identified within the general locality (Figures 5A and 5B) – as detailed below.

The definitions of various terms used within this SIS (see the *Glossary* and below) are derived from definitions provided in the TSC Act, the EP&A Act, the DGRs for this SIS and/or from the definitions of terms contained within the text of the SIS.

# Subject Site

The "subject site" is defined in the DGRs as "the area directly affected by the proposal".

On the basis of that definition, the "*subject site*" for the Culburra Golf Course project (Chapter 2.3; Appendix C1; Figures 3A and 3B) includes:

- the footprint of all proposed vegetation clearing and earthworks (see detailed figures in Appendix C1);
- some small areas between proposed earthworks (which may not survive the works) although any such areas will be rehabilitated;
- the footprint of the access road, and adjacent areas for drainage and stormwater management, and a 10m wide APZ in areas of open forest or woodland;
- the existing access road into the site which will be used for the route of sewer, water and other services;
- the access road and bridge alignment across Downs Creek noting that works here are to be tightly constrained and that all disturbed areas are to be rehabilitated following the completion of works; and
- temporarily small parts of the existing cleared land on Long Bow Point (for the storage of equipment, fuels and materials, and for the provision of facilities for workers.

The clearing and construction phase of the Culburra Golf Course project is to be very tightly controlled. All felling of trees and all removal of vegetation is to be undertaken into and from within areas of golf holes or other clearings for the project. No equipment will be permitted in areas beyond the identified earthworks areas, and no trees may be felled into any retained vegetation.

It is noted that the "*subject site*" includes a number of areas which will subsequently be rehabilitated (to native grassland or shrubland and/or ponds and wetlands) – to provide additional and/or supplementary habitat for native biota (Chapters 2.3 and 12).

Consequently, the area which will be **adversely** affected (as opposed to simply "*directly affected*", without any qualification) for the Culburra Golf Course project will be somewhat less than that identified as the "*subject site*".
## Subject Land

The "*subject land*" (Figure 5A) is identified as part of two private landholdings (currently owned by the proponent) - located south of the Culburra Road and west of Lake Wollumboola. These lands (the southern parts of Lots 5 and 6 in DP 1065111) occupy an area of approximately 201ha are referred to throughout this SIS as the "*subject land*".

The subject land (Figure 5A) is bound by:

- Culburra Road to the north with the northern parts of Lots 5 and 6 located further north (to the north of the Culburra Road);
- Lake Wollumboola to the east and southeast;
- the township of Culburra to the northeast; and
- other private landholdings (including the southwestern part of Lot 6) to the south and west.

The Culburra Golf Course itself (see Chapter 2.3; Appendix C1; Figures 3A and 3B) will occupy a total of approximately 35.2ha (or 17.3%) of the subject land. Approximately 6.55ha of that area (or 20.7%) is already cleared, and approximately 6.66ha is to be rehabilitated or to be specifically created as supplementary habitat (shrubland, grassland or detention basins/wetlands).

## Study Area

The DGRs identify the "study area" as "the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. The study area should extend as far as is necessary to take all potential impacts into account".

The "study area" therefore is:

- the "subject site" "the area directly affected by the proposal" (see above); and
- an additional area around the "*subject site*" which is "*likely to be affected by the proposal*" through indirect effects.

The indirect effects which could potentially or theoretically be imposed by the Culburra Golf Course project include:

- ecological "edge effects" modifications to vegetation along edges between the cleared golf course elements and retained vegetation;
- contaminant or pollutant discharges beyond the edges of the Golf Course into adjoining retained vegetation;
- contaminant, nutrient or pollutant discharges into groundwater; and
- noise and light 'spill' into adjoining vegetation, and the effects of passing golfers on fauna in bushland adjoining the golf course.

As discussed below, the impacts of noise and light 'spill' and golfers on the Course are considered likely to be extremely limited – given that the Golf Course will only be used during the day, and golf is not an

inherently noisy or particularly disturbing activity.

Further, potential ecological "*edge effects*" are likely to be very limited in extent (as discussed in detail in Chapter 10.6) – because of the nature of the activity (*ie* a golf course rather than a residential development). These impacts will extend for only approximately 10 metres into adjoining bushland (Appendix C2) – based on evidence and observations on the subject land currently, and observations specifically collected from several existing golf courses in the region and in Sydney (see Chapter 2.4).

Lake Wollumboola and its immediate environs are not included in the "study area" for this SIS.

This is because (as detailed in subsequent Chapters of this SIS and in relevant *Management Plans* – Appendices D1 and D2), the proposed Culburra Golf Course project has been designed, and is to be managed, specifically *inter alia* to avoid the potential for any adverse impacts (either direct or indirect) to be imposed upon Lake Wollumboola, its associated ecosystems and/or any native biota which dependent upon it.

Lake Wollumboola and its immediate environs are not "*likely to be affected by the proposal, either directly or indirectly*" given:

- the detailed design of stormwater management measures;
- the specific measures for the construction and long-term maintenance and management of the Golf Course; and
- an array of safeguards with respect to water quality associated with the Golf Course (see Chapters 10 and 12).

These measures are, or will be, documented in various *Management Plans* including:

- the *Integrated Water Management Plan* (June 2015) of Martens Consulting Engineers (Appendix D1);
- the *Culburra Golf Course Plan of Management* (March 2015) of Golf by Design (Appendix D2);
- a *Construction Environmental Management Plan* (CEMP) for the Golf Course (see Chapter 12.4) to be prepared on approval of the Golf Course and prior to any works;
- a *Culburra Golf Course Ecological Management Plan* (see Chapter 12.4) to be prepared in accordance with this SIS on approval of the Golf Course and prior to any works; and
- a Long Bow Point Conservation Reserve Plan of Management (see Chapter 12.4) to be prepared in accordance with this SIS on approval of the Golf Course and prior to any works being undertaken.

It is noted that the preparation of such *Management Plans* are regularly required as *Conditions of Consent* for development approvals throughout NSW. By way of example, Shoalhaven City Council has requested the provision of just such *Management Plans* for the approved extension of the Shoalhaven Heads Golf Course.

### Culburra Survey Area

The "*Culburra survey area*" includes all of the lands to the immediate west and southwest of Culburra Beach which have been the subject of previous detailed investigations (see Chapter 3) – to the north and south of the Culburra Road (Figure 5B).

These lands include all of Lots 5 and 6 in DP 1065111 (north to the Crookhaven River), as well as Lot 7 in DP 1056111 and Lot 61 in 755571 – to the west. Lands to the north of the Culburra Road (as well as Long Bow Point) have been the subject of detailed and extensive flora and fauna surveys since at least 1996, and have most recently been considered during deliberations for the Culburra West Urban Development project.

The results of those investigations are relevant to the Culburra Golf Course project and to the consideration of ecological issues on Long Bow Point – because the native vegetation to the north and south of The Culburra Road are essentially contiguous, and because the two portions of land support very similar or identical vegetation types and habitats. A significant part of the Downs Creek catchment is located to the north of the Culburra Road.

As a consequence, the flora and fauna surveys and data from the lands to the north of the Culburra Road (including the considerable detailed and extensive investigations undertaken for the Culburra West Urban development project and the Culburra Urban Development Area (UEA) – particularly (but not exclusively) those undertaken between 2010 and 2013) are regarded as a valid part of the database for this SIS. Those surveys are detailed in Chapter 3 of this SIS, and in the SLR Ecology *Reports* for the Culburra West Urban development project (SLR Ecology 2013a, b).

### Local Survey Area

The total extent of the "*local survey area*" includes all of the lands to the immediate west and southwest of Culburra Beach which have been the subject of previous detailed investigations (the "*Culburra Survey Area*"), as well as other lands in and around the Lake Wollumboola catchment surveyed by the author of this SIS and his agents since 1995 (Figure 5B), including Lot 1 in DP604617 at East Crescent, Culburra.

In addition, given the 'connectivity' of habitats through the area, lands to the south and further west of Lake Wollumboola which had been the subject of previous investigations by Gunninah Environmental Consultants and/or Environmental InSites (Figures 5A and 5B) are considered part of the "*local survey area*" - including lands at Callala and around Carrama Creek, as well as at Kinghorne Point.

### Locality

The "*locality*" for the purposes of this SIS encompasses the area of contiguous, or near-contiguous, ecosystems and habitats within a radius of up to at least 10 kilometres (depending on individual species) from the "*subject site*".

Obviously, the extent of relevant 'contiguous habitat' for different threatened biota will vary significantly. By way of example, for small threatened terrestrial mammals (none of which are present), the "*locality*" would extend only for a few or several hundred metres. Conversely, the "*locality*" for an individual of a

species such as the Square-tailed Kite or Powerful Owl would extend for many kilometres, and would not necessarily be constrained by barriers such as the Crookhaven River.

## Region

The *"region"*, when generally referred to in this SIS, constitutes the *Jervis Bay Regional Area*, as identified in the *Jervis Bay Regional Environmental Plan*. That area is relevant for many of the threatened and other native biota discussed in this SIS, and correlates approximately to the *Shoalhaven Local Government Area* (LGA).

This is considered the relevant *"region"* with respect to local populations of many of the potentially relevant or known threatened biota - such as the Powerful and Masked Owl, Square-tailed Kite, Glossy Black Cockatoo and the array of microchiropteran bats.

It is noted that the term *"region"* is also used in the TSC Act with respect to *"biogeographical regions"* or *"bioregions"*. These are used *inter alia* to identify the broad distribution of threatened ecological communities, but are not particularly relevant when considering the potential for an individual proposal to impose adverse impacts upon threatened biota or their habitats. Where relevant, the biogeographical regions will be identified separately as *"bioregions"*.

## Subject Species, Populations or Ecological Communities

DGRs – "those threatened species, populations or ecological communities that are known or considered likely to occur in the study area. The SIS is to explicitly consider the impacts of the proposal on each of these entities".

As discussed in detail in Chapters 7 and 8 of this SIS, the "*subject species, populations or ecological communities*" include a substantial number of biota that are of no actual relevance to the Culburra Golf Course proposal. The SIS identifies those threatened biota that are actually of relevance to the proposed Culburra Golf Course – which are identified as "Affected Species" (see Chapter 8).

### **Direct Impacts**

DGRs - those impacts "that directly affect habitat and individuals, usually within the footprint of the proposal. They include, but are not limited to, clearing and habitat removal. Consideration must be given to all of the likely direct impacts of the proposed activity or development".

The direct impacts which would be imposed by the Culburra Golf Course proposal are addressed in detail in Chapter 10 of this SIS. These impacts are addressed with respect to the relevant biota (the *"affected species"*) which are likely to be or could potentially be affected by the proposed Culburra Golf Course on Long Bow Point.

#### **Indirect Impacts**

DGRs – "Indirect impacts occur when project-related actions affect species, populations or ecological communities in a manner other than direct loss, usually beyond the footprint of the proposal".

"Indirect impacts can include loss of individuals through predation by domestic and/or feral animals, deleterious hydrological changes (including increased runoff and raising or lowering of the water table), erosion, weed invasion, pollution, trampling or other impacts due to increased human activity within or directly adjacent to sensitive habitat areas, altered fire regimes, habitat fragmentation and disruption of wildlife movement corridors".

"As with direct impacts, consideration must be given to all of the likely indirect impacts of the proposed activity or development".

The indirect impacts which would or might be imposed by the Culburra Golf Course proposal are addressed in detail with respect to the relevant biota (the "*affected species*") which are likely to be or could potentially be affected by the proposed Culburra Golf Course on Long Bow Point - in Chapter 10 of this SIS.

### Life Cycle

DGRs – "the series or stages of reproduction, growth, development, aging and death of an organism".

### Viable

DGRs – "the capacity to successfully complete each stage of the life cycle under normal conditions".

### **Risk of Extinction**

DGRs – "the likelihood that the local population of the species or local occurrence of the endangered population or ecological community will become extinct either in the short, medium or long-term as a result of direct or indirect impacts on the viability of that population and includes changes to the ecological function of communities".

In considering the likelihood of a "*significant effect*" to be imposed as a result of any proposed development, therefore, it is necessary to consider whether that activity would render the relevant biota "*likely*" to be completely obliterated or rendered totally unviable on a "*local*" scale.

In this regard, it is not sufficient that a proposal be likely to adversely affect such biota in an adverse way, or even that there be some notable reduction in population or the distribution or abundance of relevant resources. Rather, it must be "*likely*" that the "*local occurrence*" of an "*endangered ecological community*" be rendered incapable of surviving in the locality.

The relevant 'test' is "extinction"; not merely reduction.

### Local Population

DGRs - "the population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions".

"The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area".

"The local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area".

"The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time".

"In cases where multiple populations occur in the study area, each population should be assessed separately".

Specific consideration of the "*local population*" for each of the "*affected species*" is addressed in Chapter 8 of this SIS.

### Local Occurrence

DGRs – "the ecological community that occurs within the study area. However the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated".

As discussed in detail in Chapters 5, 7 and 8 of this SIS, there are no "threatened ecological communities" (TECs) present on the subject site or the subject land at Culburra – for a variety of reasons. There are, however, several vegetation types on the subject land with the floristic characteristics of some TECs, although these vegetation types fail other criteria for the potential TECs considered by some to be present.

Notwithstanding the lack of TECs on the subject land, the Culburra Golf Course has been designed *inter alia* to minimise any potential adverse impacts upon the vegetation types with the floristic characteristics of any TECs.

#### 1.6 Basis of This SIS

The proposed Culburra Golf Course has been designed and refined over a long period (by the author of this SIS amongst others) in full cognisance of the potential or likely environmental and ecological constraints which pertain (or which may pertain) to the subject land, and with respect to its location and context.

The analysis contained within this SIS of the likely impacts the proposed Culburra Golf Course is based *inter alia* on the extensive and comprehensive surveys and investigations undertaken on Long Bow Point and other areas in the vicinity and survey area – over at least two decades. Specific and detailed supplementary investigations have been undertaken for this SIS (see Chapter 3) – to complement the existing substantial local database, and to satisfy the requirements of the DGRs.

Issues of particular relevance in determining the potential ecological constraints to the proposed Culburra Golf Course have included *inter alia*:

- the significance of Lake Wollumboola as habitat for native wildlife (particularly wetland and water birds) and as an Intermittently Closed and Open Lake or Lagoon (ICOLL);
- the presence of SEPP 14 Coastal Wetlands adjacent to Long Bow Point;
- the presence of several vegetation types which have floristic affinities with some "endangered ecological communities" (EECs), within and adjacent to the subject site; and
- the presence or likely presence of threatened biota, and of relevant or potential habitats or resources for such species, within the proposed Golf Course area.

In assessing the potential constraints to the construction and operation of the Golf Course, it is assumed that all activities associated with the Golf Course would be undertaken in an environmentally sensitive and sound manner. In particular, the creation and future management of the Culburra Golf Course would utilise current 'best practice' construction, development and long-term management methods and approaches - designed *inter alia* to minimise or avoid the imposition of adverse impacts upon the natural environment and on sensitive habitats and features downstream (such as Lake Wollumboola and Downs Creek).

Further, the need for 'best practice' stormwater management and treatment has been recognised as a fundamental requirement of the proposed Culburra Golf Course. This is addressed in detail in the *Integrated Water Management Report* of Martens 2015 (Appendix D1). This issue *inter alia* is also in part the basis for the Golf Course project requirement for, and commitment to, the creation and implementation of a comprehensive *Culburra Golf Course Plan of Management* (GCPoM) – which has been provided by Golf by Design (Appendix D2).

In addition, there is a specific commitment to the preparation of a dedicated *Construction Environment Management Plan* (CEMP) and a *Golf Course Ecological Management Plan* (GCEMP) for the Culburra Golf Course, as well as a *Conservation Reserve Plan of Management* (CRPoM) for the Long Bow Point Conservation Reserve – see Chapter 12.

### 2 CONTEXTUAL INFORMATION

#### 2.1 Introduction and Scope

Section 110(1) of the TSC Act requires that:

"a Species Impact Statement must include a full description of the action proposed, including its nature, extent, location, timing and layout".

The DGRs for this SIS (Appendix A), obtained pursuant to Section 111 of the TSC Act, document the following requirements:

- a "full description of the action proposed" which "includes a description of all associated actions" – which "may occur on or off the site";
- "details of the location of any auxiliary infrastructure and all component parts of the proposal" as detailed in Item 2.1 of the DGRs (Appendix A);
- "the timetable for the construction of the proposal. If a staged construction approach is adopted then the timetable shall clearly indicate this";
- any "subsequent development of adjacent land to the extent that it is known at the time of preparing the SIS" - and the relocation of any "existing structures", if known;
- full documentation of the "vegetation within the study [sic] that is to be retained" and the "proposed management regimes for such areas";
- a "detailed plan of the study area .. at a preferred scale of 1:4,000 or finer" which details "the proposal, the location and type of vegetation communities present within the study area, the full extent of vegetation clearing anticipated, and the scale of the plan";
- a plan showing "the location of any key habitat resources for threatened species, such as Glossy Black-cockatoo feed trees, trees used as nesting sites by large forest owls and Gang-gang cockatoo, Yellow-bellied Glider feed trees, micro bat roosting or nest trees, and trees bearing hollows";
- "colour aerial photography of the locality";
- a "topographic map of the subject site and immediate surrounds at a scale of 1:25000";
- a "map of the locality, showing landscape features" "within at least a radius of 5km from the subject site" as detailed in Item 2.2 of the DGRs (Appendix A); and
- the "land tenure across the study area .. and any limitations to sampling across the study area resulting from this tenure" Item 2.3 of the DGRs.

The provision of each of these items within the SIS is documented in detail in Appendix B.

The "*detailed plan of the study area* .. *at a preferred scale of 1:4,000 or finer*" has required the inclusion of two A3 plans (Appendix C2 of the SIS). In addition, the SIS is to be made available electronically – so that Council or the OEH (and any other reader) can produce a "*detailed plan*", or plans, from the SIS at any desired scale.

## 2.2 Subject Site and Study Area

## 2.2.1 Definitions

As detailed in Chapter 1.5.5 of this SIS, the DGRs define:

- the "subject site" as "the area directly affected by the proposal"; and
- the "study area" as "the subject site and any additional areas that are likely to be affected by the proposal, either directly or indirectly. The study area should extend as far as is necessary to take all potential impacts into account".

Other relevant definitions are provided in the DGRs (Appendix A) and in the Glossary, with the most relevant detailed in Chapter 1.5.5.

## 2.2.2 General Context

As indicated above, the subject land is located to the immediate southwest of the township of Culburra Beach, on the south coast of New South Wales (Figures 1 and 2). The subject land is surrounded by:

- Lake Wollumboola to the immediate east which is part of the Jervis Bay National Park;
- the existing township of Culburra Beach (also known as Culburra) to the immediate northeast and along the northern edge of the subject land;
- vegetated private lands to the north, west and south; and
- the Culburra Road (along its northern boundary).

The subject land is located entirely within the catchment of Lake Wollumboola (Figure 6), occupying less than 6% of the Lake catchment (of 3,410 ha). The total area to be affected by the proposed Culburra Golf Course, however, occupies just 35.2ha (or approximately 1%) of the Lake Wollumboola catchment.

The subject site is largely vegetated by an array of native plant communities and ecosystems (Figure 2), although there has been substantial clearing in the past (see Chapter 4.3).

### 2.2.3 Land Tenure

The whole of the subject land (in addition to substantial portions of land to the north, west and south of Long Bow Point), are currently in the ownership of Sealark Pty Ltd. Lands further to the south and southwest include significant areas of the National Parks estate and State Forests (Figures 7A and 7B).

There have been no "limitations to sampling across the study area".

## 2.3 Detailed Description of the Proposal

## 2.3.1 The Underlying Basis of the Culburra Golf Course

The Culburra Golf Course project has been designed and developed on the basis that the natural environment is a significant and valuable asset, rather than a problem or an issue.

The underlying approach has been that the Culburra Golf Course is 'a golf course embedded within the natural environment'. It is fundamental to this approach that the construction and management of the Golf Course will provide supplementary habitats and resources, as well as imposing a very limited and constrained impact on the natural environment on Long Bow Point.

On the basis of that approach, the Culburra Golf Course project proposes to 'celebrate' the natural environment within which it is located. In addition to the creation of new and valuable habitat (such as the areas of native grassland and the wetland basins), the Golf Course will contain an array of educational signage for golfers and visitors which will:

- highlight and describe areas of particular environmental value;
- illustrate and explain the value of hollow-bearing trees as habitat for native, including particularly for threatened, biota;
- illustrate and discuss relevant threatened, and other native, biota and their habitats; and
- promote a sense of enjoyment of the natural environment around the Golf Course.

The Culburra Golf Course project is committed to an environmentally responsible approach - which protects and retains natural resources as an integral part of the project, and as a highly valued feature of the Golf Course. The natural bushland on the subject land is not seen as an impediment to the proposed Golf Course, but rather as a major attribute. As noted above, the concept is of a golf course embedded in, and part of, the natural environment.

The Culburra Golf Course project seeks to retain, enhance and protect native vegetation on Long Bow Point – as an important element of the Golf Course itself.

### 2.3.2 The Iterative Process

The proposed 18-hole golf course on Long Bow Point at Culburra, as addressed in this *Species Impact Statement* (SIS), is a refinement of the golf course design which was included in the original *Development Application* (DA) to Shoalhaven City Council (SCC) in 2011.

That original golf course design was addressed inter alia in:

- the original DA and Statement of Environmental Effects (SoEE) prepared by Allen Price & Associates (2011);
- the Environmental InSites 2011 Ecological & Riparian Assessment Report (ERAR); and
- a Supplementary Ecological Assessment Report prepared by SLR Ecology (2012).

The more refined (current) version of the 18-hole golf course at Culburra (Figures 3A and 3B; Appendix C1), which is addressed in detail in this SIS, has been prepared on the basis of requests for additional detail by the OEH and by the relevant consent authority (Shoalhaven City Council). These additional

details and the relevant design elements for the Golf Course were anticipated in the original DA and in the ecological *Reports* cited above.

The refined Golf Course design addressed in this SIS has been the subject of an exhaustive and iterative detailed design process by a dedicated golf course designer (Mr James Wilcher of Golf by Design) and the author of this SIS – providing detailed specialist ecological advice. That process included *inter alia* a walked survey of the Golf Course layout - which resulted in an array of changes to the Golf Course, including the relocation of several holes and the refinement of the design to retain virtually all hollow-bearing trees. Additional specialist advice has been provided by Mr Andrew Norris of Martens Consulting Engineers – with respect to stormwater flows, groundwater, hydrology and water quality.

The refinements contained in the current design (Figures 3A and 3B; Appendix C1) for the Culburra Golf Course from the earlier golf course DA design include *inter alia*:

- a considerable narrowing of all of the golf course holes and fairways (in accordance with expert golf course design requirements) – leading to a substantial reduction in the area of native vegetation which is required to be cleared for the project;
- the relocation and re-orientation of several golf holes to various degrees to avoid specific ecosystems or habitat features and resources (particularly Holes 3, 4, 5, 13 and 14);
- the refinement of the locations and sizes of a number of the water storage ponds around the golf course – in consultation with the project hydrologists (Martens Consulting Engineers);
- adjustments at a number of locations to avoid (or at least to minimise) the removal of hollow-bearing trees by changes to the design of the fairways, the locations of tees, and the locations and extent of the greens – following a walked survey of the proposed course by the Golf Course designer (Mr James Wilcher) and the project ecologist (Mr F Dominic Fanning); and
- additional refinements of the layout by the author of this SIS to further reduce the potential for adverse impacts on specific features (*eg* the Square-tailed Kite nest tree near the green on Hole 5).

This iterative process of refinement has enabled the creation of a golf course design which is highly responsive to the natural environment, and which facilitates the retention of important habitat features and resources (such as special foraging resources, hollow-bearing trees and nest trees).

That process has enabled the retention of virtually all hollow-bearing trees throughout the Culburra Golf Course project - although it is accepted that some tree-hollows may not have been visible from the ground. There is, therefore, some (limited) potential for the loss of a few tree-hollows during clearing for the Golf Course project, beyond the 5 or so identified hollow-bearing trees which are already mapped in areas to be affected (see Chapter 6).

Any such loss would be infinitesimal in respect of the extremely large quantum of the hollow-bearing tree resource on the subject land, and in the immediate vicinity and general locality. Further, as detailed in Chapter 12 of this SIS, the Culburra Golf Course project will involve implementation of the *Hollow-bearing Tree Protocol,* as an integral part of the project – to ensure that there is **no nett loss** of tree-hollows as a consequence of the Culburra Golf Course project.

## 2.3.3 An Integrated Approach

Features of the proposed 18-hole golf course on Long Bow Point which have been responsive to the natural environment, and which seek to avoid, minimise and/or ameliorate adverse impacts (see Chapter 12 for details), include *inter alia*:

- the design of the stormwater runoff system for the project to capture stormwater runoff and overland flow from golf course elements (fairways, greens and tees) – to protect water quality and for the irrigation of elements of the golf course (Martens 2015; Appendix D1);
- the retention of bands of native open forest and woodland vegetation between the golf course fairways and holes throughout the project (Figures 3A and 3B; Appendix C1);
- the retention of virtually all hollow-bearing trees (as discussed above), and the implementation of a *Hollow-bearing Tree Protocol* – to ensure that there is no nett loss of tree-hollows;
- the provision of a vegetated 'buffer' between the Golf Course and Lake Wollumboola of a minimum of 100m (Figures 3A and 3B; Appendix C1) – to further ensure the protection of the Lake and the avoidance of impacts on lake-dependent fauna;
- the rehabilitation and enhancement of the vegetated buffer around Lake Wollumboola by the removal of weeds (Lantana and Bitou Bush in particular), the management of access, and the facilitation of natural regeneration (or active planting where, and if, necessary);
- the design of various elements of the Golf Course (*eg* detention basins, native grassland rehabilitation areas) to provide supplementary habitat for native (including threatened) biota; and
- the implementation of various *Plans of Management* to ensure the long-term and ongoing management of vegetation, habitats and resources throughout the Culburra Golf Course land for biodiversity conservation purposes, the control of pest species, and the protection of ecosystems and biota on Long Bow Point.

These matters are all addressed in detail in this SIS for the Culburra Golf Course. Other matters are addressed, as relevant, in:

- the *Bushfire Protection Plan* (Martens 2011) noting that few elements of the Golf Course require *Asset Protection Zones* (APZs), and that the club house is not part of the Culburra Golf Course *Development Application* (DA);
- the Integrated Water Management Plan prepared by Martens Consulting Engineers 2015; (Appendix D1) – which provides full details of the stormwater quality and flow management regime;
- the detailed Golf Course design and earthworks plans prepared by Golf by Design (Appendix C1);
- the detailed Culburra Golf Course Plan of Management (GCPoM) prepared by Golf by Design (Appendix D2); and
- the amended *Statement of Environmental Effects* (SEE) which details *inter alia* the relevant planning considerations for the project (Allen Price & Associates APA 2015).

## 2.3.4 Golf Course Design Elements

The proposed Culburra Golf Course has been located and designed *inter alia* to avoid or limit the potential for adverse impacts to be imposed upon the natural environment.

Specific design elements of the Culburra Golf Course proposal include:

- the avoidance (with the exception of a narrow crossing of Downs Creek) of all of the lands zoned 7(a) – Environmental Protection (Wetlands) on the subject land (Figures 3A and 3B; Appendix C1). These protected lands are all to be incorporated into the Long Bow Point Conservation Reserve (see below);
- the provision of a carefully designed water management regime to facilitate the capture and re-use of stormwater discharges and the treatment of all stormwater, and to avoid the discharge of contaminants or nutrients into adjoining watercourses and wetland environments - pursuant to the *Integrated Water Management Plan* of Martens 2015 (Appendix D1);
- the design of individual golf holes and fairways throughout the Golf Course through an exhaustive and iterative design process (Appendix C1) – to retain virtually all hollowbearing trees and other resources of value (or potential value) for threatened biota;
- the design of specific elements of the Golf Course project (*eg* the water detention basins and lake) for biodiversity conservation purposes – by providing supplementary habitat and resources for native, including threatened, species (such as wetland birds, the Largefooted Myotis and the Green & Golden Bell Frog);
- the provision of a detailed *Culburra Golf Course Plan of Management* (GCPoM) prepared by Golf by Design (Appendix D2); and
- provision for the long-term management of the Golf Course, and of all retained vegetation and created habitats around the Golf Course, for the conservation of threatened biota – pursuant to:
  - a *Golf Course Ecological Management Plan* (GCEMP) for the Culburra Golf Course lands; and
  - a *Conservation Reserve Plan of Management* (CRPoM) for the Long Bow Point Conservation Reserve (both to be prepared on receipt of development approval).

It is noted that the preparation of such *Management Plans* are regularly required as *Conditions of Consent* for development approvals throughout NSW. By way of example, Shoalhaven City Council has requested the provision of just such *Management Plans* for the approved extension of the Shoalhaven Heads Golf Course.

Of particular importance is the design and implementation of a comprehensive and integrated water management regime for the proposed Culburra Golf Course (Martens 2015; Appendix D1). This has been designed specifically *inter alia* to capture and treat stormwater discharges from areas that could potentially generate contaminants (such as fertilisers, pesticides or other golf course chemicals).

As noted above, the requirement for very high standards of water quality to be discharged from the Golf Course site has been identified from its inception as a fundamental basis for the Culburra Golf Course

project. The management of stormwater throughout the Golf Course (see Appendix D1) will ensure that:

- there will be no adverse impacts on groundwater (Chapter 4.10 of Appendix D1) with a minor increase in groundwater seepage from the Golf Course but a reduction in nutrient discharge to groundwaters;
- the Golf Course will be self-sufficient with respect to irrigation requirements; and
- there will be no increase ion the discharge of nutrients or pollutants as a result of overland flows from the Golf Course into adjoining retained native vegetation.

To further ensure that any discharges of potential contaminants from the Golf Course will be minimal and of no environmental significance, a *Culburra Golf Course Plan of Management* (GCPoM) has been drafted (Appendix D2), which will:

- ensure the implementation of environmental management measures during construction of the Golf Course;
- guarantee that excessive fertilisers, pesticides and other chemicals are not applied to the completed Golf Course (see considerations in Chapter 2.4); and
- provide for ongoing monitoring of the golf course, and the implementation of mechanisms to respond to any circumstances that might arise.

An important element of the Culburra Golf Course is the management of retained vegetation through and around the Golf Course for biodiversity conservation purposes. The wetlands and outer 'roughs' are to be managed to provide habitat for native biota, and the bands of open forest and woodland between the golf course holes will be maintained for the provision of an array of habitat features – including the hollow-bearing trees. These elements of the Golf Course will be managed and monitored in accordance with a *Golf Course Ecological Management Plan* (GCEMP) for the Culburra Golf Course lands.

As discussed in detail below (Chapter 2.4), modern golf course management in Australia involves an array of measures designed specifically *inter alia* to minimise adverse impacts on the natural environment.

## 2.3.5 Vegetation Removal and Modification

The proposed Culburra Golf Course will occupy only approximately 35.2 hectares *in toto*, or 17.5% of the subject land at Culburra (Figures 3A and 3B; Appendix C1; Chapter 10.3). However, it is important to note that, of the 35.2 hectares to be affected:

- approximately 7.2 hectares is already cleared and/or consists of regrowth Tick Bush Shrubland – which has little or no biodiversity conservation value at this location;
- approximately 4 hectares is to be rehabilitated following earthworks activities, using native groundcover and shrublayer vegetation to provide habitat for native biota; and
- approximately 3 hectares is to become detention basins and the main irrigation lake all of which are of potential relevance for native (including threatened) biota.

Given those considerations:

- the total area of native open forest and woodland which will be removed is 27.84 hectares (or just 13.85% of the subject land and less than 1% of the Lake Wollumboola catchment); and
- a total of 7ha of new habitat and resources (*eg* ponds, wetlands, native grasslands *etc*) will be created.

Importantly, no element of the proposed Culburra Golf Course is located closer than approximately 100m to Lake Wollumboola (Figures 3A and 3B; Appendix C1) or the SEPP 14 Wetlands present (see Chapter 2.4 below). Further, the intervening band of xeric vegetation would act as a buffer (if it is necessary) to the Lake and to the important ecosystems adjoining it, in addition to the protection provided by the stormwater management regime (Martens 2015; Appendix D1) - which is an integral element of the Culburra Golf Course project – and the GCPoM (Appendix D2).

It is not considered likely that any further 'buffering' will be required by that band of vegetation, however, given the effectiveness of the management regime of Martens 2015 (Appendix D1).

It is also pertinent to note that:

- the 27.84ha of open forest and woodland to be removed represents just 0.81% of the Lake Wollumboola catchment;
- the project will create approximately 7ha of other habitats and resources *inter alia* for some threatened biota; and
- less than 3ha of the project (including roads, buildings *etc*) will be impervious surfaces thus minimising any potential impacts on hydrologic regimes.

The requirements for bushfire protection, particularly *Asset Protection Zones* (APZs) pursuant to *Planning Bushfire Protection 2006* (PBP), will be extremely limited - because of the nature of the proposed development. The only requirements for APZs (Martens 2011) are:

- around the future (conceptual) club house (25m wide);
- around the carpark (10m wide); and

along parts of the access road in bushland (10m on both sides). It is noted that much of the
access road is located in already cleared parts of the site, and no clearing for APZs would be
required in those areas.

Any removal of vegetation required for any APZ anywhere on Long Bow Point will be undertaken in a sensitive manner, under the direction of a project ecologist - to enable the avoidance of features of value (*eg* hollow-bearing trees, stands of she-oaks, Yellow-bellied Glider feed tree *etc*). Further, all APZs within areas of native vegetation are to be managed so as to retain native understorey vegetation, and to prevent any weed infestation – in accordance with the comprehensive *Golf Course Ecological Management Plan* (GCEMP) – see Chapter 12.

# 2.3.6 Staging and Construction

The Culburra Golf Course project will be undertaken in a staged manner, involving the following elements – conducted in accordance with a detailed *Construction Environment Management Plan* (CEMP) – to be prepared for the project once consent is obtained for the Golf Course.

- Stage 1 Clearing of the Site
  - Flagging of the outer edge of clearing and installation of safety mesh fencing to delineate works areas
  - Pre-clearing surveys of vegetation, logs and hollow-bearing trees by an ecologist prior to their removal
  - Re-deployment of tree-hollows into large trees around the Golf Course or in the Long Bow Point Conservation Reserve
  - Clearing of vegetation over the whole of the subject site with the use of sterile cover-crop grasses and/or mulched native plant material from the site to protect soils against erosion

# • Stage 2 Construction of the Front Nine

- Earthworks and construction of the 'Front Nine' (holes 1 to 9)
- Earthworks and construction of water treatment features for the 'Front Nine'
- Construction of the access road, carpark, toilets, maintenance facilities, greenkeepers shed and turf nursery
- Installation of infrastructure and services (sewer, water supply, electricity, communications *etc*) along the existing excess track from the Culburra Road
- Rehabilitation of identified areas to native vegetation and landscaping of the stormwater features as habitat

### • Stage 3 Construction of the Back Nine

- Earthworks and construction of the 'Back Nine' (holes 10 to 18)
- Earthworks and construction of water treatment features for the 'Back Nine'
- Construction of the golf buggy and maintenance bridge over Downs Creek
- Rehabilitation of identified areas to native vegetation and landscaping of the stormwater features as habitat

Stage 1 of the project will be commenced no earlier in the year than April and be completed no later than October. This timing will avoid the majority of fauna breeding seasons, and thus minimise the potential impacts on wildlife.

For the purposes of construction activities, there will be a requirement for access by earth-moving vehicles, trucks and other vehicles, and the establishment of a site office, works areas, parking areas and areas for the stockpiling of materials. Those activities will be undertaken in the existing cleared and disturbed land on Long Bow Point and/or on areas of clearing for the Golf Course, including:

- the existing access track from Culburra Road;
- the existing areas of cleared and degraded land; and/or
- areas identified for clearing and development activities (*eg* the driving range, golf course fairways *etc*).

Details with respect to the clearing works and construction activities associated with the Culburra Golf Course project are documented in the *Culburra Golf Course Plan of Management* (GCPoM - Appendix D2) and/or will be included in the detailed *Construction Environment Management Plan* (CEMP) - including with respect to:

- the protection of areas of environmental significance and value including vegetation to be retained and hollow-bearing trees;
- the installation of erosion control devices and water quality control structures downstream of all earthworks prior to the clearing of any vegetation;
- clear identification of all areas where earthworks activities are to be undertaken using star pickets and orange protective fencing;
- topsoil striping and stockpiling (for re-use), and bulk earthworks (cut and fill) on a staged basis through the Golf Course;
- the construction of all elements of the stormwater detention and water quality management system, as well as landscaping of these features to provide habitat for native fauna;
- the installation of irrigation systems, golf buggy paths and maintenance tracks;
- grassing of relevant areas of the Golf Course; and
- revegetation of areas to be rehabilitated as native vegetation.

Detailed *Bulk Earthworks Plans* are provided in Appendix C1, and further required *Plans* of *Management* (including an *Access and Haul Road Location Plan* and a *Sediment and Erosion Control Plan*) will be prepared following approval of the Golf Course.

These will be associated with a detailed *Construction Environment Management Plan* (CEMP) – to be prepared for the project once consent is obtained for the Golf Course. The CEMP will detail the measures required for the protection of vegetation to be retained, the protection of wildlife during the clearing and construction operations, the treatment of cleared vegetation and tree-hollows, and the mechanisms to be implemented to deal with any unforseen problems or accidents.

## 2.4 Golf Courses – Management Regimes and Edge Effects

## 2.4.1 Introduction

This paper has arisen out of some commentary (by the Threatened Species Officer of Shoalhaven City Council) on the proposed Culburra Golf Course on Long Bow Point at Culburra Beach.

Relevantly, concerns have been raised with regard to:

- the management of golf courses including the potential for the discharge of contaminants (fertilisers, pesticides, herbicides and fuels) either into the groundwater or by overland flow; and
- the impact and extent of "edge effects" around golf courses.

The purpose of this paper is to address some of the misconceptions and/or assumptions surrounding golf courses and their management, and to provide up-to-date information about current golf course management regimes. The paper also addresses some myths and assertions regarding "*edge effects*" around golf courses.

At the outset, it is valuable to consider the positive outcomes associated with golf courses, and to counter the perception (of some commentators) that golf course are inherently bad for the environment. Even where a golf course involves the removal of some native vegetation, there are environmentally positive outcomes derived from the creation and management of golf courses.

- Compared to other potential land uses (*eg* residential development), golf courses are relatively benign. Golf courses provide green open space, a place for exercise, habitat for wildlife, opportunities for people to get close to nature, and possibilities for ecosystem regeneration (see below).
- In addition, golf courses provide an opportunity for carbon sequestration through the growth, harvesting and recycling of grasses and reeds.
- Golf courses provide an enhanced food resource for some groups of native species. A number of macropods, bandicoots and some duck species benefit from the supplementary grazing provided on the fairways and roughs, and other species (such as the Australian Magpie and Magpie-lark, fantails, butcher-birds and the Kookaburra) benefit from the insect larvae and adults in the fairways and roughs. Several of the parrots also use these elements of golf courses for grazing and/or collecting grubs.
- Golf courses invariably contain ponds and wetlands used both to provide water for irrigation and for the treatment and management of water. These features often become valuable habitat for an array of native fauna (even if sometimes accidentally), and can also be deliberately landscaped and managed to provide significant habitat for native biota (including threatened species).
- Golf courses provide edges (between forest/woodland and grasslands) which are of value and benefit to some species and groups of species (see discussion below).
- Golf courses provide opportunities for the regeneration and/or rehabilitation of ecosystems, including endangered ecosystems. The management and maintenance of

parts of a golf course can readily be adapted to enhance and/or rehabilitate ecosystems – given the large areas generally available and the ongoing maintenance activities associated with golf courses. This can facilitate the achievement of community conservation goals, at no cost to the public purse.

For example, parts of the Bonnie Doon Golf Course in Sydney are being used for the reestablishment and/or rehabilitation of the Eastern Suburbs Banksia Scrub "*endangered ecological community*" (EEC).

• The ongoing management and maintenance, which is necessary on golf courses, can also include natural resources and habitats. These management activities, and the strict monitoring required as part of the *Management Plan* for any modern golf course, will also generally result in better environmental outcomes than most land use activities.

All of these positive outcomes will apply to the Culburra Golf Course on Long Bow Point. Notwithstanding the loss of some native open forest and woodland, the Golf Course has been designed and will be managed and maintained in a manner which is sympathetic to the surrounding environment and which is conducive to the conservation of biodiversity on Long Bow Point.

# 2.4.2 Management Regimes

Modern golf courses in Australia are the subject of comprehensive management regimes – designed both to ensure excellent environmental outcomes and to minimise waste (in order *inter alia* to control costs). All of the management measures outlined below will be applied on the Culburra Golf Course.

Relevant golf course management regimes include the following measures.

- Water
  - Capture of stormwater runoff from elements of the golf course
  - Treatment (generally in water quality control ponds and wetlands using native vegetation) prior to discharge to the external environment
  - Recycling the use of captured water for irrigation purposes
  - Irrigation over-watering is wasteful of resources and is expensive
- Fertilisers
  - Modern golf courses **judiciously** use non-organic fertilisers generally in a 'slow release' form as this reduces the potential for chemical runoff and for leaching into the soil profile
  - Many golf courses use 'foliar fertilisers' as an alternative where small quantities of fertiliser are applied more frequently onto the grasses, and the nutrients are absorbed directly through the leaves
  - Foliar fertilisers have several benefits
    - Greater control over quantities applied
    - No fertiliser needs enter the soil
    - · Little or no likelihood of leaching

## Pesticides and Herbicides

- This is a highly scrutinised and heavily controlled element of modern green-keeping and golf course management at all golf courses in Australia
- Only registered and approved chemicals are used, and application rates are limited to approved rates
- All chemical use is well documented and highly monitored
- Careful ongoing monitoring of soils and waters within golf courses is standard practice, with detailed documentation of any impacts on waters on the course and in the adjoining environment
- · Modern golf courses use targeted pesticides and herbicides
- Broad-scale spraying is rarely used on modern golf courses
- A minimalist approach pesticides and herbicides are expensive

# Controls and Management

- · Strict controls on the storage and use of fertilisers, pesticides and herbicides
- Bunding of fuels storages and chemical storage sheds
- Ongoing monitoring of all such materials on modern golf courses

An illustration of these management measures is provided in the Conditions of Consent provided by Shoalhaven City Council in their approval of the construction of 3 additional holes at the Shoalhaven Heads Golf Club (in June 2011). That project involved the removal of 6ha of an EEC and the loss of 33 hollow-bearing trees, and received *concurrence* from the then DECCW.

Relevant Conditions of Consent included inter alia:

- the preparation of a *Chemical and Fertilizer Management Plan* to be approved by Council prior to the issue of a *Construction Certificate*;
- "pesticides, fungicides and weedicides shall be used infrequently on the fairways and only on a needs basis applied to locally affected areas";
- "Chemicals for use on the putting greens shall be applied curatively and preventatively";
- "Turf-grass shall be selected for resistance to disease, environmental stress and insect pressure";
- "High degradation type pesticides frequently applied shall be used in place of high persistence pesticides"; and
- "Avoid the use of Phosphate based fertilisers".

There are many other such *Conditions* in the SCC approval – which were also accepted by the then DECCW. The Culburra Golf Course management regime is intended to be exemplary in this regard.

## 2.4.3 Edge Effects

In the first instance, it needs to be recognised that not all 'edges' are bad, and that 'edges' are not all bad.

Indeed, edges are a natural feature – between shrubland or open forest and Lake shoreline; between open forest/woodland and grassland; between riparian vegetation and stream.

Many species of animals and plants are adapted to or are reliant on 'edges'.

- Many microchiropteran bats use tracks through open forest and the edges of open forest and woodland for movements and for foraging.
- Square-tailed Kites use the forest canopy (an 'edge') and the edges of open forest and woodland for hunting.
- Species such as fantails, butcher-birds and the Kookaburra use the forest edges for perching thence to pounce upon their prey.
- Some plant species flourish along forest edges where light levels are higher than within the forest.

It has also been asserted that the 'edge effects' of golf courses would extend for some considerable distance into the adjoining retained open forest and woodland.

To test this assertion, I visited several golf courses and recorded my observations – investigating the extent of any 'edge effects' in the adjoining vegetation along the golf course fairways (see photographs in Appendix M3). Three golf courses with retained open forest and woodland (similar, albeit not identical, to the proposed Culburra Golf Course) were visited -

- Mollymook Golf Course (south coast)
- Sussex Inlet Golf Course (south coast)
- Avondale Golf Course (Sydney)

Other golf courses on which I have worked, and which further inform my opinions in this regard, include the Bonville Golf and Country Club (near Coffs Harbour) and the Terrey Hills Golf Club (in Sydney). The observations on golf courses are supplemented by my observations of edges on Long Bow Point – between the cleared grassland patches and the adjoining open forest and woodland vegetation.

### Observations

- In the majority of areas where dry open forest or woodland abuts either golf course fairways or the open grassland on Long Bow Point there is no significant or notable 'edge effect' (see Appendix M3) with the open forest/woodland simply giving way to the grassland. Microclimatic impacts appear minimal with changes in temperature on hot summer days being almost instantaneous, or measured over a few metres at most. There was no discernible variation in floristics or vegetation structure beyond possibly (in some instances) the first 2-3 metres into the open forest/woodland.
- In some areas involving such vegetation types, there were patches of dense shrub growth immediately at the edge of the retained open forest/woodland. These patches extended only for a few metres into the open forest/woodland, however, often being just a single shrub in thickness. Beyond, the open forest/woodland was not affected.

- Where such stands of denser shrubs do occur they do provide some potential protection for species of plants and animals dependent on forest interiors (if any such species are present). Alternatively, given the generally small extent of affectation, such stands of shrubs can readily be thinned or managed.
- Where more dense forest vegetation (such as Swamp Oak Forest or Swamp Paperbark Forest) abuts golf course fairways, similar results have been observed. In many areas there tends to be an increase in foliage and bulk adjacent to the fairways because the plants on the outer edge are no longer constrained by neighbouring plants.
- That effect, however, extends no deeper into the forest than the single line of plants at the outer edge. Further into the forest than 2-3 metres, there is no discernible variation in floristics or vegetation structure from vegetation 20 metres or more (including much more) into the forest.
- In virtually no instance was there any evidence of introduced grasses in fairways or roughs invading the adjoining vegetation.

The assertion that golf courses inevitably and unavoidably impose significant or extensive adverse 'edge effects' on adjoining native vegetation has not been substantiated - in the experience of this author. The 'edge effects' observed on several golf courses, at the interface between the golf course fairways and the retained open forest and woodland, have generally been extremely limited – both in the actual effects on the immediately adjoining native vegetation and in the extent of their penetration into retained vegetation.

Further, such 'edge effects' can, in most instances, be addressed by the judicial management of shrubs along the interface between the fairways and the vegetation. This is readily achieved on a golf course – where there are permanent trained staff on the ground.

In addition, the recent exercise by the author (reviewing a number of golf courses and speaking with keepers, reviewing literature, and visiting a number of golf courses with fringing native open forest and woodland) has revealed that current management and maintenance practices on modern golf courses in Australia are designed to protect (and in some instances enhance) the natural environment and to reduce or carefully manage the use of chemicals (for both financial and environmental reasons).

## 2.4.4 Lessons for the Culburra Golf Course

The Culburra Golf Course has been designed through an iterative process of refinement – involving the project ecologist (Mr F Dominic Fanning of Gunninah), the golf course designer (Mr James Wilcher of Golf by Design) and the project hydrologist (Mr Andrew Norris of Martens).

In addition to that iterative design process, the Culburra Golf Course proposal is committed to a comprehensive and responsive management regime, which will incorporate the measures and approaches identified above (as relevant to the Culburra Golf Course project). It is the intention of the proponent that the Culburra Golf Course be an exemplar of the best practices in modern golf course management in Australia.

Specific elements of the construction, management and maintenance of the Culburra Golf Course and adjoining retained vegetation have been described in earlier parts of this SIS, and are documented in the *Culburra Golf Couse Plan of Management* (Appendix D2), and include the following.

- Further fine-tuning of the Golf Course layout (under the supervision of an ecologist) 'on the ground' during construction activities to ensure the maximal retention of hollow-bearing trees and/or other habitat features.
- Creation and management of outer roughs around the golf course using native grasses requiring no use of fertlisers and simple slashing for maintenance.
- Landscaping and planting of wetlands and basins to provide habitat for native biota, potentially including the Green & Golden Bell Frog.
- Long-term monitoring of forest/woodland edges to determine whether management of shrub growth is required.
- The use of low-nutrient demand and low-maintenance grasses on fairways as has been required by SCC on the extension to the Shoalhaven Heads Golf Course.
- The use of slow release and/or foliar fertilisers to minimise the potential discharge of nutrients into the soil and groundwater.
- Strict controls on and management of pesticides, herbicides, fuels and other potential contaminants – including specialist storage, bunding (where necessary) and documentation as per EPA *Guidelines* (see *Conditions of Consent* imposed by SCC on the extension to the Shoalhaven Heads Golf Course and accepted by the then DECCW).
- Finalisation of the *Culburra Golf Course Plan of Management* (to manage the Golf Course itself) and a *Golf Course Environmental Management Plan* (to manage the natural elements of the Golf Course ponds, retained vegetation *etc*).
- Implementation of the *Hollow-bearing Tree Protocol* to ensure that there is no net loss of tree-hollows.

### **3** INFORMATION BASE

### 3.1 Introduction and Scope

The DGRs for this Species Impact Statement (SIS) include a requirement (in Item 4) that:

"A fauna and flora survey is to be conducted in the study area. Targeted surveys must be conducted for all subject threatened species, populations and ecological communities identified in section 4.3" – as determined in accordance with Item 3 of the DGRs.

Item 4 of the DGRs provides a list of information and details for the documentation of survey efforts that are required, requested or recommended by the OEH (Appendix A), including:

- "Targeted surveys shall be conducted for all subject species, populations and ecological communities";
- documentation of the survey efforts and the survey techniques undertaken both generally and for an array of threatened species (see Appendix 1 to the DGRs);
- an "assessment of the efficacy of each survey regime in detecting each species under the intensity utilised by the study used to be provided".

Details of the flora and fauna investigations that have been undertaken on Long Bow Point and in the nearby Culburra Urban Expansion Area lands over the last 20+ years is provided in Appendices E to H of this SIS, and described briefly below.

### 3.2 Previous Investigations – 1993 to 2010

### 3.2.1 Summary of Previous Investigations

As noted above, parts of the Culburra survey area, including Long Bow Point and the subject site, have been investigated on previous occasions for other development proposals or concepts at this general location. Those investigations have included the application of an array of flora and fauna assessment techniques by a variety of ecologists (Appendices E and G), which provide a comprehensive and substantial database of the native biota within the 'vicinity' (*ie* the northern part of the "*survey area*" – including the Culburra UEA lands and Long Bow Point; see Figures 5A and 5B).

With respect to native flora and vegetation communities, various parts of the Culburra "*survey area*" have been surveyed on a substantial number of occasions over a period of 20+ years (Appendices E to H). The survey techniques have included:

- driven transects throughout the study area with the recording of plant communities and inspections for threatened plant species;
- extensive walked surveys to provide floristic details of plant communities, and to establish a comprehensive plant species list for the study area; and
- dedicated surveys for individual threatened plant species known to occur in the locality, and which could potentially occur on the subject lands.

In addition, a substantial array of surveys for native fauna (particularly for threatened species and their habitats and resources) have been undertaken over that same period within the "*survey area*" (see above). The investigations between 1993 and 2010 (Appendix G; Table 3.1) have involved the application of a comprehensive and extensive array of fauna survey techniques (Tables 3.2 and 3.3):

- trapping for native fauna using a variety of techniques (pit traps, Elliott traps both terrestrial and tree-mounted, cage traps, harp traps, hair tubes and mist nets);
- extensive diurnal surveys for native fauna and for habitats and features of particular relevance over many years and in all seasons;
- extensive spotlighting surveys for nocturnal species including the use of call playback for amphibians, gliders and forest owls;
- targeted surveys for threatened species known to occur in the locality;
- the use of Anabat recorders for microchiropteran bats; and
- targeted searches for habitats and resources of special relevance for native species (*eg* hollow-bearing trees).

As indicated in Chapter 2.1 of this SIS, Gunninah Environmental Consultants and Environmental Insites have surveyed various parts of the subject lands on a number of occasions since 1995. A brief summary of the *Reports* that have been prepared during this time is provided below, with details of the field surveys conducted provided in Appendices E and G.

Date	Author	Report
1994	Gaia Consultants	Fauna Assessment. Culburra Urban Expansion Stage 1
1994	Gaia Consultants	Supplementary Assessment of Protected Fauna. Culburra Urban Expansion Stage 1
1996	Daly & Leonard	Fauna and Flora of Long Bow Point
1996	G Hoye	Bat Survey of the Proposed Long Bow Point Urban Development Area
1999	Gunninah Environmental Consultants	Proposed Residential Development. Long Bow Point, Culburra. Fauna Impact Statement
2001	Gunninah Environmental Consultants	Proposed Rural Residential Subdivision. Culburra Urban Expansion Area. Flora and Fauna Assessment
2002	Gunninah Environmental Consultants	Proposed Residential Subdivision. East Crescent, Culburra Beach. Flora and Fauna Assessment
2003	Gunninah Environmental Consultants	Proposed Industrial Subdivision at Culburra. Flora and Fauna Assessment
2008	Environmental InSites	Culburra West Demonstration Project. Flora and Fauna Assessment Surveys
2010	Lesryk Environmental Consultants	Culburra West Urban Development Project. Fauna Investigations
2010	Environmental InSites	Flora & Fauna Assessment Reports for 7 dwelling sites south and west of Long Bow Point

## Table 3.1Relevant flora and fauna survey and assessment Reports (1993 – 2010)

Table 3.2Earlier fauna investigations of the subject site and other lands in the vicinity (Table 3.1) –<br/>not including general surveys and observations

Year	Who	Technique	Effort
1993	Daly 1994 #	Trapping survey	100 trap-nights – pitfall traps 100 trap-nights – terrestrial Elliotts 140 hair tubes - terrestrial
1993- 1996	Daly & Leonard #	Spotlighting	11 hours 30 mins
1996	Daly & Leonard 1996 #	Trapping Hair tubes Anabats Spotlighting Harp traps	<ul> <li>500 trap-nights – arboreal Elliotts</li> <li>55 trap-nights – terrestrial Elliott Traps</li> <li>140 trap-nights – terrestrial</li> <li>140 trap-nights – arboreal</li> <li>4 nights</li> <li>4 nights</li> <li>4 nights</li> </ul>
1996	Hoye 1996 #	Anabats Harp traps	15 unit-nights 16 trap-nights
1997 and 1998	Gunninah 1999 #	Spotlighting Call playback Anabats Harp traps Hair tubes	62.5 hours 1 hour 30 mins 20 unit-nights 21 trap-nights 425 trap-nights
2001	Gunninah 2001 #	Trapping Anabats Harp traps Hair tubes Call playback (Owls, Yellow-bellied Glider, Koala and Black Bittern) Spotlighting	<ul> <li>1000 trap-nights – terrestrial Elliotts</li> <li>85 trap-nights – cage traps</li> <li>190 trap-nights – pitfall traps</li> <li>200 trap-nights – arboreal Elliott traps</li> <li>14 nights</li> <li>25 trap-nights</li> <li>1700 trap-nights</li> <li>10 nights</li> <li>22 hours 40mins</li> </ul>
2002	Gunninah 2003	Spotlighting Call playback (Owls, Squirrel Glider, Yellow-bellied Glider, Koala) Anabats Harp traps Trapping	6 person-hours 3 hours 2 nights 2 nights 200 trap-nights

# Surveys undertaken on Long Bow Point

## 3.2.2 Details of Specific Investigations

## Fauna Impact Statement - Long Bow Point, Culburra (Gunninah 1999)

A *Fauna Impact Statement* (FIS) was prepared for a proposed residential development on Long Bow Point - based on field investigations throughout the Culburra West Urban Expansion Area (UEA), as well as on lands which are now dedicated as National Park (*ie* the "*survey area*" – Figure 5A) between 1995 and 1999.

The southern part of the former Culburra UEA proposal is substantially the same as the current "*subject land*" for the proposed Culburra Golf Course - located on the northwestern shore of Lake Wollumboola, south of the Culburra Road. The total area of that proposed development concept was approximately 195 hectares, of which 125ha of land on Long Bow Point was proposed to be subdivided for residential development.

As part of the database for the FIS, extensive surveys were undertaken not only on the Long Bow Point site itself but also in adjoining lands, both within the Jervis Bay National Park and within other private landholdings in the locality (Appendix G; Figure 5B).

A number of previous surveys were also considered within that assessment (including those identified in Table 3.1) as well as documentation by the then NPWS:

- Consideration of the Potential Impact of the Proposed Development at Long-Bow Point on Threatened Fauna (NPWS 1996); and
- A Regional Assessment of the Natural Heritage Values of the Proposed Culburra Urban Expansion Area and Environs (NPWS 1997).

Several threatened fauna species (currently listed in the TSC Act) were recorded within the Long Bow Point development area or in its vicinity during those substantial and comprehensive investigations. The recorded threatened species included:

- the Glossy Black Cockatoo on Long Bow Point
- the Powerful Owl to the immediate southwest
- the Yellow-bellied Glider to the immediate southwest
- six microchiropteran bats on Long Bow Point the Southern Myotis, Common (Eastern) Bent-wing Bat, Little Bent-wing Bat, Eastern Freetail Bat, Eastern False Pipistrelle and Greater Broad-nosed Bat
- the Green & Golden Bell Frog.

### Culburra Urban Expansion Area - Flora & Fauna Assessment (Gunninah 2001)

A Development Strategy Plan for the Culburra West Urban Expansion Area (UEA) was the subject of a detailed Flora & Fauna Assessment Report and associated investigations (Gunninah 2001). The area of relevance for that Report, and the rural and residential subdivision proposed, was confined to that part of the 'survey area' north of the Culburra Road (Figure 5B).

In addition to extensive investigations for threatened plant species and the identification of plant communities, the Gunninah 2001 *Report* provides documentation of the extensive fauna surveys undertaken throughout the Culburra West UEA (Appendix G).

The specific field investigations for the Gunninah 2001 investigation (Appendices E and G; Table 3.2) included:

- flora surveys throughout the land which was the subject of that investigation (Appendix E)

   including the identification of plant community boundaries and dedicated surveys for
   threatened plant species known to occur in the general locality;
- dedicated and intensive fauna surveys including:
  - the use of Elliott traps, cage traps and pit traps for terrestrial fauna;
  - the deployment of Elliott traps in trees for arboreal mammal species;
  - spotlighting surveys throughout the Culburra UEA study area;
  - the deployment of harp traps and Anabat recorders for microchiropteran bats;
  - call playback and spotlighting surveys for nocturnal fauna species; and
  - diurnal surveys for birds, reptiles and other native fauna throughout the Culburra UEA site, particularly in areas likely to support threatened species or which contained resources of potential relevance for such species.

The 2001 Gunninah *Report* identifies a number of threatened fauna species within the subject lands, but no threatened plant species were recorded. Threatened fauna species which are of potential relevance to the Culburra West UEA, and which are considered in further detail in this SIS, include the Powerful Owl, Glossy Black Cockatoo, Green & Golden Bell Frog and a number of threatened microchiropteran bats (East Coast Freetail Bat, Common Bent-wing Bat, Greater Broad-nosed Bat, Yellow-bellied Sheath-tail Bat, Large-footed Myotis and Eastern False Pipistrelle).

### Proposed Industrial Subdivision at Culburra - Flora & Fauna Assessment (Gunninah 2003)

A flora and fauna investigation was undertaken in 2003 on land north of Culburra Road, south of the Culburra STP and to the east of Strathstone Street (Part Lot 5 in DP 872852) – for a proposed industrial subdivision (Gunninah 2003; Appendix E).

The small area of land immediately south of the STP which was investigated for the proposed industrial development was surveyed both for flora and fauna by walked transects and 'Random Meander' searches (*sensu* Cropper 1993), and by dedicated fauna surveys - to identify threatened species which could potentially be present. Relevant information from that investigation has been incorporated into this SIS (Appendix E), particularly with respect to threatened flora and fauna species.

Specific field investigations for the industrial subdivision *Report* (Gunninah 2003) included:

- walked flora surveys throughout the land which was the subject of that investigation; and
- dedicated fauna surveys, including:
  - call playback and spotlighting surveys for nocturnal fauna species; and
  - diurnal surveys for native fauna.

## Culburra West 'Demonstration Project' – 2007/2008 Surveys

Supplementary investigations for flora and fauna were undertaken for the preparation of an *Ecological & Riparian Assessment Report* for the Culburra West 'Demonstration Project' (InSites 2008) - which was a precursor to the Culburra West Urban Development Project (see Chapter 3.4). Those surveys also included investigations on Long Bow Point (Table 3.3; Appendices E and G), involving:

- the refinement of the vegetation mapping which had previously been undertaken;
- the identification of threatened biota more recently listed in the TSC Act and/or suitable habitat and resources for such biota; and
- the conduct of supplementary targeted and general flora and fauna studies.

The dedicated flora surveys of the study area in 2007-2008 (Table 3.3; Appendix E) included:

- flora surveys through most of the subject land, with the collection of supplementary flora species lists;
- the more accurate mapping of vegetation community boundaries by GPS; and
- the undertaking of flora quadrats and surveys at various locations including dedicated searches for threatened flora species. The surveys of the 20m x 20m (400m<sup>2</sup>) flora quadrats involves a thorough search of the whole quadrat and recording of all plants and their densities. This is an even more intensive survey than the 5m-spaced transects recommended by the OEH for the survey of threatened orchids.

The supplementary fauna surveys of the area which were undertaken in 2007 and 2008 (Appendix G; Table 3.3) involved 5 days and 4 nights of investigations - including:

- supplementary spotlighting and call playback surveys throughout the subject land, particularly focusing on threatened nocturnal fauna known to occur in the locality (threatened forest owls, the Yellow-bellied Glider and Green & Golden Bell Frog);
- the deployment of Anabat recorders to detect microchiropteran bat species;
- the inspection of tree-hollows for threatened fauna or for evidence of their presence (*eg* scratches, feathers or fur, owl 'whitewash');
- dedicated diurnal surveys of fauna habitats and resources throughout the subject site; and
- searches for indirect evidence of threatened fauna species (*eg* diggings, scratches, feeding indications, footprints, remains and other indirect evidence).

### Culburra West Urban Development Project - 2010 Investigations

Further field investigations for native fauna within Culburra UEA lots (north of the Culburra Road) were undertaken in December 2010 – to supplement the previous fauna surveys that had been undertaken previously on those lots. Those investigations (Table 3.3; Appendix G) were undertaken by LesryK Environmental Consultants.

Those investigations involved three field biologists over a period of a full 5 days, and included a complete array of standard fauna survey techniques (Table 3.3), including:

• trapping – using pit traps, cage traps and Elliott traps (terrestrial and arboreal);

- hair tubes for terrestrial mammals;
- harp traps and Anabat detectors for microchiropteran bats;
- call playback and spotlighting surveys for nocturnal mammals and birds, and for amphibians;
- dedicated herpetological and bird surveys; and
- the deployment of infra-red cameras.

It is noted that in undertaking the specific dedicated field survey techniques during the December 2010 survey, a total of 15 person-days of general opportunistic surveys were also undertaken by the field ecologists during that week of investigations.

Year	Technique	Effort
2007	Avifauna surveys	12 hours
	Spotlighting	11 hours
	Anabats	4 nights
	Avifauna surveys	4 hours
	Call playback (Owls, Yellow-bellied Glider)	1 hour
2010	Echolocation	Dusk to dawn totalling ~ 70 hours
13-17 Dec	Elliott traps – terrestrial and arboreal	300 trap-nights
	Cage traps	24 trap-nights
	Hair tubes	400 trap-nights
	Harp traps	4 trap-nights
	Pitfall traps	72 trap-nights
	Call playback	~ 3 hours
	Spotlighting	~ 24 person hours
	Dedicated herpetological searches	~ 3 person hours/day
	Diurnal bird surveys	~ 5 person hours/day
	Infrared cameras	~ 192 camera hours

 Table 3.3
 Summary of more recent (2007 – 2010) field surveys on the subject site and adjoining lands around Culburra

## 3.2.3 Other Previous Investigations

There have been a significant number of other investigations undertaken by the author of this SIS and his staff and agents within the study area, all of which have contributed to the accumulation of knowledge and understanding of the study area and the subject land. As indicated earlier, these investigations have been conducted over an extensive period by the author of this SIS and his staff and agents, and constitute a very considerable body of information regarding the biota, threatened or otherwise, in the study area.

Other investigations which are not documented in particular detail include inter alia:

- flora and fauna surveys at Kinghorne Point, including surveys for the threatened Jervis Bay Leek Orchid *Prasophyllum affine*;
- extensive investigations on land around Carama Creek to determine the potential constraints to development opportunities on the land;
- various flora and fauna habitat assessment surveys throughout lands which are now part of the Jervis Bay National Park *inter alia* for the Long Bow Point *Commission of Inquiry*; and
- investigations of various portions of land at Callala for a range of development proposals, over at least the last 15 years.

## Rural Dwelling Sites between Culburra and Callala (2011 - 2013)

In 2011 and 2012, investigations were undertaken on various portions of land between Culburra and Callala Bay for a total of seven rural dwelling sites. Those investigations occurred on lands to the south of the "*subject land*" (within the "*survey area*"), and included walked surveys and investigations of potential dwelling sites, *Asset Protection Zones* (APZs) and driveway locations in forested private lands in the months of February and August of 2010, July 2011, June, October and December 2012, and January 2013.

Whilst no dedicated trapping or spotlighting was conducted for six of those investigations, supplementary surveys have been undertaken, with a total of approximately 100 person-hours of field surveys on Lots 2 and 507 Callala Beach Road by two SLR ecologists, involving extended walked surveys, and spotlighting, Anabats and infra-red camera surveys (on 14, 15 and 16 June 2012).

Further surveys for threatened orchids, and other threatened biota simultaneously, have been undertaken on those two lots in October and December 2012, and in January 2013.

### 3.3 The Culburra West Project - 2012 and 2013 Investigations

In addition to the 2010 fauna surveys undertaken by Lesryk (see Table 3.3), and the previous investigations by Gunninah Environmental Consultants (Tables 3.1, 3.2 and 3.3) at Culburra West, extensive investigations for flora and fauna have been conducted by SLR Ecology at Culburra West. These are considered relevant to this SIS because of the proximity of the Culburra West site to the Culburra Golf Course site (see Figure 5A).

An array of recent investigations have been undertaken on the Culburra West land - throughout 2012 and 2013, as detailed below. A further detailed fauna survey and habitat assessment was conducted on the Culburra West land over 5 days in early May 2012 by two SLR Ecologists.

One primary objective of that survey was to document all of the significant hollow-bearing trees present on the site, and to record and map their locations. This was carried out by opportunistic spotting while walking throughout the entire site. Each tree which contained favourable habitat features for bird species, arboreal mammals or microchiropteran bats was tagged, and its location mapped using GIS Roam. A total of 92 hollow-bearing trees have been located within the Culburra West land.

In order to supplement the previous fauna surveys undertaken on the subject land and nearby, the May 2012 fauna survey also employed an array of appropriate techniques (Table 3.4), which involved:

- spotlighting and call playback for nocturnal mammals and birds;
- opportunistic sightings throughout each of the 5 days of survey, while conducting hollowbearing tree searches;
- deployment of infrared cameras (x2) with baits for nocturnal mammals;
- deployment of Anabat detectors (x2) and harp traps (x2) for microchiropteran bats; and
- deployment of 40 hair funnels for small terrestrial mammals.

During the May 2012 survey period, the weather conditions were predominantly cold and dry, with moderate SW winds each day. The last two days (10 and 11 May) saw a large increase in temperatures during the middle of the day (reaching around 30°C), and the evening temperatures returned to around 15°C and decreased further into the mornings. The sky was clear each day and night except for Thursday and Friday afternoons, when storm clouds formed. There were no precipitation events during the May 2012 survey.

There were three subsequent surveys on the Culburra West land during 2012, as well as on Long Bow Point (see below), undertaken by SLR Ecology. Those investigations included:

- a general survey for flora and fauna (28-31 August) with cool temperatures (9°C 24°C), dry southwesterly winds and slight cloud cover, with nil precipitation;
- a follow-up general survey for flora and fauna (17-21 September) including the deployment of 40 hair funnels for 2 weeks. This survey was undertaken in slightly milder weather, with mostly overcast days and a brief evening storm with light precipitation; and
- spring flora and fauna surveys (16-18 October), including specific searches for threatened orchid species. Temperatures during this survey were warmer (14°C to 26°C).

Survey methods employed during these supplementary surveys (Table 3.4) included:

- spotlighting for nocturnal fauna species;
- stag watching at hollow-bearing trees for arboreal, nocturnal mammals or birds;
- call playback to attract nocturnal mammal or bird species;
- diurnal avifauna surveys for terrestrial and aquatic bird species;
- reptile searches beneath logs, rocks and debris, as well as opportunistic spotting;
- installation of glider tube traps to capture gliders or small arboreal mammals;
- installation of harp traps to capture microchiropteran bat species;
- installation of Anabat detectors to record microchiropteran bat species;
- installation of infrared cameras and baits to record terrestrial species; and
- setting of hair funnels and baits to take small mammal hair samples.

Year	Dates	Technique	Effort
2012	07 to 11 May	Harp trapping Call playback Spotlighting Opportunistic diurnal searches Infrared cameras Anabat detectors Hair funnels (2 weeks)	8 trap-nights 16 person-hours 12 person-hours 48 person-hours 180 camera-hours 96 hours 560 trap-nights
	28 to 31 August	Spotlighting Stag watching Call playback Anabat detectors Infrared cameras	7 hrs 1 hr 1 hr 16 hrs (x 2 units) 48 hrs (x 2 units)
	17-21 September	Avifauna surveys Spotlighting Stag watching Anabat detectors Infrared cameras Call playback Hair funnels	8.5 hrs 5.5 hrs 1.5 hrs 24 hrs (x 2 units) 36 hrs (x 2 units) 1 hr 720 trap-nights
	16-18 October	Infrared cameras Avifauna surveys Reptile surveys	38 hrs (x 2 units) 5.5 hrs 1.5 hrs
2013	13-17 March	Infrared cameras Avifauna surveys	106 hrs (x 4 units) 4 person-hours
	18-20 March	Infrared cameras Avifauna surveys Glider traps Anabat detectors Reptile surveys Spotlighting Call Playback	92 hrs (x 4 units) 18 person-hours 20 TN 1 night (x 3 units) 3 hrs 4 hrs 1 hr

### Table 3.42012 and 2013 fauna surveys on the Culburra West land

### 3.4 Investigations for the 2011 Culburra Golf Course DA

Further field investigations were undertaken on Long Bow Point in April and June 2011 by Environmental Insites, to refine and clarify the vegetation mapping of the subject site, and to undertake additional diurnal surveys for native biota – both flora and fauna.

Those investigations involved a total of 20 person-hours on the subject site over two days, utilising an accurate GPS unit to confirm and/or refine the vegetation types. The surveys involved substantial walked and driven transects through the subject site, recording both vegetation characteristics and fauna habitat types, and recording any novel native biota.

These supplementary investigations did not include additional intensive or lengthy fauna surveys - because of the substantial number of investigations which had occurred on the subject site and in the 'survey area' (see above) over a considerable period (approximately 18 years at that time), and because of the recent intensive surveys on the land to the immediate north (in the Culburra West Urban Development Project).

### 3.5 Supplementary Surveys for This SIS

### 3.5.1 Flora Surveys

Recent dedicated field surveys for flora within the subject land at Culburra, specifically for this SIS, have involved:

- targeted searches for threatened flora species (Appendix F; Table 3.5) particularly for threatened orchids and the Round-leafed Wilsonia; and
- extensive walked surveys of the land to further refine the vegetation mapping. During these surveys, all SLR ecologists also searched for threatened plants (and threatened fauna).

Searches for threatened orchids were also a focus of all time spent on the subject land during recent fauna surveys (see below), including searches while walking between trap sites and during general diurnal fauna surveys.

The subject land had previously been the subject of substantial ecological investigations, as detailed above. The previous surveys involved the mapping of vegetation communities based on dominant canopy species. An array of driven and walked inspections have been undertaken by SLR Ecology to verify the vegetation community mapping, and to make any changes to the vegetation mapping on the subject land, where relevant.

### NOTE

As is the case with all of the surveys undertaken by all ecological consultants over the last 20+ years, surveys for threatened biota (flora and fauna) are NOT confined to dedicated survey efforts. All surveys (including general walked surveys, trap-checking, directed and random meanders) involve searches for all threatened biota – plants and animals. Given the cryptic nature of many of the threatened orchids, and their irregular flowering, these species were targeted opportunistically during all surveys.

Year	Dates	Threatened Species	Effort
2012	18 October	Illawarra Greenhood Pretty Beard Orchid	7 hours
	20 December	Leafless Tongue Orchid Bauer's Midge Orchid Eastern Lynne Midge Orchid Tangled Bedstraw	4.5 hours
2013	19 January	Leafless Tongue Orchid Narrow-leafed Wilsonia Round-leafed Wilsonia Tangled Bedstraw	5 hours
	21 February	Leafless Tongue Orchid Bauer's Midge Orchid <i>Pterostylis ventricosa</i>	3.5 hours
	6 March	Leafless Tongue Orchid Bauer's Midge Orchid <i>Pterostylis ventricosa</i>	3 hours
	18 March	Leafless Tongue Orchid Bauer's Midge Orchid <i>Pterostylis ventricosa</i>	3 hours
	18 April	Pterostylis ventricosa	2 hours
	22 and 23 August	Illawarra Greenhood	4.5 hours
	3 and 4 September	Thick-lipped Spider Orchid Narrow-leafed Wilsonia Round-leafed Wilsonia Illawarra Greenhood Eastern Underground Orchid	8 hours
	24, 25 and 26 September	Thick-lipped Spider Orchid Illawarra Greenhood Eastern Underground Orchid	17 hours
	9 October	Eastern Underground Orchid	0.5 hours
	30 October	Pretty Beard Orchid Thick-lipped Spider Orchid Narrow-leafed Wilsonia Round-leafed Wilsonia Eastern Underground Orchid	7.5 hours
	14 November	Pretty Beard Orchid Thick-lipped Spider Orchid Narrow-leafed Wilsonia Round-leafed Wilsonia Eastern Underground Orchid	4 hours
	3 and 4 December	Leafless Tongue Orchid Narrow-leafed Wilsonia Round-leafed Wilsonia Tangled Bedstraw Jervis Bay Leek Orchid	7 hours

## 3.5.2 Fauna Surveys

In order to supplement the substantial previous investigations which have been undertaken at Long Bow Point, and on nearby lands, and in order to satisfy the *Director-General's Requirements* (DGRs) for this SIS, an array of additional dedicated and detailed fauna surveys have been undertaken within the subject land for the Culburra Golf Course project (Appendix H).

Those investigations include an array of fauna survey techniques (Table 3.6) undertaken between September 2012 and November 2013 (inclusive), including:

- trapping harp traps, pitfall traps, cage traps, Elliott traps and hair funnels, as well as glider tubes on trees;
- the deployment of Anabat detectors for microchiropteran bats and infra-red cameras for terrestrial fauna;
- call play-back, spotlighting and walked nocturnal transects;
- extensive walked diurnal surveys throughout the subject land to obtain a comprehensive fauna inventory, as well as to search for specific evidence of threatened biota (*eg* glider chew marks in trees, owl whitewash, scratches, diggings and bones/feathers *etc*);
- stag watching in the late afternoon/early evening; and
- documentation of hollow-bearing trees.

Additional survey techniques included dedicated dawn and dusk avifauna surveys, waterbird surveys around Lake Wollumboola, and dedicated amphibian and reptiles searches throughout suitable habitat.

The timing of the dedicated surveys at Long Bow Point is indicated in Table 3.6 (below). Details of the timing of surveys and the weather conditions during the fauna surveys undertaken for this SIS are contained in Appendix H.

Additional information regarding native fauna of the locality was obtained from the separate detailed fauna surveys undertaken by SLR Ecology during the same period (Appendix H) on the land to the immediate north of the Culburra Golf Course project site (the Culburra West Mixed Use development site and adjoining land (see Chapter 3.4). Those surveys involved the same or similar dedicated survey and trapping techniques as applied on Long Bow Point, during the period from May 2012 to March 2013 (inclusive).

### NOTE

As is the case with all of the surveys undertaken by all ecological consultants over the last 20+ years, surveys for threatened biota (flora and fauna) are NOT confined to dedicated survey efforts. All surveys (including general walked surveys, trap-checking, directed and random meanders) involve searches for all threatened biota – plants and animals.
Year	Dates	Technique	Location	Effort
2012	1-17 Sep	Hair tubes	Long Bow Point	640 trap-nights
	17-19 Sep	Spotlighting		8.5 person-hours
	17-19 Sep	Stagwatching		2 person-hours
	17-19 Sep	Call playback		1.5 person-hours
	17-21 Sep	Avifauna		12 person-hours
	17-21 Sep	Amphibian Surveys		2 person-hours
	17-19 Sep	Anabat (x2 units)		4 unit-nights
	17-19 Sep	Infrared Cameras (x2 units)		48 hours (total)
	18-21 Sep	Avifauna	Culburra West	8.5 person-hours
	19-20 Sep	Spotlighting		5.5 person-hours
	19-20 Sep	Stagwatching		1.5 person-hours
	19-21 Sep	Anabat (x2 units)		4 unit-nights
	19-21 Sep	Infrared Cameras (x2 units)		72 hours (total)
	19-20 Sep	Call Playback		1 person-hours
18 Sep – 06 Hair Tubes Oct		Hair Tubes		720 trap-nights
	16-17 Oct	Infrared Cameras (x2 units)		24 hours (total)
	17-18 Oct	Avifauna		5.5 person-hours
	17-18 Oct	Reptile surveys		4 person-hours
	17-18 Oct	Infrared Cameras (x2 units)	Long Bow Point	36 hours (total)
	7-9 Nov	Avifauna		7 person-hours
	7-9 Nov	Infrared Cameras (x2 units)		76 hours (total)
	7-9 Nov	Anabat (x2 units)		4 unit-nights
	19-20 Dec	Infrared Cameras (x2 units)		24 hours (total)
	19-20 Dec	Avifauna		2 person-hours
	19-20 Dec	Reptile surveys	Culburra West	1 hour
	19 Dec	Amphibian Surveys	Long Bow Point	2 person-hours
	20 Dec – 8 Jan	Hair Tubes		800 trap-nights

**Table 3.6a**Fauna surveys on Long Bow Point and the Culburra West land in 2012 and 2013

Year	Dates	Technique	Location	Effort
2013	14-19 Jan	Spotlighting	Long Bow Point	32 person-hours
	14-19 Jan	Stagwatching		5 person-hours
	14-19 Jan	Call playback		4 person-hours
	14-19 Jan	Avifauna		32 person-hours
	14-19 Jan	Anabat (x 2 units)		10 unit-nights
	14-19 Jan	Infrared Cameras (x2 units)		120 hours (total)
	14-19 Jan	Reptile surveys		12 person-hours
	14-19 Jan	Amphibian Surveys		4 person-hours
	14-19 Jan	Cage traps		16 trap-nights
	14-19 Jan	Pitfall trapping		4 nights (2 lines)
	14-19 Jan	Glider traps		60 trap-nights
	13-20 Mar	Avifauna	Culburra West	11 person-hours
	13-20 Mar	Anabat (x3 units)		3 unit-nights
	13-20 Mar	Infrared Cameras (x2 units)		336 hours (total)
	13-20 Mar	Reptile surveys		6 person-hours
	13-20 Mar	Cage traps		16 trap-nights
	13-20 Mar	Amphibian Surveys		6 person-hours
	13-20 Mar	Spotlighting	Long Bow Point	8 person-hours
	13-20 Mar	Stagwatching		4 person-hours
	13-20 Mar	Call Playback		1 hour
	13-20 Mar	Glider traps		20 trap-nights
	2-6 Apr	Avifauna		26 person-hours
	2-6 Apr	Harp traps		8 trap-nights
	2-6 Apr	Elliot Traps		400 trap-nights
	2-6 Apr	Glider traps		60 trap-nights
	2-6 Apr	Cage traps		16 trap-nights
	2-6 Apr	Pitfall trapping		4 nights (1 line)
	2-6 Apr	Reptile surveys		9 person-hours
	2-6 Apr	Infrared Cameras (x4 units)		192 hours (total)
	2-6 Apr	Stagwatching		1.5 person-hours
	2-6 Apr	Spotlighting		29 person-hours
	2-6 Apr	Call playback		2.5 person-hours
	3-14 Apr	Hair tubes		300 trap-nights
	24-26 Sep	Avifauna		10 person-hours
	24-26 Sep	Reptile surveys		1 person-hours
	30 Oct	Avifauna		6 person-hours
	30 Oct	Reptile surveys		2 person-hours
	14 Nov	Avifauna		7 person-hours
	3-4 Dec	Avifauna		9 person-hours

**Table 3.6b**Fauna surveys on Long Bow Point and the Culburra West land in 2013

### 3.6 Efficacy of Surveys

The "*efficacy*" of the field surveys on Long Bow Point, including those conducted throughout the Culburra Survey Area (which are considered of relevance for the Culburra Golf Course project), for threatened plants and threatened fauna is considered to be very high (relative to the surveys conducted for threatened biota in most other instances) for a number of reasons - including:

- the substantial number of occasions that intensive flora and fauna surveys have been undertaken on Long Bow Point and on other lands in the immediate vicinity (particularly the Culburra West UEA lands) over a very long period (in excess of 20 years);
- the wide array of field survey techniques which have been applied on those lands involving a variety of trapping methods and types, Anabat recorders, harp traps, infrared cameras, hair tubes, spotlighting and call play-back;
- the dedicated surveys for threatened orchids which have been undertaken throughout 2012 and 2013 on Long Bow Point; and
- the substantial array of climatic conditions and seasons over which surveys have been undertaken on lands at Culburra generally.

Appropriate dedicated survey techniques for the full array of threatened biota that could occur on Long Bow Point have been applied on several occasions over a long period. In addition, there have been thousands of person-hours of opportunistic investigations on Long Bow Point and within the Culburra Survey Area.

Long Bow Point and the Culburra West lands (the Culburra Survey Area) have doubtless been the subject of a greater intensity and breadth of investigations for threatened flora and fauna than virtually any other lands in the general region.

As is the case with all of the surveys undertaken by all ecological consultants over the last 20+ years (Table 3.7), surveys for threatened biota (flora and fauna) are NOT confined to dedicated survey efforts. All surveys (including general walked surveys, trap-checking, directed and random meanders) involve searches for all threatened biota – plants and animals.

The efficacy of the surveys and investigations undertaken over the last 20+ years is well demonstrated by the detailed information contained in the previous sub-chapters of this SIS and in the details contained in Appendices E, F, G and H.

Table 3.7 Flora and f	auna investigations of Lor	ng Bow Point and Culburra West
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Year	Who	Where	Months
1993	Daly	Long Bow Point	December
1993-96	Daly & Leonard	Long Bow Point	-
1996	Daly & Leonard	Long Bow Point	September
1996	Ноуе	Long Bow Point	October
1997	Gunninah	Long Bow Point	July August
1998	Gunninah	Long Bow Point	November
2001	Gunninah/Lewis Ecological Surveys	Culburra UEA	January February March
2002	Gunninah	Culburra Industrial	December
2007	InSites	Culburra West	October
2010	InSites	Culburra West	October December
2011	InSites	Culburra West	April June
2012	SLR	Culburra West	May August September October December
2012	SLR	Long Bow Point	September October November December
2013	SLR	Culburra West	March
2013	SLR	Long Bow Point	January February March April August September October November December

#### 3.7 Other Information

In addition to the information obtained during the substantial number of field investigations and inspections of the subject site and the subject land by a variety of experts (as documented above), information has been obtained from the following sources.

- A specific search of the OEH Wildlife Atlas (Appendix J).
- A review of records for the 'locality' (10km around Long Bow Point) of Matters of National Environmental Significance (Appendix K) – pursuant to the EPBC Act.
- Information contained in a variety of other investigations undertaken in the locality.
- The Information regarding threatened biota contained on the OEH website see Appendices T, U and V.
- The general scientific literature on threatened biota and the natural environment.
- Interviews with golf course managers and review of golf course management methods as documented in Chapter 2.4 of this SIS.

#### 3.8 Weather Conditions

Given that field investigations on the subject land have been conducted over an extensive period (since 1993), surveys for threatened species and biota generally have included a wide range of weather conditions and seasons (see dates and times in Appendices E to H; Table 3.7 above).

Weather conditions during the surveys undertaken specifically for this SIS are detailed in Appendix H. Those surveys occurred throughout 2012 and 2013, over a range of weather conditions. Those surveys were undertaken in:

- May, August, September, October, November and December 2012; and
- January, February, March, April, August, September, October, November and December 2013.

Further details of weather conditions during the previous surveys are provided in Appendices E to H.

# 3.9 Compliance with the DGRS

The investigations undertaken to date have exceeded the requirements and expectations of the DECC *Guidelines* for the surveying of relevant threatened biota, by virtue of:

- the very substantial array of investigations and studies undertaken during previous individual projects - and the accumulated surveys of and data on the relevant and potentially relevant threatened biota, both on the subject site itself and in the vicinity (Appendices E and G), over a period in excess of 20 years; and
- the intensive and comprehensive supplementary surveys undertaken for this SIS through 2012 and 2103 (Appendices F and H).

The investigations that have been undertaken specifically for this SIS (particularly with respect to threatened orchids), as well as the substantial array of investigations on Long Bow Point and on the Culburra West urban development land (in the period between 2010 and 2013 inclusive) more than satisfy the survey requirements identified in the DGRs for threatened species.

As is clear from the details documented in this Chapter, and in Appendices E, F, G and H to this SIS, a very substantial array of investigations, utilising an array of appropriate techniques by a number of different ecological consultants, has been undertaken at the Culburra West and Long Bow Point survey sites over the last four years. Long Bow Point and the Culburra West lands have been the subject of thousands of person-hours of flora and fauna surveys over a period in excess of 20 years.

As is the case with all of the surveys undertaken by all ecological consultants over the last 20+ years, surveys for threatened biota (flora and fauna) are NOT confined to dedicated survey efforts. All surveys (including general walked surveys, trap-checking, directed and random meanders) involve searches for all threatened biota – plants and animals.

The investigations and data (going back over 20 years) on Long Bow Point and Culburra West constitute a body of information and ecological research on this site and in its immediate vicinity that would rarely be equalled.

In response to those who suggest that the surveys undertaken on the Culburra West lands are not of relevance to the Culburra Golf Course project or to this SIS, the following considerations are pertinent.

- The two portions of land are contiguous.
- Indeed, the two portions of land are parts of the same Lots.
- The vegetation types and habitats present are contiguous, and there are many common resources and specialist habitat features shared by the two portions of land.
- The southern part of the Culburra West land contains the upper catchments of both Downs and Wattle Creek therefore constituting a relevant part of the habitat and home range of many threatened species that could live in either area.
- Further, that area is directly contiguous with the lands in the northern part of the Culburra West land, and is therefore relevant (native biota, including threatened species< do not recognise cadastral boundaries).

Given those considerations, the data collected from the Culburra West lands are of direct relevance to Long Bow Point and the Culburra Golf Course project. Accordingly, and on a precautionary basis, those threatened biota recorded at Culburra West have been considered in further detail in this SIS (even if not recorded on Long Bow Point). This can hardly be regarded as inappropriate.

As discussed above, the very substantial array of data which have been derived from the investigations undertaken on Long Bow Point and at Culburra West over the last 20+ years are valid and relevant to the consideration of threatened biota in this SIS. As noted in the DGRs – "*Previous surveys and assessments may be used to assist in addressing this requirement*", although the DGRs also state that "the efficacy of such previous surveys and assessments in meeting this requirement must be described in full".

The efficacy of the surveys and investigations undertaken over the last 20+ years is well demonstrated by the detailed information contained in the previous sub-chapters of this SIS and in the details contained in Appendices E, F, G and H.

It is the opinion of the author of this SIS that the surveys and investigations conducted on Long Bow Point and at Culburra West more than satisfy the DGRs for this SIS with respect to investigations for threatened biota, and the natural environment in general, at this location.

#### 3.10 Survey Pro-formas

Item 4.2 of the DGRs states that the "*survey proformas*" provided with the DGRs by the OEH "*shall be used by field staff when undertaking fauna surveys*".

Many, indeed most, of the detailed field investigations on which the SIS relies (on Long Bow Point and in the Culburra Survey Area) had been completed prior to receipt of the DGRs for preparation of the SIS - given the previous surveys and the timing requirements for the SIS - and those proformas therefore were not used.

Some of the SLR Ecology data have subsequently been transposed onto the OEH pro-forma sheets (see Appendix I to this SIS).

# 3.11 Limitations

It is a function of all ecological studies, virtually without exception, that the information regarding flora and fauna on any one site is incomplete.

That circumstance arises because the natural environment is dynamic, not static, and because there will be variations in the flora and fauna assemblage on any one site through various seasons and through different climatic circumstances, over a few years or decades.

As a consequence, all ecological assessments are unavoidably reliant on only a partial and incomplete information base. All such assessments, therefore, must also rely *inter alia* on:

- various other sources of information, in addition to on-site field investigations;
- studies and investigations on other lands in the immediate and general vicinity particularly those involving the same or similar ecosystems;
- informed assumptions regarding the biota (including threatened species) likely to occur on a site - based on the habitats and resources present, and their habitat preferences and requirements;
- the general and scientific knowledge of native biota, and their habits and habitats; and
- the experience of the investigators and assessors involved.

However, with respect to Long Bow Point and the associated lands at Culburra, it must be noted that there have been a considerable and substantial array of investigations undertaken both on the subject site itself and on contiguous habitat in its immediate vicinity (as documented in detail above).

Those investigations (see above; Appendices E, F, G and H; Bibliography) have included:

- studies by the author of this *Report*, and his staff and agents, at Culburra and Callala over a period of 2 decades;
- investigations undertaken by other ecological consultants for the proponent of the previous residential subdivision proposal on Long Bow Point;
- investigations undertaken by opponents of that proposal, as documented in the Long Bow

Point Commission of Inquiry (1999);

- investigations undertaken by the then National Parks & Wildlife Service (NPWS) on Long Bow Point and in the vicinity, *inter alia* for the *Long Bow Point Commission of Inquiry*; and
- surveys by other consultants of the Culburra UEA lands.

The subject land and immediately adjoining lands of relevance, therefore, have been the subject of a considerable and comprehensive array of investigations by a variety of ecological consultants and agencies over a period of more than 20 years. The subject lands at Culburra have been the focus of a greater level of inspection, investigation and survey than almost any other location within the *Jervis Bay Regional Area*.

It is to be noted that opportunistic records of threatened flora and fauna species were collected during the many thousands of person-hours of field surveys undertaken on Long Bow Point and in the Culburra UEA lands, by an array of ecologists, over a period in excess of 20 years. Field investigations have been undertaken at Long Bow Point and at Culburra on a large number of occasions - involving several hundred person-days and many thousands of person-hours of field surveys and investigations.

It cannot reasonably be asserted that there have been insufficient investigations of the subject site or the subject lands (including Long Bow Point) at Culburra. It should be noted that - with respect to the Culburra West Urban development project, located approximately 1km to the north of the Culburra Road - the OEH has stated that "quote re 20 years of studies" (see Chapter 3.9 above).

Furthermore, the approach adopted in this SIS is, *inter alia*, that threatened species for which there is suitable habitat present on the subject site, and for which there are relevant records, should be assumed to be present or assumed to utilise the vegetation on Long Bow Point on occasions, even if there is no evidence for their presence on the site.

Obviously, on that basis, if they are assumed to be present in potentially suitable habitat on the subject site or the subject land, any such species should also be assumed to be present in other potential and similar habitat in the vicinity and the locality.

Thus, the approach which has been adopted for this *Report* is one of an 'abundance of caution' (*ie* a 'precautionary' approach). It is assumed for the purposes of this *Report* that some threatened species which have not been recorded on the subject site or in its immediate vicinity (despite the plethora of investigations) could in any case potentially be present.

In addition, the Culburra Golf Course project has been designed specifically *inter alia* to avoid, minimise and/or mitigate the potential for adverse impacts to be imposed upon any threatened species (present or possible), and to facilitate the enhancement and maintenance of biodiversity values on the subject land.

# 4 DESCRIPTION of the SUBJECT LAND

# 4.1 Introduction and Scope

Item 2 of the DGRs requires a description of the subject site and the study area - as "*Contextual Information*" for the proposal.

In particular, various plans, maps and an aerial photograph are requested in Item 2.4 of the DGRs (Appendix A). The provision of relevant material as requested is documented in Appendix B of this SIS.

#### 4.2 Context of the Subject Site and Study Area

The "*subject land*" to which this SIS refers (the southern parts of Lots 5 and 6 on Long Bow Point) is located within the greater *Jervis Bay Regional Area*<sup>1</sup>. The existing residential area of Culburra Beach is located on the northern shore of Lake Wollumboola, with the Crookhaven River to the north and west, and the Tasman Ocean to the east.

The subject land (Figures 1 and 2) is bound:

- to the north by the Culburra Road and private open forest and woodland extending to the Crookhaven River;
- to the south and west by extensive areas of open forest and woodland vegetation on private lands;
- to the east by Lake Wollumboola; and
- to the northeast by the township of Culburra Beach.

The "*subject land*" within which the Culburra Golf Course (the "*subject site*") is to be located (*ie* the southern parts of Lot 5 and Lot 6 in DP 1065111) occupies approximately 201 hectares of land - directly to the west and southwest of Culburra Beach (Figures 1 and 2).

It constitutes the northeastern extremity of a very substantial band of native open forest and woodland at this location, which extends for many kilometres to the west and south (Figure 2). The "*subject site*" (*ie* the area to be occupied by the Culburra Golf Course and its associated features) occupies a total of approximately 35.2 hectares (Figures 3A and 3B), of which 27.84ha is open forest and woodland.

The majority of the "*subject land*", and much of the 'survey area' (as identified in Chapter 5), is vegetated by a mosaic of (predominantly) native xeric (dry) and less common mesic (moist) plant communities, with patches of agricultural land scattered throughout.

Whilst the xeric open forest and woodland vegetation on the subject land has previously been harvested for timber (as indicated by large tree stumps present and the patchy distribution of very large trees within the subject site), most of the forest and woodland communities in the 'survey area' are in good to very good condition - with respect to levels of degradation or disturbance and/or levels of weed

<sup>1</sup> The *Jervis Bay Regional Area* is defined as the land identified in the *Jervis Bay Regional Environmental Plan* 1996, and corresponds essentially with the Shoalhaven LGA.

infestation. There are, however, patches of significant weed infestation (Bitou Bush, Lantana and introduced grasses) within the subject land, particularly closer to Lake Wollumboola.

As indicated in the historical aerial photographs contained in Appendix L, parts of the subject land at Culburra had been subjected to considerably greater clearing of vegetation than is currently the case. In 1949 and at least through until 1963 (Appendix L), there was a much larger area of clearing in the centre of Long Bow Point than at present, as well as a substantial clearing in the northeastern part of the land (near the Culburra Road).

Other small areas of clearing had also occurred in the central western part of the subject land (see Appendix L). Subsequent regeneration has occurred in many of those areas, although the central part of the subject land remains either cleared grassland or contains dense regrowth stands of Tick Bush *Kunzea ambigua* and Tea-tree.

The subject land is located within the catchment of Lake Wollumboola, on the northwestern shore of the Lake itself (Figure 6). Other than the southern parts of the existing township of Culburra, the Lake Wollumboola catchment is largely undeveloped, and supports a substantially native cover of open forest and woodland communities (Figure 6). The majority of the Lake Wollumboola catchment is contained within the Jervis Bay National Park, including the body of Lake Wollumboola itself (Figure 7A).

It is significant to note that there is essentially no active treatment of stormwater discharged into Lake Wollumboola from the Culburra Beach township by Shoalhaven City Council, yet the Lake is considered by many to be both highly 'sensitive' and near 'pristine'. The area of the Culburra Beach township which discharges untreated stormwater into Lake Wollumboola is approximately 80ha (or approximately 2.5 times the area of the proposed Culburra Golf Course).

It is also of note that the Culburra Beach township was only provided with a sewer system in 1984. Prior to that time, the dwellings in Culburra Beach within the Lake Wollumboola catchment utilised septic tanks for the treatment and discharge of sewage.

Conservation reserves (National Parks and Nature Reserves) are abundant and extensive, both in the immediate locality (Figure 7A) and in the Shoalhaven LGA (Figure 7B). There are (approximately) 229,000ha of National Parks estate and 52,000ha of State Forests in the Shoalhaven LGA, as well as 31,000ha of Crown Lands, and mostly vegetated and/or conserved Commonwealth lands.

In addition, there are very substantial private lands with open forest and woodland vegetation (Figure 7C) that will never be developed (including adjacent to the Culburra Golf Course land) – given any conceivable future planning outcomes. These substantial conservation areas provide abundant resources for the threatened species identified on the subject land, including all of those addressed in this SIS.

By contrast, the proposed Culburra Golf Course will occupy just 27.84ha of existing native open forest and woodland vegetation.

#### 4.3 Site History

As is clearly evident from the historical photographs contained in Appendix L, substantial parts of the subject land on Long Bow Point had previously been cleared for agricultural purposes and/or thinned and used for timber harvesting. There are many tree stumps present over the subject land which reflect that history, and a significant proportion of the trees present are of relatively young age (see photographs in Appendix M1).

As also indicated elsewhere in this SIS, hollow-bearing trees tend to be concentrated in specific areas (*ie* those which had not been previously cleared). Some parts of the subject land in proximity to the proposed Golf Course have only limited densities of hollow-bearing trees (see Chapter 6).

Elements of the subject land which reflect previous and (in some cases ongoing) disturbance (Appendix L), include:

- the large area of slashed and cleared vegetation (grassland) in the centre of the subject land which has long been modified for agricultural and grazing purposes;
- an array of tracks and cleared spaces throughout the subject land; and
- a number of old fence lines.

#### 4.4 Climate

The climate experienced on the subject site at Culburra is typical of the coastal climate of the Central and South Coast of NSW, with warm to hot summers and general cool to mild winters. Frosts are rare.

Winter evening temperatures rarely drop below approximately 4-5°C, and winter day-time temperatures can vary between approximately 10°C and 20°C+. Summer day-time temperatures regularly exceed 30°C, but onshore breezes are a regular summer feature.

Rain is scattered throughout the year, with occasional extended periods of rain during the winter and serious thunderstorms during the summer. Annual rainfall is 900mm to 1200mm.

#### 4.5 Soils

The soil landscapes on the subject lands have been classified into two main types (Hazelton 1992) - the Greenwell Point and Seven Mile soil landscapes. Descriptions of these soil landscapes are:

- the Greenwell Point soil landscape which consists of "gently undulating rises on siltstone with small coastal cliffs". The soils are generally "shallow ... structured loams or moderately deep yellow podzolic soils on coastal cliffs. Red Podzolic Soils occur on simple slopes and in drainage lines"; and
- the Seven Mile soil landscape which is described as a "series of dune ridges and swales, swamps or lagoons on Quaternary marine sands". These landscapes support "deep siliceous sands", and "podzols occur on ridges".

Notwithstanding the mapping of parts of the subject land as containing the Seven Mile soil landscape ("*on Quaternary marine sands*"), there is in fact no evidence for the presence of that soil landscape type on the subject land or subject site. The subject land appears to consist substantially, if not entirely, of the Greenwell Point soil landscape.

The water table is described in Hazelton (1992) as generally being close to the surface, and it is stated that standing water is common in these landscapes. On Long Bow Point, however, areas of "*standing water*" are confined predominantly to the lower parts of the Wattle Creek catchment (to the north of the proposed Golf Course), and along parts of the channels of Downs Creek and its main tributary (which also has an overgrown farm dam). There are no areas of "*standing water*" within those parts of the subject site which are proposed for the Culburra Golf Course.

# 4.6 Topography and Drainage

The subject land is predominantly gently undulating, with slopes of less than 10% being characteristic of most of the area (Figures 9 and 10). The only areas where slopes are greater than 10% is around the Lake Wollumboola foreshore, a few small patches along Downs Creek and at a few other scattered locations (Figure 9).

It is also of note that the subject land does not contain rock outcrops, rocky ridges or significant cliff lines, which represent specific habitat or resources for a range of native fauna species. There is a small cliff line around Long Bow and Swan Points, but there are no caves, rock outcrops or other such features at this location (see photographs in Appendices M1 and M2). As a consequence, biota which specialise in rocky habitats are unlikely to be present on the subject land.

There are two watercourses/swales which traverse the subject land at Culburra (Figure 2):

- Wattle Creek in the north which flows into Lake Wollumboola on the northern side of Long Bow Point; and
- Downs Creek (which flows through the centre of the subject land) and its tributary (which traverses the southwestern part of the site) to the west and southwest of Long Bow Point.

Wattle Creek is a gentle swale which drains an area of gentle slopes and gradual topography. It does not contain a formed channel, except in its very lowest reaches (see photographs in Appendix M1). There are broad areas of swampy and mesic vegetation types in the lower parts of the Wattle Creek catchment.

By contrast, Downs Creek is more deeply incised into the land, particularly in its lower reaches (Figure 10) - between the Culburra Road and Lake Wollumboola (Appendix M1). There is a channel of open water into the mudflats at the bottom of Downs Creek, although this dries up in part when the Lake is low (see photographs in Appendix M2; Figure 2). The southern tributary to Downs Creek is well incised (with a discernible channel in its lower reaches), although this feature is not of relevance for the proposal, as no works are proposed within its catchment.

In early 2014, following the opening of Lake Wollumboola to the sea in late 2013, the exposed dry mudflats around the Lake foreshore (Appendix M2) were approximately 400-450m wide at the base of

Downs Creek (between the Lake shore and the fringing Swamp Oak Swamp Paperbark Forest) and 200m wide at the base of Wattle Creek. Both creeks had ceased flowing, with Wattle Creek having dried up entirely, and the water remaining in Downs Creek being separated from the body of the Lake by a 250m+ stretch of dried mud (see photographs in Appendix M2).

No evidence of groundwater discharges (seepages, soaks or exposed moist soil at the upper end of the Wattle Creek channel) was observed during the investigation of the dried mudflats in January 2014, and there was no standing water at all at the lower end of Wattle Creek.

# 4.7 Flora and Fauna – General Considerations

As a result of the substantial array of investigations which have been undertaken on the subject land and on other lands in the immediate vicinity (Chapter 3; Appendices E to H), there is a very substantial body of information regarding the flora and fauna assemblages, and the ecosystems and vegetation community types, present on the subject land at Culburra and around it.

The general features of the flora and fauna assemblages on the subject land at Long Bow Point are documented in Chapters 5 and 6 of this SIS, including some initial discussion of the "*threatened species, populations and ecological communities*" present (or potentially present) on the subject land. More detailed consideration of threatened biota is contained in Chapters 7 and 8 of this SIS.

It should be noted that the proposed Culburra Golf Course is separated from Lake Wollumboola by a vegetated buffer of at least 100 metres in width (Figure 3A). Thus, notwithstanding the discussion of wading and lacustrine birds associated with Lake Wollumboola throughout this SIS, none of those species will be affected by the proposed Culburra Golf Course project (see further detailed discussion in Chapters 7 and 8).

# 4.8 SEPP 14 Wetlands

There are two relevant wetlands identified in *State Environmental Planning Policy No. 14 – Coastal Wetlands* (SEPP 14) - which have been mapped where Downs Creek and Wattle Creek enter into Lake Wollumboola (Figure 8A). Those SEPP 14 Wetlands (No. 343 and No. 364) were mapped by the then Department of Planning - at a scale of 1:25,000 (Figure 8A).

Accurate mapping of the vegetation on and around Long Bow Point by SLR Ecology (see Chapter 5) confirms the presence of vegetation and features characteristic of SEPP 14 Wetlands at those general locations – including areas of periodically exposed mudflats, as well as fringing areas of Sea Rush-Twig Rush Herbland.

However, as indicated in Figures 8B and 8C, the extent of the SEPP 14 Wetlands on the DP&I maps does not accurately reflect the distribution of wetland vegetation types or ecosystems at these locations. The amended SEPP 14 Wetland maps (Figures 8B and 8C) prepared by SLR Ecology provide more refined and ground-truthed wetland boundaries.

It is to be noted that the SEPP 14 Wetlands around Long Bow Point are located at a considerable distance from any element of the Culburra Golf Course project (Figures 3A, 8B and 8C). These Wetlands will be protected from any direct or indirect impacts by virtue of the intervening vegetation, as well as by the comprehensive water management regime for the Culburra Golf Course (Martens 2015; Appendix D1) and the *Draft Culburra Golf Course Plan of Management* (GCPoM; Appendix D2) – prepared by Golf by Design (see Chapter 12).

Thus, there will be no adverse impacts imposed upon those wetlands, or upon any ecosystems or biota which are or may be dependent upon them.

It is of note that none of the vegetation within the SEPP 14 Wetlands is a 'Groundwater Dependent Ecosystem' (GDE). The NSW State Groundwater Dependent Ecosystems Policy 2002 defines GDEs as "ecosystems which have their species composition and their natural ecological processes determined by groundwater".

The only parts of the subject land on which the Culburra Golf Course is to be located that are anticipated to have groundwater at shallow depths (*ie* of potential relevance to plants) is within the alluvium deposits in low-lying areas and drainage depressions (Martens 2015). However, the soils which characterise most of the subject land have low permeability, and therefore groundwater transmission through these soils will be very slow.

#### 4.9 Lake Wollumboola

Lake Wollumboola is an Intermittently Closed and Open Lake or Lagoon (ICOLL), and is regarded as a 'wetland of international importance' (although it is not listed as a RAMSAR Wetland). It is recognised by all concerned as an extremely valuable resource for native and migratory wetland and wading birds, and a very important breeding site for many species.

The Lake has a variety of characteristics – including the following.

- An extensive surface area (~650ha) and shallow depths.
- The Lake is mostly closed to the ocean, discharging through a narrow sand bar at its northeastern extremity when 'over-full' either naturally or on occasions assisted by local residents or the OEH.
- As a result of the generally closed entrance, the Lake is mostly non-tidal with tidal influences limited to short periods during Lake openings.
- Water levels in the Lake vary dramatically from sea level (when open to the ocean) to as much as almost 3 metres above sea level.
- Salinity levels vary substantially (Scanes *et al* 2013 see Chapter 4.10 below) ranging from close to zero PSU (freshwater) up to 45 PSU<sup>2</sup> (hypersaline). Salinity levels in the Lake are dependent on the timing and lengths of openings to the ocean, as well as the frequency and volumes of stormwater inflows when closed to the ocean, and the relative influence of evaporation.

<sup>&</sup>lt;sup>2</sup> PSU - Practical Salinity Units. Sea water is approximately 35 PSU.

- There are extensive beds of seagrasses and macrophytes which are crucial to the Lake's productivity and nutrient cycling. Additionally, changes in water levels in the Lake result in periods of plant decay and the release of significant sulphurous gasses.
- The Lake supports a very substantial array of wetland bird species, including significant numbers of the Black Swan and of seasonal migrant species.

The significance and very high value of Lake Wollumboola has been accepted by the author of this SIS and the designers of the Golf Course, and by the proponent of the Golf Course. It is a fundamental basis for the design, construction and management of the Culburra Golf Course that the protection of Lake Wollumboola and its ecosystems is paramount.

Those considerations *inter* alia have driven the design and management of the Culburra Golf Course and its stormwater management regime – as detailed in the comprehensive water management regime for the Golf Course (Martens 2015; Appendix D1) and the *Culburra Golf Course Plan of Management* (GCPoM; Appendix D2) – prepared by Golf by Design (see Chapter 12).

Specific features of the Culburra Golf Course that will ensure there are no adverse impacts imposed upon Lake Wollumboola include:

- the very low permeability of the soils on Long Bow Point, and therefore the low levels of groundwater movement through the site;
- the capture, treatment and re-use of stormwater from the Golf Course for irrigation purposes – leading to only a minor increase in freshwater discharges to groundwater, and no increase in nutrients in groundwater (Martens 2015 notes that nutrient discharges from the Golf Course will be lower than current discharges – although not by a substantial amount);
- the use of foliar fertilisers on the Golf Course fairways, greens and tees thus avoiding any increase in soil nutrient levels (see Chapters 2.4, 4.10 and 10.4);
- the implementation of a minimalist policy to the maintenance of the Golf Course with respect to the use of pesticides or herbicides; and
- the maintenance and enhancement of 100m+ vegetated buffers between the Golf Course and the closest elements of the Lake.

# 4.10.1 The Scanes *et al* Report

A *Report* regarding the proposal and Lake Wollumboola (Scanes *et al* 2013) has been prepared by the Office of Environment & Heritage (OEH) and the Southern Rivers Catchment Management Authority (SRCMA).

The Scanes et al 2013 Report identifies three key issues or assertions.

- Lake Wollumboola is a Groundwater Dependent Ecosystem (GDE)
- Lake Wollumboola is "fragile" and "vulnerable to .. catastrophic state change".
- There is a real (and serious) risk that development near the Lake (such as the Culburra Golf Course project) will, or at least could, result in a catastrophic change to Lake Wollumboola

# 4.10.2 A Groundwater Dependent Ecosystem ?

Scanes *et al* 2013 maintain that Lake Wollumboola is a *Groundwater Dependent Ecosystem* (GDE) – asserting (without any relevant empirical evidence) that "*groundwater is most probably a major component* of freshwater inputs to the lake" (emphases added).

On the basis of that (unsupported) assertion, Scanes *et al* further assert that "*Pollution of groundwater therefore represents a major risk to the lake*". Whilst this **might** (theoretically) be a reasonable assumption, it depends on the first assertion being true - which it is not (see below).

The Scanes *et al* argument that "groundwater is **most probably** a **major component** of freshwater inputs to the lake":

- is, at best, circumstantial;
- provides no actual or empirical evidence for any groundwater flows anywhere into Lake Wollumboola; and
- is not supported by the available evidence (see below for actual data).

In contrast with the Scanes *et al* theory, the Martens *Report* (2015) documents the very low levels of groundwater movements through Long Bow Point – given the nature of the soils and rock strata beneath the site.

The Martens 2015 *Report* concludes that any groundwater flows which could potentially discharge into Lake Wollumboola from Long Bow Point are confined to the regional groundwater system – which is located within the rock strata deeper below the site. Conversely, shallow soil groundwater would predominantly be utilised by the vegetation on the site and on the slopes around Long Bow Point

In further support of that proposition, it is noted that there was NO evidence of any groundwater seepage at bottom of Downs Creek or Wattle Creek during the low Lake levels in early 2014, as is indicated in the photographs taken by the author of this SIS at that time (Chapter 4.6 of the SIS; Appendix M2). Downs Creek had ceased flowing, and was separated from the Lake by more than

200m of dried mud. The soil face at the bottom of Wattle Creek (~1m high) was completely dry (see Appendix M2) – with no evidence of any higher level groundwater flows.

Based on their empirical data from Long Bow Point, Martens (2015) has calculated that the quantum of groundwater discharge from the regional groundwater system beneath the Culburra Golf Course project site into Lake Wollumboola would be:

- 0.412 m<sup>3</sup>/day (= 412 L/day) or 150.38 KL/year; or
- 85.8 mL/day/metre of Lake interface.

As is stated by Martens (2015) - this rate of groundwater discharge is "very low and would be imperceivable at a submerged seepage face".

It is noted that the Martens 2015 (Appendix D1) calculations have not included groundwater flowing through the subsoils, as these will be predominantly subjected to evapotranspiration by the dense vegetation on the slopes and low-lying areas around Long Bow Point. As Martens 2015 (Appendix D1) state – the minor increase in groundwater from the Culburra Golf Course development "*is likely to be consumed by the dense vegetation on the side slopes, in riparian vegetation zones on lower slopes or be stored in alluvial soils*".

Thus, the majority (if not all) of the increased groundwater discharged from the developed Golf Course is not likely ever to reach Lake Wollumboola.

Martens (2015) have determined that "seepage volumes to groundwater" will increase following development of the Golf Course from the current 4 ML/year to 44 ML/year (a nett increase of 40ML/year). As noted above, most of that groundwater "is likely to be consumed by the dense vegetation on the side slopes, in riparian vegetation zones on lower slopes or be stored in alluvial soils".

Critically however, even if it all of that increased groundwater (40 ML/year) did reach the Lake (however extremely improbable is that possibility), the potential impacts of this increase in groundwater on Lake Wollumboola would be inconsequential<sup>3</sup>.

The total volume of Lake Wollumboola at its lowest level would be approximately 6,500 megalitres (ML) - 650ha times an average depth of 1 metre. The contribution of the developed Golf Course to Lake Wollumboola via groundwater flows (assuming that all of the groundwater seepage enters the Lake – which is not even theoretically possible) would be 0.68% of the Lake volume. The current total groundwater seepage from the Golf Course site (again assuming that it all 'flows' into the Lake – which is not even vaguely likely) would be 0.062% of the Lake Volume.

For groundwater to be "a **major** component of freshwater inputs to the lake", there would have to be hundreds of times more groundwater discharge into Lake Wollumboola than is likely or is predicted, or indeed is even possible – on the basis of the data and calculations regarding the soils, lithology and groundwater movements by Martens.

<sup>&</sup>lt;sup>3</sup> Highly localised impacts (be they from localised or concentrated runoff or maybe even from groundwater) are acknowledged – adjcent to the Culburra Beach village and possibly at the deltas of Downs Creek and Coonemia Creek. And even Wattle Creek. However, there is little (if any) likelihood that these impacts are a function of groundwater flows. They are much more likely a result of concentrated freshwater overland flows and nutrient runoff.

Clearly, Lake Wollumboola **CANNOT** be dependent or reliant on groundwater discharges - at any point in its cycle. There is simply too little groundwater even potentially entering the Lake.

Lake Wollumboola Is **NOT** a *Groundwater Dependent Ecosystem*.

# 4.10.3 Catastrophic Change in Lake Wollumboola

Scanes *et al* 2013 maintain that Lake Wollumboola would be subject to catastrophic change in the event that it is affected by increased or altered groundwater discharge and/or nutrient levels.

Scanes et al 2013 allege (with no actual evidence):

- the "sensitivity [of Lake Wollumboola] to catastrophic change";
- "impacts on the lake are likely to irreversible"; and
- the Lake "is definitely "fragile"".

Whilst "*catastrophic change*" in Lake Wollumboola as a consequence of excessive nutrient input is at least theoretically possible, there are several relevant matters that appear not to have been taken into account by Scanes *et al* 2013.

- Lake Wollumboola would have to be subjected to very very substantial additional nutrient inputs given its size (at minimum 6,500,000 kilolitres of Lake water) and the existing very high natural variability in the Lake (salinity, water levels, existing nutrient inputs from 80ha of the Culburra Beach village and up to 20,000 birds), as well as the existing feedback and control measures outlined by Scanes *et al.*
- There has been no such catastrophic damage to the Lake apparently despite 50+ years of unmanaged and untreated stormwater inputs (including from *in situ* and unmanaged septic tanks) from the village of Culburra Beach. Indeed, Lake Wollumboola is considered by Scanes *et al* 2013 to be of high "*ecological significance*" and quality.
- The nutrient input from up to 20,000 wetland birds (varying from just a few thousand in some years) on the Lake each year appears to have had no adverse impact on the nutrient cycling of the Lake, notwithstanding the huge nutrient input that would arise from such a number of birds.

Furthermore, as discussed below, on the basis of the empirical evidence and data provided by Martens 2015 (Appendix D1) - the Culburra Golf Course project:

- will involve only a minor increase in the quantum of water discharges into the groundwater at Long Bow Point – which will be of **no** relevance for Lake Wollumboola;
- will result in a nett decrease in nutrient discharges; and
- cannot be determined by any measure to be likely to adversely affect Lake Wollumboola or its ecosystems.

Lake Wollumboola has had NO protection from the runoff from 80ha of the Culburra Beach residential area for over 50 years. For most of that period, Culburra Beach had no sewer system, and the properties draining in the Lake used septic systems to treat human effluent. There are still no

stormwater treatment facilities for the residential area draining into the Lake – including roads, driveways, gardens and managed parks.

The Scanes et al 2013 paper clearly implies that the Culburra Golf Course project imposes a real risk of *"catastrophic change"* in Lake Wollumboola. There is **NO** such risk.

# 4.10.4 Culburra Golf Course Impacts

Scanes *et al* 2013 implies that the proposed Culburra Golf Course is likely to impose adverse impacts on Lake Wollumboola - through the discharge of nutrients and additional water into the groundwater system from the Golf Course. Scanes *et al* 2013 assert that *"the lake is vulnerable to a catastrophic state change if key processes are disrupted by nutrient enrichment"*.

Conversely, the *Report* By Martens 2015 (Appendix D1) provides the following details with respect to nutrient and groundwater discharges from the Golf Course.

- Following development of the Culburra Golf Course "nutrient concentrations within seepage water will be slightly **reduced** compared to existing conditions. Modelled golf course nutrient leachate concentrations are considerably lower than observed existing local groundwater nutrient concentrations. Any change to nutrient leaching is very minor with annual nutrient budgeting suggesting there shall be an annual nutrient **deficit**"."
- There will be an increase in groundwater seepage by 40 megalitres/year. This increase "*is likely to be consumed by the dense vegetation on the side slopes, in riparian vegetation zones on lower slopes or be stored in alluvial soils*". Even if the whole of that 40 megalitres/year was to be discharged to Lake Wollumboola (which is NOT likely), that would constitute just 0.615% of the total volume of Lake Wollumboola at its lowest point.
- As noted above, the Martens 2015 *Report* (Appendix D1) demonstrates "*very low*" rates of groundwater movements through the site and vicinity. Thus, the potential for adverse impacts on groundwater flows into Lake Wollumboola would be miniscule.

Further, as discussed in Chapter 2.4, modern management regimes on golf courses in Australia are designed *inter alia* to ensure that nutrients and fertilisers are neither over-used nor lost from golf courses. These materials are expensive, and the application of fertilisers in excess of their use by plants on a golf course would simply be a waste of money.

In addition, the fertilisers used on modern golf courses are predominantly foliar – that is applied at low levels and absorbed through the grass leaves, not the roots. Thus, the fertilisers generally do not come into contact with the soil at all, and there is little or no potential for leaching into the groundwater.

Importantly, the Golf Course will not result in any discharges of Phosphorous (P) into Lake Wollumboola – *inter alia* because the Golf Course will avoid the use of phosphate-based fertilisers (a *Condition* placed by SCC on the approved extensions to the Shoalhaven Heads Golf Course – see Chapter 2.4.2 above). The principal concern of Scanes *et al* 2013 with regard to nutrient inputs into the Lake is a potential increase in phosphorous.

Martens 2015 calculate that there will be:

- **NO increase** in phosphorous entering Lake Wollumboola
- A minor decrease in nitrogen entering the Lake

Any suggestion that Lake Wollumboola would (or even could) be adversely affected by the proposed Culburra Golf Course (including its proposed management regime) does not appear well-founded. The Golf Course will **NOT** result in the discharge of any additional contaminants or nutrients into Lake Wollumboola, and the impact of the Golf Course (even under a 'worst case' scenario) would be significantly less than the impacts of the existing residential area of Culburra Beach.

As concluded by Martens (2015) – the Culburra Golf Course project will "not adversely impact on local or regional groundwater resources or groundwater receiving environments".

The implication by Scanes *et al* 2013 that the Culburra Golf Course project would be likely to adversely affect Lake Wollumboola through groundwater discharges (either by substantial changes to groundwater volumes or by increased nutrients) simply has **NO** basis.

# 4.10.5 Summary

On the basis of actual data, empirical observations and established calculations (Martens 2015 – Appendix D2; FD Fanning *pers obs*), the following comments can be provided in response to Scanes *et al* (2013).

- 1 Lake Wollumboola is **not** a *Groundwater Dependent Ecosystem*.
- 2 There is **no** likelihood or even possibility that "*groundwater is most probably a major component of freshwater inputs to the lake*".
- 3 The proposed Culburra Golf Course will **not** result in an increase in nutrient levels in the groundwater underlying the site (rather, it will decrease nutrient levels).
- 4 Whilst the proposed Culburra Golf Course will increase the total quantum of groundwater seepage from the Golf Course, that increase:
  - is **not** likely ever to reach Lake Wollumboola being *"likely to be consumed by the dense vegetation on the side slopes, in riparian vegetation zones on lower slopes or be stored in alluvial soils*"; and
  - even if it did, the total quantum of such water is miniscule compared to the volume of the Lake, and could not conceivably impose any adverse impacts upon the Lake.

There is no valid basis to assert that the Culburra Golf Course project on Long Bow Point would, or indeed even could, impose adverse impacts upon Lake Wollumboola as a consequence of any likely changes to groundwater volumes or nutrient levels.

# 5 FLORA and VEGETATION

#### 5.1 Plant Communities

# 5.1.1 Plant Community Types

The mapping of vegetation within the subject land on Long Bow Point, and on the surrounding lands, as detailed in this SIS (Figure 11A) has identified a total of fifteen main vegetation community types, with a number of variants within some of those community types (Table 5.1; Appendices M1, N and O). The vegetation mapping of other parts of the "*survey area*" (Figures 5A and 5B) has identified a number of additional plant community types which are not present on the "*subject land*" itself.

The vegetation types on the subject land (Figures 11A and 11B) have been grouped into four main classes of vegetation (Table 5.1):

- xeric (dry) plant communities which are typically located on the ridges and slopes of the subject land, and which constitute the bulk of vegetation to be affected by the Golf Course;
- mesic or swamp plant community types which are confined to the watercourses and drainage features (along Downs Creek and Wattle Creek) or low-lying parts in the survey area, and around the edges of Lake Wollumboola;
- wetland communities which are either confined to the edges of Lake Wollumboola or to the lower end of Downs Creek and Wattle Creek; and
- cleared and disturbed areas some of which remain open grassland and some of which are regenerating as shrubland.

As discussed in detail below (in Chapter 5.7 and in Chapter 8.5), a number of the mesic and wetland vegetation types on and around the subject land at Long Bow Point have the floristic characteristics of one or other of several "*endangered ecological communities*" (EECs) listed in the TSC Act.

However, as also discussed in considerable detail subsequently in this SIS (particularly in Chapters 5.7 and 8.5), none of the "*endangered ecological communities*" (EECs) identified in Table 5.1 and/or in the DGRs (Appendix A) is accepted by the author of this SIS as being present on or around Long Bow Point at Culburra.

- Most of those EECs are defined as being located "*on coastal floodplains*". However, there are no "*coastal floodplains*" on Long Bow Point or adjacent to it (nor are there any such floodplains "*associated with*" Long Bow Point).
- The artificial wetland on the southern tributary to Downs Creek is an old farm dam, and is thus excluded from the Freshwater Wetlands on Coastal Floodplains EEC. Further, as noted above, that feature is not located on a "coastal floodplain", in any case.
- The Sea Rush/Twig Rush Herbland at the bottom of Downs Creek and Wattle Creek is not located in an "*intertidal zone*". As a consequence, that vegetation type fails to satisfy Paragraph 1 of the *Final Determination* for the Coastal Saltmarsh EEC.

None of the xeric vegetation types on the subject land at Culburra is an EEC (Chapters 5.7 and 8.5).

Map Unit	Description	Floristic Equivalent EECs #			
Xeric Commur	Xeric Communities				
D1a	Grey Ironbark – Rough-barked Apple Open Forest	-			
D1b <sup>4</sup>	Grey Ironbark – Woolybutt Open Forest	-			
D2	Bangalay Woodland/Open Forest	-			
D3	Blackbutt Open Forest	-			
D4	Bangalay – Woolybutt – Rough-barked Apple Open Forest	-			
D5	Forest Red Gum Open Forest	-			
D6	Hard-leaved Scribbly Gum Woodland	-			
E	Ecotone – between mesic and xeric vegetation	-			
Mesic Commu	nities				
M1a	Swamp Oak – Eucalypt Open Forest on Flats	SSFCF/REFCF			
M1b	Eucalypt - Swamp Oak Open Forest on Slopes	-			
M2a	Swamp Paperbark Closed Forest	SSFCF			
M2b	Swamp Paperbark – Swamp Oak Closed Shrubland/Closed Forest	SSFCF			
M3	Swamp Oak Closed Forest	SOFF			
M4	Swamp Mahogany Open Forest	SSFCF/REFCF			
Wetland Communities					
W1b	Sea Rush-Twig Rush Herbland	CSM			
W4	Artificial Wetland/Sedgeland	FWCF			
Modified Com	Modified Communities				
CD	Cleared and Disturbed	-			

Гable 5.1	Summary of vegetation	communities recorded	on the subject land at Culburra	а
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- # Endangered Ecological Communities (EECs) listed in the TSC Act. These are plant communities on Long Bow Point which are floristically equivalent to some EECs, but which do not conform in other respects (see Chapters 5.7 and 8.5)
- REFCF River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions
- SSFCF Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions
- SOFF Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions
- CSM Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions
- FWCF Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

<sup>&</sup>lt;sup>4</sup> The Grey Ironbark – Woolybutt Open Forest community is located at low elevations, particularly in the lower catchment of Wattle Creek. This vegetation type is a transitional community between the xeric and the mesic vegetation types – the Grey Ironbark typically found in more xeric environments and the Woolybutt in more mesic locations.

# 5.1.2 Vegetation Boundaries

It should be noted that the mapped 'boundaries' of vegetation communities are in most instances somewhat arbitrary, given that distinct boundaries rarely occur naturally, and that adjacent communities will often share a number of species. Additionally, different parts of a vegetation type may be dominated by one or other of several different canopy trees. Such fine scale variations are not considered of significance for this SIS, and would, in any case, be extraordinarily difficult and time-consuming to map on a site the size of the subject land.

Further, because of the gentle slopes over much of the subject land, there are often broad ecotones – both within the xeric community types and the moist communities, and between adjoining xeric and mesic communities. There are, however, a number of vegetation types that are quite distinct and readily distinguishable (*eg* the shrublands and herblands around Lake Wollumboola, cleared areas and the artificial wetland).

As a consequence of the observations noted above, and the nature of the subject land, the mapping of vegetation types contained within this SIS is approximate only. It is, for the most part at least, inappropriate to regard the boundary of a vegetation type as depicted in this SIS as being the precise edge of that community type.

It is also relevant to note that there are many different approaches to the identification, classification and mapping of vegetation communities. It is not to be assumed by readers of this SIS either that the vegetation mapping contained herein is the only possible depiction of vegetation on the subject land or that there are no variations within the vegetation types which are depicted.

By way of example, two other depictions of vegetation on the subject land are available:

- that generated by Shoalhaven City Council (Figure 12A); and
- that prepared by the OEH as part of the vegetation mapping of southeastern NSW by Tozer<sup>5</sup> et al (2010) – as depicted in Figure 12B.

Neither of those vegetation maps provides the level of detail which characterises the SLR Ecology mapping of vegetation on the subject land at Culburra (Figures 11A and 11B), and neither has been ground-truthed. The most accurate depiction of the vegetation types on the subject land at Culburra is that presented in this SIS.

<sup>&</sup>lt;sup>5</sup> The authors of Tozer *et al* were employed by the then DECC – now relevantly the OEH – at the time of that *Report* 

# 5.2 Xeric Vegetation Communities

The xeric (dry) forest communities (Table 5.2) occupy the majority of the subject land at Long Bow Point (Figures 11A and 11B; Appendices M1, N and O) and the majority of the vegetated land in the Culburra West UEA.

Within the "*subject land*" on Long Bow Point, the xeric forest communities occupy the overwhelming majority of the areas proposed for the Culburra Golf Course (Figures 11A and 11B), covering most of the more elevated areas and slopes. The mesic and/or lacustrine communities are generally confined to narrow bands along the watercourses, and along the edges of Lake Wollumboola (Figure 13A; Table 5.3). Most of these areas are to be avoided by the proposal (Figures 14A and 14B).

Map Unit	Community Type	Comments
D1a	Grey Ironbark – Rough-barked Apple Open Forest	<ul> <li>Scattered distribution on mid to upper slopes</li> <li>In the northeastern part of the subject land, south of Culburra Road and on the southwestern slope of Long Bow Point</li> </ul>
D1b	Grey Ironbark – Woolybutt Open Forest	<ul> <li>Around the lower parts of Wattle Creek</li> <li>Generally on mid to lower slopes and flats adjacent to the swamp communities bordering Lake Wollumboola</li> <li>A slightly more 'mesic' variant of Community D1a</li> </ul>
D2	Bangalay Woodland/Open Forest	<ul> <li>Along the ridge and slopes in the west of Long Bow Point</li> <li>Limited to small patches on the ridgeline and lower slopes - adjacent to Wattle Creek</li> </ul>
D3	Blackbutt Open Forest	<ul> <li>Extensive distribution on mid to upper slopes</li> <li>Covers the eastern and western ends of Long Bow Point, and in the southwest of the subject land</li> </ul>
D4	Bangalay Woolybutt – Rough- barked Apple Open Forest	<ul> <li>At scattered locations on lower slopes</li> <li>Generally occurs adjacent to drainage lines and along the banks of Lake Wollumboola</li> </ul>
D5	Forest Red Gum Open Forest	<ul> <li>Mid slope locations</li> <li>A small patch at the southeastern and northeastern tips of Long Bow Point</li> </ul>
D6	Hard-leaved Scribbly Gum Woodland	<ul> <li>Generally on mid to upper slopes and plateaus</li> <li>Patches in the north, northwest (along Culburra Road) and in the southwest of the subject land</li> </ul>

# Table 5.2 Xeric forest communities on the subject land at Culburra

As noted above, the majority of the subject land at Long Bow Point, and virtually all of the "*subject site*", is characterised by xeric forest community types. Open forest dominated by the Blackbutt and/or the

Hard-leaved Scribbly Gum are characteristic of broad areas on Long Bow Point (Figure 11A), as well as large areas of other lands in the vicinity and locality (Figures 12A and 12B).

The xeric open forest communities on Long Bow Point are characterised by generally small to moderate sized trees, but there are patches where large hollow-bearing trees are common (see Chapter 6). The patchy distribution of hollow-bearing trees is doubtless a consequence of previous clearing of parts of the subject land (Appendix L), as well as the ongoing practice of timber harvesting which had occurred for a long period on Long Bow Point.

In most places, the open xeric forest has a scattered mid-storey and shrub layer, with a dense groundcover consisting of an array of native grasses, mat rushes, herbs and small shrubs (Appendices M1, N and O). There are, however, areas with a dense shrub layer – either of common native species (Tick Bush, tea-trees, wattles) or of introduced weeds (such as Lantana and Bitou Bush) – see Appendix M1.

As elsewhere on the subject land (and, indeed, generally), vegetation types or communities are not 'precise'. There are patches within any xeric community where one or other of the 'characteristic' tree species may be dominant. In addition, adjoining xeric vegetation types can merge across often broad ecotones. These variations are not considered of particular relevance for the biota considered in this SIS, although orchid surveys were concentrated in areas of vegetation regarded as of particular relevance, where required.

# Grey Ironbark - Rough-barked Apple Open Forest (Map Unit D1a)

This vegetation type is present in small to moderate patches on the subject land, intergrading with similar vegetation communities - including the Grey Ironbark - Woolybutt Forest/Open Forest downslope and Hard-leaved Scribbly Gum Woodland upslope (Figure 11A; Appendix N).

The canopy foliage projective cover (FPC) is 30% to 40%, with the canopy reaching a height of 20m, occasionally to 25m where mature trees exist. The mid-canopy layer is generally discontinuous, to 8m high where isolated mature examples exist or where extensive regeneration is occurring. The shrub layer is similarly discontinuous throughout much of the community. Where continuous stands exist, shrub species occur to 2.5m, and occasionally to 3.5m high. The herb layer consists of a mixture of hardy native species, with occasional exotic species.

Common canopy species are Grey Ironbark and Rough-barked Apple, with a number of other less common eucalypts – scattered or in patches. Mid-canopy species include Forest Oak, Black She-oak, Two-veined Hickory, Sweet Pittosporum, Prickly-leaved Paperbark and Narrow-leaved Geebung. Native shrub species include Tick Bush, Prickly Heath, Sweet Wattle, Tea-trees and Rice Flower.

The groundcover layer comprises a range of native grasses, sedges and vines, including Bordered Panic, Hedgehog Grass, Spear Grass, Bracken, Sword Sedge, *Poranthera microphylla*, Love Creeper, Mat Rush, Stinkweed and Apple Dumplings.

Weeds are generally uncommon, although patches of Lantana, Flaxleaf Fleabane and Bitou Bush are present along exposed edges of the community and along tracks.

# Grey Ironbark - Woolybutt Open Forest (Map Unit D1b)

This community is located in the northeastern part of the subject site, in the lower catchment of Wattle Creek (Figure 11A; Appendix N), adjacent to and above the swamp communities bordering Lake Wollumboola. It is a more mesic variant of the xeric community D1a.

The canopy has an FPC of 20% to 35%, and reaches a height of 20m, occasionally to 22m where mature trees exist. The canopy species are broad, upright and commonly single-trunked. The mid-canopy layer is discontinuous (typically 6 to 8m high) and the understorey is generally patchy, at a height of around 2m, but more commonly to 1.2m high. The groundcover is generally continuous, with indigenous grass and herb species to 1m high. Sedge and rush species are common in damper areas, with bracken occasionally forming dense monotypic stands.

Common canopy species are Grey Ironbark and Woolybutt, with occasional Swamp Oak. Characteristic mid-canopy species include Black She-oak, Sweet Pittosporum, Cherry Ballart, Forest Oak, Coffee Bush, Hickory, Prickly-leaved Paperbark and Two-veined Hickory.

Common shrub layer species include paperbarks, Prickly Heath, Sweet-scented Wattle, Prickly Moses, *Daviesia ulicifolia*, Sydney Golden Wattle, Rice Flower and Narrow-leaved Geebung. Typical groundcover species include Blue Flax Lily, Blady Grass, Bordered Panic, Weeping Meadow Grass, White Root, Wallaby Grass, Kidney Weed, Pomax, Sword Sedge, Tick Trefoil, *Poranthera microphylla*, Common Couch, Mat-rush and Bracken.

Native grass and fern species are regenerating along disturbed margins of this community (*eg* Blady Grass, Mat Rush and Bracken), with occasional exotic species (such as Paddy's Lucerne, Paspalum and Flaxleaf Fleabane). Weeds are generally confined to tracks and forest edges.

# Bangalay Woodland/Open Forest (Map Unit D2)

This community is limited to small patches on the upper slopes tin the northwestern part of Long Bow Point (Figure 11A; Appendix N).

The FPC is 25% to 35%, with trees up to 18m in height, occasionally to 20m. The majority of the canopy is of semi-mature individuals and juvenile specimens, with small numbers of mature trees scattered throughout. A discontinuous mid-canopy layer to 8m high is present along the Wattle Creek corridor. The understorey is open, to 2-4m in high. The groundcover is generally continuous throughout, and is composed of endemic species and occasional exotic species.

Common upper canopy species are Bangalay, with occasional Blackbutt, White Stringybark, Red Bloodwood, Hard-leaved Scribbly Gum, Woolybutt, Swamp Mahogany and Rough-barked Apple. Occasional mid-canopy species include Forest Oak, Hickory, Pittosporum, Hickory, Two-veined Hickory, Snow-in-Summer and Prickly-leaved Paperbark. Characteristic species where the mid-canopy layer is less disturbed are Tick Bush, Sweet Wattle, Broad-leaved Hakea, Hairpin Banksia, *Lomatia ilicifolia*, Tea-trees, Geebungs, *Gahnia* species and Prickly Moses.

Typical climbers and groundcover species include False Sarsaparilla, Blue Flax Lily, Common Couch, *Pratia purpurascens*, Guinea Flower, Bordered Panic, Fishbones, *Lindsaea microphylla, Eustrephus latifolius*, Hedgehog Grass, *Billardiera scandens*, Love Creepers, Common Silkpod, Weeping Meadow

Grass, Wallaby Grass, Blady Grass and *Xanthorrhoea* species. In damper sites, close to the drainage line, species include Basket Grass, *Gahnia sieberiana*, Commelina, Mat Rush and Maiden Hair Fern.

Common exotic species in disturbed areas include Paddys' Lucerne, Cat's Ears, Bitou Bush, *Sporobolus indicus* var. *capensis*, Quaking Grass, Trembling Grass, *Oxalis corniculata* and Plantago.

# Blackbutt Open Forest (Map Unit D3)

This community is the most extensive vegetation type on the subject land, generally occupying the midslopes and upper slope areas (Figure 11A; Appendix N).

The FPC is 25% to 40%, with trees to 25m in height, occasionally to 30m where mature specimens occur. The mid-canopy layer is generally discontinuous, with occasional dense pockets in more protected areas, typically 6m to 8m high. The understorey is patchy throughout, and 1-3m high. The groundcover is continuous throughout, with endemic grass and herb species to 0.5m high. Sedge and rush species are common in open areas adjacent to minor drainage features.

The community is generally dominated by the Blackbutt, with scattered or patchy Grey Ironbark, Red Bloodwood, White Stringybark, Bangalay, Swamp Mahogany, Rough-barked Apple, Grey Gum, Turpentine, Woolybutt and Hard-leaved Scribbly Gum. Common mid canopy species include *Acacia implexa*, Two-veined Hickory, Black She-oak, Sweet Pittosporum, Mock Olive, Snow-in-Summer and Narrow-leaved Geebung.

Typical shrub species include Tick Bush, Sydney Golden Wattle, Corkwood, Narrow-leaved Geebung, Cherry Ballart and Tea-tree. Common groundcover species include Weeping Meadow Grass, Mat Rush, Kangaroo Grass, *Gahnia sieberiana, Carex appressa,* Spear Grass, Hedgehog Grass, Wombat Berry, Stinkweed, Apple Berry, Blue Flax Lily, Wallaby Grass, Sword Sedge, Bracken and Pomax.

Common exotic species include Bitou Bush, Fireweed, Paddys' Lucerne, Paspalum, Common Centaury, Cat's Ears and Senna. These tend to be concentrated along tracks and in previously cleared areas, although Bitou Bush is common.

# Bangalay – Woolybutt – Rough-barked Apple Open Forest (Map Unit D4)

This community is restricted to the lower slopes around Long Bow Point (adjacent to Lake Wollumboola) and near Wattle Creek, as well as adjacent to the small tributary to Downs Creek in the southwest of the subject site (Figure 11A; Appendix N).

The FPC through this community is 20% to 35%, with trees generally to 18m in height, occasionally to 25m where mature specimens are present. The mid-canopy is generally patchy or discontinuous (and occasionally absent), typically to 3m high, and the understorey is also discontinuous, with occasional dense thickets of exotic species to 2.5m high. The groundcover is generally continuous, with endemic grass and herb species to 1m high.

Common tree species are Bangalay, Woolybutt and Swamp Oak, with occasional other eucalypts and the Rough-barked Apple. Common mid canopy species include Two-veined Hickory, Snow-in-Summer, Prickly-leaved Paperbark and Narrow-leaved Geebung.

Common shrub species include Tick Bush, Blackthorn, Native Olive, Prickly Heath and Cherry Ballart. Common groundcover species are *Brunoniella pumilio*, Blady Grass, Mat Rush, Weeping Meadow Grass, Blue Flax Lily, White Root, Saw Sedge, Common Couch, *Entolasia stricta*, Kangaroo Grass, *Viola hederacea*, Sword Sedge and Bracken. Characteristic climbing and twining species include Golden Guinea Flower, False Sarsaparilla, Silkpod, Wonga Wonga Vine and Apple Berry.

Bitou Bush and Lantana are scattered throughout this community, but do form dense thickets along the margins and in patches.

# Forest Red Gum Open Forest (Map Unit D5)

This vegetation type is confined to a small patch on the southeastern tip of Long Bow Point and a second small patch on its northeastern side (Figure 11A; Appendix N).

The FPC is 30% to 40%, with trees up to 25m in height, and occasional specimens to 30m. The midcanopy is generally patchy and typically 6-8m high, and the understorey is also patchy to 1.5m high. The groundcover is continuous, with endemic grass and herb species to 1.5m high.

The dominant tree species is the Forest Red Gum, with occasional Blackbutt, Rough-barked Apple, Woolybutt and other species. Common mid-canopy species include Two-veined Hickory, Narrow-leaved Geebung, Sweet Pittosporum and Black She-oak.

Common shrub species include Sydney Golden Wattle, Native Olive, Hairy Clerodendron and Blackthorn. Characteristic groundcover species include Blady Grass, Mat Rush, Hedgehog Grass, Bordered Panic, Kangaroo Grass, White Root, Blue Flax Lily and Bracken. Characteristic climbing and twining species include *Marsdenia rostrata*, Common Silkpod and Apple Berry.

Bitou Bush and Lantana are present as scattered individuals, and in dense localised patches in various parts of this community.

# Hard-leaved Scribbly Gum Woodland (Map Unit D6)

This vegetation type is present on the mid to upper slopes in the north and northwest of the subject land, and in an extensive band in the west of the subject land (Figure 11A; Appendix N).

The FPC is 30% to 40%, with trees growing 18m in height (with occasional individuals to 22m). The mid-canopy layer is generally sparse (typically to 6m high), but is locally dense, particularly near the watercourses. The understorey is generally continuous (to 3m in height), but more commonly to 1.5m high. The groundcover is also continuous, with endemic grass and herb species to 1.5m high, and sedge and rush species in damper sites.

The dominant tree species is the Hard-leaved Scribbly Gum, with occasional and patchy specimens of White Stringybark, Rough-barked Apple, Blackbutt and Red Bloodwood. Typical mid-canopy species include Black She-oak, Bushy Needlebush, Old Man Banksia and Finger Hakea.

The shrub layer is typically diverse, and common species include *Banksia oblongifolia*, *Pultenaea daphnoides*, Narrow-leaved Geebung, Hairpin Banksia, Broad-leaved Wedge-pea, Prickly Moses, Mountain Devil, Cone-sticks and Drumsticks. Characteristic groundcover species include Bracken,

Kangaroo Grass, Mat Rush, Blue Flax Lily, Rock Xanthosia, Silky Purple Flag, Sword Sedge and Milkmaids. The Large Tongue Orchid, Hyacinth Orchid and Hooded Orchid occur sporadically, and characteristic climbing species include Variable-leaved Goodenia, Snake Flower, False Sarsaparilla and Apple Berry.

Disturbed margins of this community generally harbour a few exotic species, and the regeneration of shrub layer species is commonplace along tracks and fire trails.

# 5.3 Mesic Vegetation Communities

The subject land also supports smaller areas of mesic vegetation types, predominantly associated with the watercourses and drainage features on the subject land (Table 5.3; Figures 11A and 11B; Appendices M1, N and O), including along Wattle and Downs Creeks - to the north and south of Long Bow Point.

The mesic forest communities, located along the lower elements of the landscape around Long Bow Point, are characterised by an array of mesic canopy species – particularly the Swamp Oak, Swamp Paperbark and several moisture-loving eucalypts (such as the Swamp Mahogany and Woollybutt).

However, because of the generally gentle slopes through the landscape at Long Bow Point, there are substantial areas of overlap (or ecotone) between the xeric and mesic vegetation types. Tree species (such as the Scribbly Gum and Blackbutt), which are generally typical of more xeric environments are also found in places in low-lying lands associated with moist soils.

In many places, the groundcover is particularly dense within these mesic vegetation types. In addition, there are large patches of dense midstorey and shrub layer species, and occasional dense patches of Lantana and Bitou Bush.

Map Unit	Community Type	Comments	'Floristic EEC'
M1a	Swamp Oak – Eucalypt Forest	On low-lying lands at the lower extremities of Downs Creek and Wattle Creek	SSFCF or REFCF
M1b	Eucalypt – Swamp Oak Forest	Regrowth on lower slopes to the south of Wattle Creek	SSFCF
M2a	Swamp Paperbark Closed Forest	On low-lying land along the lower parts of Wattle Creek	SSFCF
M2b	Swamp Paperbark – Swamp Oak Closed Shrubland/Closed Forest	Bands along the foreshores of the embayments to the south and north of Long Bow Point	SSFCF
M3	Swamp Oak Closed Forest	A narrow band around the edges of Lake Wollumboola and patches at the lower end of Wattle Creek	SOFF
M4	Swamp Mahogany Open Forest	Along the upper and middle parts of Downs Creek and the main Downs Creek tributary	SSFCF or REFCF

# Table 5.3 The mesic forest communities on and adjacent to the subject land at Culburra

'Floristic EEC' = the floristic equivalent EEC – but no EECs are present (see Chapters 5.7 and 8.5)

As indicated above (Tables 5.1 and 5.3), most of the mesic forest communities within the subject site (and throughout the study area) satisfy the floristic criteria of two "*endangered ecological communities*" (EECs) listed in the TSC Act. However, none of those areas of mesic vegetation are regarded as constituting EECs, as they are not located on, or "*associated with*", any "*coastal floodplains*" (see detailed discussion in Chapters 5.7 and 8.5).

# Swamp Oak – Eucalypt Open Forest (Map Unit M1a)

The Swamp Oak - Eucalypt Open Forest community (Map Unit M1a) is confined to predominantly lowlying land around the margins of the Downs Creek mudflats (above the Swamp Oak – Swamp Paperbark Closed Shrubland), as well as low-lying land along and adjacent to Wattle Creek (Figure 11A; Appendix N).

The FPC of this community is 25-35%, with trees to 8-14m high, and occasionally to 18m. A discontinuous mid-canopy layer of sclerophyllous and mesic tall shrub species is present - to 8m in height along the Downs Creek corridor, and the understorey is moderately dense (to 4m high). The groundcover stratum is generally continuous throughout.

Common canopy species include Swamp Oak, Bangalay, Woolybutt and Rough-barked Apple, with occasional specimens of other eucalypts (Appendix J). Mid-canopy species include Prickly-leaved Paperbark, Snow-in-Summer, Black She-oak and Two-veined Hickory.

Common understorey species include Sydney Golden Wattle, Rice Flower, Sweet-scented Wattle, Coffee Bush, Sandfly Zieria, Flaky-barked Tea-tree and Tick Bush. Common groundcover species include Blue Flax Lily, Mat Rush, Weeping Meadow Grass, Common Couch, Blady Grass, Kidney Weed, Lacy Wedge Fern and Bracken. Occasional specimens of Bare Twig Rush, Sea Rush and Warrigal Cabbage are present in more saline areas, and occasional climbing species include Love Creepers, Golden Guinea Flower, Scrambling Lily, Common Silkpod and Apple Berry.

Introduced species are not common, and include Paddy's Lucerne, Cat's Ears, Bitou Bush, Lantana, Fireweed, Slender Rat's Tail Grass, Winter Senna and Plantain.

# Eucalypt – Swamp Oak Forest (Map Unit M1b)

This variant of the community is located on lower slopes, above any 'floodplain' on the northern side of Long Bow Point (Figure 11A; Appendix N). It is an area which has been regenerating from previous clearing.

The floristic and structural characteristics of this vegetation type are similar to those of Map Unit M1a, with the Swamp Oak forming a dense upper canopy and numbers of regenerating eucalypts, as well as a few large remnant eucalypts. In this instance, the eucalypts are more dominant than in Map Unit M1a. Otherwise, the floristics are very similar.

# Swamp Paperbark Closed Forest (Map Unit M2a)

This community is present as a patch in the lower part of the Wattle Creek catchment and as a narrow band along parts of the Wollumboola shoreline (Figure 11A; Appendix N).

The FPC is between 60% and 90%, with a canopy height of 6-8m, occasionally to 12m in height. The canopy is discontinuous, although dense in areas, and the herb layer is generally dense, to 0.2m to 0.5m high, with many sedge and rush species.

The canopy is dominated by the Swamp Paperbark, with occasional specimens of Snow-in-Summer and Bottlebrush. Characteristic groundcover species include a range of native herbs, grasses and vines, such as Flax Lily, *Brunoniella pumilio*, Yellow Stars, Vanilla Lily, Mat Rush, Hedgehog Grass, *Billardiera scandens*, Silky Purple Flag, Kidney Weed, White Root, Bordered Panic, Wiry Panic and Kangaroo Grass.

Very few exotic species were recorded within this community.

# Swamp Paperbark – Swamp Oak Closed Shrubland (Map Unit M2b)

This community occurs as narrow bands along the foreshores of the embayments to the south and north of Long Bow Point, upslope of the Sea Rush – Twig Rush Herbland community and mudflats at those locations (Figure 11A; Appendix N).

The community is predominantly composed of dense Swamp Paperbark and Swamp Oak scrub - between 4m and 6m in height, occasionally to 8m where mature specimens exist. The FPC is between 60% to 80%, and there is an occasional lower shrub layer. The herb layer is generally dense (0.2 to 0.5m high), with sedge and rush species.

The canopy is dominated by Swamp Paperbark and Swamp Oak, with occasional specimens of Snowin-Summer, Bottlebrush and Paperbark Tea-tree.

Common groundcover species include Yellow Stars, Mat Rush, Native Violet, *Parsonsia straminea*, Vanilla Lily, Fringe Lily, Spear-grass, Kidney Weed and *Lepidosperma laterale*. In wetter areas, sedge and rush species present include Tassel Rush, Saw Sedge, White Root, *Restio tetraphyllus*, Common Rush and Round-headed Bristle Rush.

Very few exotic species were recorded within this community.

# Swamp Oak Closed Forest (Map Unit M3)

This community is restricted to a small band at the upper end of Wattle Creek and narrow bands around the Lake Wollumboola foreshore (Figure 11A; Appendix N). It is also patchily distributed within the Swamp Oak – Eucalypt Open Forest (M1a and M1b) and Swamp Paperbark – Swamp Oak Shrubland (M2b) communities.

The FPC is between 45% and 90%, with trees to 12-16m in height, and mature specimens to 20m high. The mid-canopy and shrub layers are generally absent, with only occasional native or dense thickets of

exotic species to 2.5m. The groundcover is patchy, and exotic groundcover species occur sporadically throughout.

The dominant (sometimes only) canopy species is the Swamp Oak, with occasional Woolybutt, Bangalay, Grey Ironbark and Rough-barked Apple. Mid-canopy and shrub layer species include Prickly-leaved Paperbark, Snow-in-Summer, Two-veined Hickory and Lillypilly, as well as Bearded Heath, Swamp Paperbark and Mutton-wood.

Characteristic groundcover species are Yellow Stars, Mat Rush, Flax Lily, *Lobelia alata*, Swamp Pennywort and Sword Sedge. Species in low-lying, slightly more saline, areas include Bare Twig Rush, *Leptinella longipes*, Salt Couch, Sea-blite, Sea Rush and Swamp Goodenia. Occasional climbing and trailing species are Common Silkpod, Common Milk Vine and Apple Berry.

Scattered introduced species include Paddy's Lucerne, Cat's Ears, Bitou Bush, Lantana, Rat's Tail Grass, Winter Senna and Plantago.

# Swamp Mahogany Open Forest (Map Unit M4)

This community occurs predominantly along the upper and middle parts of Downs Creek and its southern tributary, in the western part of the subject land and to its southwest (Figure 11A; Appendix N).

The FPC is 35% to 40%, with trees growing to 16 to 18m in height, occasionally to 20m. A continuous mid-canopy layer to 8m in height is present throughout this community. The understorey is generally dense, to 3m high, and the groundcover is generally continuous, composed of a mixture of hardy indigenous species and occasional exotic species.

Common canopy species are Swamp Mahogany, with occasional Woolybutt, Blackbutt, Bangalay and Rough-barked Apple. Where present, the mid-canopy comprises Forest Oak, Hickory, Pittosporum, Snow-in-Summer and Prickly-leaved Paperbark. Characteristic shrub species include Sweet Wattle, Broad-leaved Hakea, Hairpin Banksia, Geebungs, *Gahnia* and Prickly Moses.

Typical climbing and groundcover species include False Sarsaparilla, Blue Flax Lily, Guinea Flower, Fishbones, Lacy Wedge Fern, Wombat Berry, Common Silkpod, Weeping Meadow Grass and Blady Grass. In moister sites, mainly along the creeklines, species include Basket Grass, Saw Sedge, Scurvy Weed, Mat Rush and Maiden Hair Fern.

Common exotic species in disturbed sites include Paddy's Lucerne, Cat's Ears, Bitou Bush, Quaking Grass, Trembling Grass, Yellow Wood Sorrel and Plantago.

#### 5.4 Wetland Communities

Of the five wetland plant communities identified in the Culburra West UEA (Environmental InSites 2011), only two are present on the subject land on Long Bow Point or adjacent to it (Figures 11A and 11B; Appendices M1, M2, N and O; Table 5.4):

- the Sea Rush-Twig Rush Herbland which occurs as a band of variable width (depending on Lake levels) around Lake Wollumboola; and
- the Artificial Wetland/Sedgeland in and around a farm dam to the southwest of the subject land.

The mudflats at the end of Wattle and Downs Creeks, along the Lake Wollumboola foreshore (Figure 11B), which are of significance for an array of wading and wetland birds, are located below the Sea Rush-Twig Rush Herbland. Their nature and condition also vary considerably depending on the water depth in Lake Wollumboola, and they support a bed of algae at certain times – when water depths are suitable.

Map Unit	Community Type	Comments	'Floristic EEC'
W1b	Sea Rush-Twig Rush Herbland	This community occupies bands of variable width along the Lake Wollumboola shoreline	CSM
W4	Artificial Wetland/Sedgeland	Located in and around an artificial farm dam created on the small tributary in the southwestern part of the subject land	FWCF

 Table 5.4
 Wetland communities on and adjacent to the subject site at Culburra

'Floristic EEC' = the floristic equivalent EEC – but no EECs are present (see Chapters 5.7 and 8.5)

The Sea Rush-Twig Rush Herbland (Figures 11A and 11B) has been identified by Council's TSO as constituting the Coastal Saltmarsh (CSM) community – which is listed as an "*endangered ecological community*" (EEC) in the TSC Act.

However, as discussed in detail in Chapters 5.7 and 8.5, it is the opinion of the author of this SIS that the Coastal Saltmarsh EEC is not present in Lake Wollumboola - because there is no "*intertidal zone*" within the Lake. Even if there was an "*intertidal zone*", it would not coincide with the location of the Sea Rush-Twig Rush Herbland. In any case, this community will not be affected in any way by the Culburra Golf Course project.

As noted above, there is a small artificial farm dam (largely overgrown) along the southern tributary to Downs Creek – to the southeast of the subject land. This dam is located in a catchment which is mostly separate from the Culburra Golf Course. It constitutes the only freshwater wetland on the subject land, although there are a few ephemeral ponds in the lower reaches of Wattle Creek.

# Sea Rush-Twig Rush Herbland (Map Unit W1b)

The Sea Rush-Twig Rush Herbland occurs as a band of variable width around the edge of Lake Wollumboola at the entrance to Downs Creek and Wattle Creek (Figures 11A and 11B; Appendix N).

The extent of this Herbland is determined by the water level in Lake Wollumboola, as well as by the upper extent of the mudflats at these two locations, and by slight increases in elevation upslope – which generally support Swamp Oak forest or shrubland.

Characteristic species in this vegetation type include Bare Twig Rush, *Leptinella longipes*, Salt Couch, Sea-blite, Sea Rush and *Swamp Goodenia*. Some parts of this community – along the northern side of Copper Cup Point and the northeastern side of Long Bow Point – support extensive but narrow stands of the threatened Round-leaved Wilsonia *Wilsonia rotundifolia*.

Notwithstanding its floristic characteristics, this community is not part of the Coastal Saltmarsh (CSM) EEC, as discussed in Chapters 5.7 and 8.5 of this SIS.

# Artificial Wetland/Sedgeland (Map Unit W4)

This community is located in and around a farm dam which had been constructed along a tributary to Downs Creek, to the southwest of the subject land (Figures 11A and 11B; Appendix N).

The vegetation generally consists of semi-aquatic reed, sedge and rush species along the banks of the wetland, with occasional low herb species. In more elevated areas around the wetland, occasional patches of native shrub and regenerating tree species are present, generally less than 5m high, with a mixture of native and occasional exotic herb species.

Common aquatic and semi-aquatic sedge and rush species are Cumbungi, Jointed Twig Rush, Native Reed, Tall Spike Rush, Branching Rush, Common Rush and Woolly Frogsmouth. Along the margins, common native species are Blady Grass, Mat Rush, Bracken, Swamp Pennywort, *Lobelia alata*, Common Rush and Swamp Goodenia.

Occasional introduced species include Cat's Ears, Fireweed and Paspalum.

Shrub and tree species on adjacent slopes are Woolybutt, Hard-leaved Scribbly Gum, Grey Gum, Golden Spray and Sydney Golden Wattle.
#### 5.5 Cleared and Disturbed Land

Cleared and disturbed areas occur predominantly in the central parts of the Long Bow Point site and as smaller patches in previously cleared vegetation (Figure 11A; Appendix N).

In those areas that remain cleared and open, the canopy, mid-canopy and shrub layers have been removed, apart from small isolated patches of canopy and shrub species, with some occasional patchy regeneration. Other parts of the previously cleared lands have regenerated, with dense areas of Tick Bush and/or Tea-tree. The more open disturbed areas often have a groundcover layer composed of a mixture of native and introduced species, with the composition dependent on previous disturbance history.

Occasional canopy species include Rough-barked Apple, Grey Ironbark and Hard-leaved Scribbly Gum, and stands of native shrub species (particularly Tick Bush and Tea-tree) are becoming common. Native groundcover species include Weeping Meadow Grass, Kidney Weed, Love Creepers, Common Rush, Wallaby Grass, Browns' Love Grass and Common Couch.

Common exotic species in the groundcover layer include Perennial Rye Grass, Fireweed, Clover, Paddy's Lucerne, Cat's Ears, Plantain, Rats Tail Grass and Paspalum.

The occurrence of woody weed species is generally limited to adjacent vegetation communities, where disturbance along vegetation margins has enabled their penetration. Common species in some areas include Lantana and Bitou Bush, and occasional Blackberry.

#### 5.6 Plant Species

A total of 359 plant species have been recorded in the local survey area during the various field investigations (Appendix P), of which 60 are introduced species.

The floristic diversity on the subject land at Long Bow Point is typical of substantial tracts of land containing an array of native vegetation in the *Jervis Bay Regional Area*. It is also indicative of the number of different vegetation communities present and the range of physical characteristics across the site (such as a variety of soil types, drainage and topographic features, and land uses).

Of the 60 introduced flora species recorded on Long Bow Point, four are classified as noxious weed species in the *NSW Noxious Weeds Act 1993* (NW Act) for the Shoalhaven City LGA (Table 5.5):

- Fireweed is classified as a 'W3' category weed and should be "prevented from spreading and its numbers and distribution reduced" in accordance with the requirements of the NW Act;
- Blackberry and Bitou Bush are both classified as 'W2' weeds and should be "fully and continuously suppressed and destroyed"; and
- Prickly Pear is classified as a 'W4f' weed and should not be "sold, propagated or knowingly distributed". Furthermore, "any biological control or other control program directed by a local control authority must be implemented" for W4f weeds.

#### Table 5.5 Noxious weed species recorded on the subject site at Culburra

Scientific Name	Common Name	Code <sup>6</sup>
Rubus fruticosus species aggregate	Blackberry	W2
Chrysanthemoides monilifera	Bitou Bush	W2
Senecio madagascariensis	Fireweed	W3
<i>Opuntia</i> sp.	Prickly Pear	W4f

As discussed in Chapter 4, parts of the subject land had previously been cleared for grazing activities (Appendix L). Some of these areas, however, have regenerated either to a dense Tick Bush shrubland or to areas of regrowth eucalypts with a dense shrub understorey. Plant species diversity in these areas tends to be relatively low.

The types and locations of disturbance and/or weed infestation through the Culburra Golf Course land include:

- disturbance associated with existing (long-term) and previous tracks through the site, including soil compaction and erosion, plant loss and some areas of weed invasion;
- localised areas of weed invasion adjacent to cleared and otherwise disturbed lands;
- the modified vegetation and soils along and adjacent to Culburra Road;
- cleared and modified vegetation in the central part of Long Bow Point, and elsewhere on the subject site (see historical aerial photographs in Appendix L) - which had previously been used for agricultural and grazing purposes;
- the band of vegetation to be retained around Long Bow Point adjacent to Lake Wollumboola (Figure 3A). This area of vegetation (approximately 100m wide or more) has high levels of Bitou Bush infestation - presumably as a result of previous clearing activities along the foreshores of Lake Wollumboola and derived from high levels of Bitou Bush along the coast and around the Lake Wollumboola foreshores. In some places, the extent of invasion by Bitou Bush is greater than 100m from the edge of Lake Wollumboola, and a substantial management effort will be required to address that problem; and
- isolated patches of weeds along the watercourses through the subject site and around the edges of Lake Wollumboola - where there has been previous disturbance and subsequent weed invasion.

<sup>&</sup>lt;sup>6</sup> W2 The weed must be fully and continuously suppressed and destroyed.

W3 The weed must be prevented from spreading and its numbers and distribution reduced.

W4f The weed must not be sold, propagated or knowingly distributed. Any biological control or other control program directed by the local control authority must be implemented.

#### 5.7 Threatened Biota

# 5.7.1 Threatened Flora Species

No threatened species of flora listed in the *Threatened Species Conservation Act 1995* (TSC Act) have been recorded on those parts of the subject land which are to be developed for the Culburra Golf Course on Long Bow Point, during any investigations conducted by any ecologists (including the OEH and its predecessors) over the last two decades.

Similarly, there are no records of any threatened flora species (including those listed in the DGRs for this SIS) from other lands in the immediate vicinity (*eg* the Culburra West project site and the Culburra UEA lands) during any recent investigations (see SLR Ecology 2011, 2012, 2013a, b).

It is noted that the OEH is satisfied that the Culburra West project lands (to the near north) "are unlikely to support the predicted threatened orchid species" (including those identified in the DGRs for this SIS), and that the Culburra West site "is unlikely to be habitat for the threatened orchid species" considered. The Culburra Golf Course will occupy lands which are predominantly the same as those on the Culburra West project site – characterised by the same xeric vegetation types (in the main).

The only threatened plant which has been recorded on or adjacent to Long Bow Point is the Roundleaved Wilsonia *Wilsonia rotundifolia*. This species was recorded in moderately extensive, but narrow, bands along the northern side of Copper Cup Point (to the south of Long Bow Point) and around the eastern and northeastern aspects of Long Bow Point (Figure 13B). This species occurs in areas which are occasionally inundated when Lake Wollumboola is full, but will not be affected by any activities associated with the Culburra Golf Course.

# 5.7.2 Endangered Ecological Communities

Of the fifteen native plant communities which have been identified and mapped within the subject land at Culburra (Figure 11A; Table 5.1), seven possess the floristic characteristics of five "*endangered ecological communities*" (EECs) listed in the TSC Act (Figure 13A; Table 5.5). All of these are mesic or wetland vegetation types.

The 'Floristic EECs' located within or immediately adjacent to the subject land (Figure 13A) include, or potentially include:

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SSFCF);
- River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (REFCF);
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SOFF);
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions (CSM); and
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (FWCF).

The vegetation types that conform (floristically at least) to those "*endangered ecological communities*" (EECs) are located (Figure 13A) either around the periphery of the subject land (along the Lake Wollumboola foreshore) or along the watercourses within parts of the subject site (particularly along Downs Creek and its tributary, and in the lower parts of the Wattle Creek catchment).

None of the drier forest communities are listed as an EEC in the TSC Act, although the DGRs do include several such xeric EECs (as discussed in detail in Chapter 8.5).

Map Unit	Endangered Ecological Community	
M1a, M2a, M2b, M4	Swamp Sclerophyll Forest on Coastal Floodplains	SSFCF
	River-flat Eucalypt Forest on Coastal Floodplains	REFCF
M3	Swamp Oak Floodplain Forest	SOFF
W1b	Coastal Saltmarsh	CSM
W4	Freshwater Wetlands on Coastal Floodplains	FWCF

Table 5.5	'Floristic EECs' recorded on or around Long Bow Point

# Coastal Floodplain Communities

Some of the mesic forest communities on the subject site at Culburra have the floristic characteristics of several "*endangered ecological communities*" (EECs), as identified in Tables 5.3 and 5.5. However, none of those mesic communities satisfy all of the necessary criteria contained within the *Final Determinations* for those EECs. In particular, none of those vegetation communities are located on a "*coastal floodplain*" (see Chapter 8.5 for further details).

Neither Downs Creek nor Wattle Creek possess the topographic or geomorphological features which are characteristic of a *"floodplain"* – notwithstanding the occasional flooding of parts of their lower reaches. The fact that a piece of land may occasionally become flooded does not mean that it is therefore a *"floodplain"*.

Although swampy in places, and occasionally flooded, the low-lying lower reaches of Downs Creek and Wattle Creek do not constitute *"floodplains"*.

Similarly, the foreshores of Lake Wollumboola do not constitute *"floodplains"*. Therefore, the Swamp Oak Forest that fringes parts of Lake Wollumboola is not the Swamp Oak Floodplain Forest EEC.

#### Other Wetland EECs

There are two other vegetation types on or near the subject land which have the floristic characteristics of two additional EECs (Table 5.5; Figure 11A):

• the artificial farm dam to the southwest of the subject land - which contains plant species

and features typical of the Freshwater Wetlands on Coastal Floodplains (FWCF) community, notwithstanding that the dam is entirely artificial; and

• the Sea Rush-Twig Rush Herbland located around the Lake margins at the entrances of Downs and Wattle Creeks and in patches around Long Bow Point – which has been identified by Council's TSO as an example of the Coastal Saltmarsh (CSM) community.

It is the opinion of the author of this SIS, however, that neither of those EECs are present (see detailed discussion in Chapter 8.5). In any case, neither vegetation type is to be affected by the proposed Culburra Golf Course.

# 6 FAUNA and FAUNA HABITATS

#### 6.1 Fauna Habitats

The diversity of vegetation types on and around the Long Bow Point subject land and 'survey area', and within the subject site for the proposed Culburra Golf Course (Figure 11A; Appendices M1, M2, N and O), provides a range of habitats and resources for native fauna species.

Four broad fauna habitat types are present on and around the subject land at Culburra:

- open forest and woodland which occupy the majority of the subject site, including areas
  of regenerating sclerophyll forest and woodland, with canopy trees, hollow-bearing trees
  and a variable flowering understorey;
- riparian habitats with moist elements (depressions, rotting logs, ponds, dense understorey *etc*);
- aquatic and lacustrine habitats associated with Downs Creek and its tributaries, Wattle Creek and Lake Wollumboola; and
- cleared areas supporting mostly grasses (native and introduced) and regenerating shrubs and small trees, located mostly in the central part of the subject land.

Much of the vegetation on the subject land displays only relatively low levels of disturbance (other than the substantial cleared area in the centre of the subject land and the various tracks created through it). It is noted, however, that the area of clearing on the subject land had previously been much greater (Appendix L), and the long-term low-level timber harvesting has resulted in a relatively low abundance of hollow-bearing trees throughout many parts of the subject land. In addition, the subject land has long been used for grazing purposes, and there are areas with high densities of Bitou Bush, Lantana and other weed infestations – particularly around the periphery of Lake Wollumboola.

#### 6.1.1 Forest and Woodland Habitats and Resources

The open forest and woodland across the majority of the subject land at Culburra provides an array of habitats and resources for a variety of native fauna species. It is also to be noted, however, that these resources and habitat types are abundant throughout the study area and general locality (Figures 1, 6 and 7A-7C), and are not confined to the subject land.

The canopy of the forest and woodland vegetation provides foraging and nesting resources for a range of native arboreal mammal (*eg* gliders and possums) and a wide array of bird species. The canopy also provides foraging habitat for microchiropteran bat species that hunt for insects while flying above, through or just below the canopy, and may also provide some foraging habitat for the larger Greyheaded Flying Fox (which forages on fruits and blossoms within the canopy). Stands of Forest Oak and Black She-oak in more elevated parts of the land provide foraging resources for the Glossy Black Cockatoo, and the canopy may also provide roosting habitat for forest owls.

Tree-hollows, ranging in size from small holes along limbs to large hollows in senescent trees (and scattered stags), are distributed throughout the woodland and open forest communities (Figure 15; Appendix Q). These resources tend to be patchy - because of the previous clearing of parts of the land

and its use for timber harvesting. Trunk and limb hollows are utilised by arboreal mammals and a range of birds for nesting, and many microchiropteran bats also utilise tree-hollows for roosting.

The mid-canopy and shrub layer of the forest and woodland, where present, provide resources for a range of native mammal, bird and reptile species. Small terrestrial mammals (*eg* bandicoots, native rats and dasyurids) would shelter, forage and nest amongst the underground layer, while small cryptic birds (*eg* thornbills, wrens and gerygones) forage and nest in the dense mid-canopy and shrub layers. Several native lizard species (*eg* skinks) also utilise this habitat for shelter and foraging.

The composition of the groundcover varies throughout the forest and woodland of the subject land, and includes areas of dense leaf litter, woody debris, vegetation and bare earth. Such resources provide habitat for native herpetofauna (*eg* skinks, dragons and frogs), including shelter and foraging resources. Large terrestrial mammals (*eg* kangaroos and wallabies) would forage amongst the native grasses and shrubs. These species are also commonly found in open grassland or cleared and disturbed areas in the study area.

The native fauna on the subject land (including small mammals, birds, reptiles and frogs) also constitute prey for carnivorous species, both native species (such as the Powerful and Masked Owls), and introduced species (*ie* the Fox, Dog and Feral Cat).

The subject land also contains an array of mesic forest types and vegetation communities. These are predominantly located along the lower parts of the Downs Creek and Wattle Creek catchments, and (with the exception of the minor crossing of Downs Creek for golf buggy and maintenance access) are located beyond any proposed development activity.

The mesic communities do not generally provide any particular additional habitat features or resources for native biota, although there is a greater density of groundcover and lower vegetative strata, which are relevant for a number of native fauna. Moist soils may also (theoretically at least) be of relevance for several of the threatened orchids. Features of particular potential significance are generally confined to the watercourses themselves, swamp and flooded areas, and associated features.

As noted elsewhere in this SIS, much of the subject land had either been previously cleared (see historical photographs in Appendix L) or had been used for timber harvesting over an extended period. There are many large cut stumps through the land, and large hollow-bearing trees (particularly those containing the very large hollows necessary for breeding by species such as the Glossy Black Cockatoo, Powerful Owl and Masked Owl) are only patchily distributed, and are not abundant.

# 6.1.2 Riparian Habitats

Riparian habitats (Figures 11A, 11B and 13A; Appendix M1) are confined to narrow bands of vegetation along Downs Creek and its minor tributary (to the southwest) and along Wattle Creek (in the northeastern part of the subject land). Whilst there is some change in vegetation (both floristically and structurally) between the xeric vegetation types upslope and the riparian vegetation types, the generally narrow widths of these bands of riparian vegetation and the nature of the subject land means that riparian habitats *per se* do not generally provide particularly specialised or different habitats or resources for native biota.

Nevertheless, riparian vegetation and mesic communities have been substantially avoided in the Culburra Golf Course design, other than for the single narrow golf cart crossing of Downs Creek

(Figure 3B; Appendix C1). The alignment of the access to the bridge, and the bridge itself, is to be used also for access during construction activities for Holes 13 and 14. That temporary access will be provided under the supervision of a project ecologist, and full rehabilitation of any adjoining vegetation will be included as part of the CEMP and VMP (see Chapter 2.3).

There are only very limited areas of riparian vegetation and habitats along Wattle Creek (in the northeastern part of the site), although there are broad areas of swampy vegetation in the lower parts of the catchment. Virtually all elements of the Culburra Golf Course have been excluded from the more mesic vegetation along Downs Creek and Wattle Creek (Figures 3A, 13A and 14B).

# 6.1.3 Aquatic and Lacustrine Habitats

Aquatic and lacustrine habitats are located primarily along the lower parts of Downs Creek and its tributaries (in the southwest of the site), in the lower parts of Wattle Creek (in the northeast), as well as in and around Lake Wollumboola (Figure 2).

Temporary swamps and wetlands are present in the lower parts of Wattle Creek, and there is a single farm dam located in the southeastern part of the site, along a tributary to Downs Creek. These features provide habitats for an array of native fauna species (including amphibians, mammals and birds).

The lacustrine habitats in and around Lake Wollumboola are of particular conservation value and significance, because of the significant array of aquatic and wading wetland birds that utilise this feature. The Lake itself provides habitat for a significant array of wetland birds (the Black Swan, an array of ducks and cormorants, grebes and species such as the Darter). It is to be noted, however, that whilst these species are often in abundance on Lake Wollumboola, the subject site itself (*ie* the area proposed for the Culburra Golf Course) provides no habitat for such species.

The shallows and mudflats at the ends of both Downs Creek and Wattle Creek (Appendix M2) also provide extensive habitat for those bird species that utilise mudflats and wading environments. An array of herons, dotterels, stilts, egrets and other such species would regularly utilise those resources, with different suites of species present depending on water depths and seasons.

The immediate shoreline below the 'drop-off' at the end of Long Bow Point (approximately 4m to 6m below the plateau of Long Bow Point) predominantly contains narrow areas of mudflats and/or exposed rock (Appendix M1), which would also provide habitat for wetland and wading species typical of lake foreshores and lacustrine habitats. The recent low Lake level has exposed more extensive areas of mudflats (Appendix M2).

None of the species which rely on aquatic and/or lacustrine habitats are of any relevance to the proposed 18-hole golf course on Long Bow Point at Culburra. The "*subject site*" currently provides no habitat of relevance to any such species. Conversely, the Culburra Golf Course will provide some features (detention basins and the irrigation lake) that may be utilised by some of those species. The Golf Course will thus provide a nett environmental benefit in this regard (see Chapter 12 of this SIS).

As discussed elsewhere in this SIS, the Culburra Golf Course is located at some considerable distance (generally more than 100 metres) from the Lake Wollumboola shoreline (Figure 3A), and there will be a retained and rehabilitated vegetation buffer between any element of the Golf Course and the Lake (see Chapter 12). Further, as discussed elsewhere in this SIS, the stormwater management regime has been designed specifically *inter alia* to avoid the potential for any adverse impacts to be imposed upon

Lake Wollumboola by virtue of water flows or water quality, and species which are reliant upon those habitats will therefore not be affected by the proposal.

# 6.1.4 Cleared Land

The areas of cleared land on Long Bow Point, whilst not constituting a significant habitat or resource for native biota, would nevertheless be utilised by a range of species which are characteristic either of open grasslands or of the interface between woodland habitats and open grasslands.

This habitat type, whilst being artificial, currently provides resources for granivorous and insectivorous bird species, and also provides foraging resources for kangaroos, wallabies and bandicoots.

The Culburra Golf Course development will provide additional areas of both introduced grasslands (along fairways and on greens) and native grasslands (on rehabilitated earthworks areas). These open grasslands will provide additional resources for macropods, bandicoots, some raptores and several parrot species, and possibly also for the Scarlet Robin.

#### 6.2 Fauna Assemblage

A total of 153 vertebrate fauna species have been recorded during the various field investigations within the subject land and the Culburra West UEA, including 103 birds, 34 mammals, 10 amphibians and 6 reptiles (Appendix R).

A further 77 species have been recorded within the subject lands or in the immediate vicinity, during previous investigations (see Chapter 3) - including 72 birds, 1 mammal, 1 amphibian and 3 reptiles (Appendix R). A total of 11 introduced fauna species have also been recorded during the fauna investigations.

The diversity of fauna species recorded reflects the array of habitats and resources within the survey area (including Lake Wollumboola, the Crookhaven River and the Tasman Sea), and the structural and floristic diversity of the vegetation present. It is also reflective of the substantial area of vegetation and habitats present on the subject land and in the survey area.

#### 6.2.1 Birds

The avifauna recorded within the subject land and survey area (Appendix R) consists of an array of waterbird species (whose habitat preferences are largely coastal and/or lacustrine) and of species which utilise areas of coastal woodland and heath in the region.

The species recorded reflect the variety of foraging resources (such as insects and other invertebrates, seeds, fruit, nectar, sap, lerps on eucalypt leaves, manna and small vertebrates) and nesting habitats (such as hollow-bearing trees, dense shrub layer and heathland) present within the subject lands.

Four broad guilds of birds (based on foraging and habitat requirements) were identified during the surveys, including:

- waterbirds which forage in or along the margins of lakes, lagoons, estuaries or shallow ponds, and which may nest along beaches, embayments or on rocky cliffs (*eg* cormorants, herons, dotterels, terns, ducks, the Black Swan and the Purple Swamp Hen);
- large and more aggressive species which prey on vertebrates and large invertebrates, and often cover large distances while foraging (*eg* the Powerful Owl, Square-tailed Kite, Southern Boobook, Kookaburra). These birds generally have large home ranges;
- granivorous and nectarivorous species which utilise forests and woodlands (*eg* the Crimson Rosella, Glossy Black Cockatoo, Rainbow Lorikeet and honeyeaters); and
- smaller and more cryptic birds which utilise dense shrubs and mid-storey vegetation for shelter and/or the tree canopy (*eg* the Eastern Yellow Robin, Eastern Whipbird, Brown Thornbill and Golden Whistler).

A number of threatened bird species have been recorded within the subject site and/or in the vicinity during the current and previous field surveys. The conservation significance of the subject site with respect to these threatened bird species is discussed in further detail in Chapter 6.3.

The aquatic bird species which utilise Lake Wollumboola (*eg* the Black Swan, ducks, cormorants, Australasian and Little Grebes) are not addressed in any particular detail - because the Culburra Golf Course project will not affect such species to any significant extent, if at all.

Any impact from the Golf Course on the ecosystems and habitats in Lake Wollumboola would be negligible (given the separation of the Golf Course from the Lake), even if the extremely high standards for water quality discharges (Martens 2015; Appendix D1) were not achieved. The Golf Course constitutes only negligible portion of the Lake Wollumboola catchment (se Chapter 10).

Wading species (such as the stilts, herons and egrets) are similarly of no relevance (although, as noted above, the detention basins and irrigation lake on the Golf Course will provide additional and/or supplementary habitat for a number of such species).

As discussed elsewhere, the Culburra Golf Course project does not involve any activities in or even in close proximity to the Lake. The Golf Course will be separated from Lake Wollumboola by a 100+ metre forested buffer, and the project does not propose any access to the Lake at Long Bow Point (as discussed in further detail in Chapters 10 and 12).

# 6.2.2 Reptiles

The reptile species which have been recorded on the subject land and in its vicinity during the current and previous field surveys (Appendix R) are generally widespread and abundant in distribution, and have been recorded from a wide variety of habitats throughout the Jervis Bay region. It is likely that a range of other reptiles could occur on the subject land, given the understorey vegetation, the variety of substrates and habitats, and the depth of the leaf litter in places.

No threatened reptile species have been recorded within the subject land, and none are considered likely to occur - given the habitats and resources present. There is no suitable habitat present for Rosenberg's Goanna on the subject land at Culburra. There are no termite mounds present (which provide both food and shelter for Rosenberg's Goanna), and there have been no records of this species in the locality or vicinity.

#### 6.2.3 Amphibians

An array of amphibian species have been recorded on the subject land and in the vicinity during the current and previous field investigations (Appendix R). Of these, the majority are common and widespread, and utilise a wide array of ponds, dams and other moist habitats.

One threatened amphibian species has been identified on the subject land - the Green & Golden Bell Frog (listed as "*Vulnerable*" in the TSC Act) - which was recorded in the farm dam in the southwestern part of the subject site in 1994 (Figure 16A). One individual male Green & Golden Bell Frog was recorded in aquatic vegetation surrounding the dam but, despite dedicated searches for this species at the dam and elsewhere on the subject land then and since, no other individuals have been recorded.

The conservation significance of the Green & Golden Bell Frog, and its relevance for the Culburra Golf Course project, is discussed in detail in Chapter 7 of this SIS.

# 6.2.4 Mammals

The variety of habitats and resources within the subject land support (or potentially support) an array of mammal species, with a total of twenty-eight native and seven introduced mammal species having been recorded in the study area during the current and previous field investigations (Appendix R). Of the native species identified, five species utilise arboreal habitats, seven are predominantly terrestrial and sixteen are aerial species.

The open forest and woodland communities provide habitats and resources for arboreal mammal species, such as the Common Brushtail Possum, Common Ringtail Possum, Yellow-bellied Glider and Sugar Glider. These arboreal marsupials, frequently recorded throughout the forested areas in the region, utilise tree-hollows as dens, and exhibit varying tolerances to disturbance.

One threatened arboreal mammal species, the Yellow-bellied Glider (listed as "*Vulnerable*" in the TSC Act), was apparently recorded to the southwest of the subject site during the field investigations in the early 1990s, and at the end of Long Bow Point in 1990 and 2001 (Figure 16B). It was also recorded on Long Bow Point in 2013 (Figure 16A) – in the forested 'buffer' between Hole 1 and Lake Wollumboola. Suitable habitat is available on the subject land (and the subject site), although the species has only been recorded at the end of Long Bow Point.

Large macropods, including the Eastern Grey Kangaroo and Swamp Wallaby, are recorded regularly on the subject land. These species graze on the grasses and understorey species of forests and woodlands of southeastern Australia. Small mammals, such as the Long-nosed Bandicoot, Brown Antechinus and Bush Rat, have also been recorded on the land or in the general vicinity. Such species are common terrestrial residents of bushland in the locality and are relatively disturbance tolerant, often utilising resources in the vicinity of residential development.

The Grey-headed Flying Fox has been recorded on a single occasion utilising the canopy resources on the subject land at Long Bow Point. Whilst individuals of this species may forage on occasions on forest vegetation within the subject land, there is no indication that Long Bow Point is of any particular relevance for the Grey-headed Flying Fox. There is no 'camp' of the Grey-headed Flying Fox at Long Bow Point or in its immediate vicinity.

There are a number of microchiropteran bats which have been recorded, both on the subject land and in the general locality, during the array of investigations which have been undertaken to date (see Chapter 3; Appendices G and H). These include both threatened and non-threatened microchiropteran bat species (Appendix R).

The relevant resources for microchiropteran bats on the subject land at Culburra include both foraging habitat (predominantly the tree canopy) and roosting habitat (the tree-hollows present on the site). There are no caves or cliffs, and there is therefore no preferred roosting habitat for species such as the Common Bent-wing Bat and Large-footed Myotis, although it is acknowledged that both species occasionally do roost in tree-hollows.

Seven introduced mammal species have been recorded in the study area, reflecting the proximity of the subject land to urban development. The presence of two introduced predators (*ie* the Cat and Fox) potentially reduces the value of the subject land for native fauna to some degree, particularly for terrestrial fauna.

#### 6.3 Threatened Biota

Eleven threatened fauna species were recorded on the subject land during the current field surveys for this SIS, and three additional species were recorded nearby (Appendix R; Table 6.1).

In total, twenty-one threatened bird species, ten threatened mammal species and one threatened amphibian have been recorded from the subject land or in the vicinity in the past (Table 6.1; Figures 16A and 16B), including twelve threatened birds that would be associated entirely or substantially with Lake Wollumboola – and NOT with Culburra Golf Course site (see Appendices R and S).

With the exception of the Little Tern and the Green & Golden Bell Frog, these species are all listed as "*Vulnerable*" in Schedule 2 of the TSC Act. The Little Tern and the Green & Golden Bell Frog are listed as "*Endangered*" in Schedule 1 of the TSC Act.

A large number of the threatened species recorded immediately adjacent to or near the subject land during the current and previous surveys (Chapter 3; Table 6.1) are waterbirds, some of which are migratory. These species utilise the coastal habitats of Lake Wollumboola, Culburra Beach and the Crookhaven River (Appendix S).

Many of these species (the Black-tailed Godwit, Great Knot, Sanderling, and Greater and Lesser Sand Plovers) forage on the mudflats or shallow waters of estuaries, lagoons, brackish swamps and ponds, and nest or roost in nearby coastal vegetation, on beaches or behind dunes. Others (such as the Little Tern, Pied Oystercatcher and Sooty Oystercatcher) generally utilise beach habitats, but could also use Lake Wollumboola and/or its margins at appropriate water levels.

None of these species are of relevance to the proposal at Culburra. The proposed Culburra Golf Course project does not involve activities in or near Lake Wollumboola, and the habitats for those threatened bird species which utilise either the waters of the Lake or the Lake shores will not be affected by the proposal.

Furthermore, the water management regime for the Golf Course is designed specifically *inter alia* to ensure that there will be no adverse impacts on the water quality or flows into Lake Wollumboola (see Chapters 10 and 12; Appendices D1 and D2). Given those circumstances, the wetland and wading birds in Table 6.1 are not regarded as any relevance for the proposed Golf Course on Long Bow Point.

Foraging habitats for these species are not present in the relevant parts of the subject land, being located on or beyond the eastern boundary of the land, on the tidal flats and foreshores of Lake Wollumboola. Further, the Culburra Golf Course will create potential habitat for such species – in the detention basins and the irrigation lake for the project (see Chapter 12).

Given the presence of relevant resources and habitat features on the subject land, it is possible (indeed likely) that individuals of a number of other threatened species could also potentially occur within the subject land on occasions. The DGRs list several additional threatened fauna species which need to be considered (see Chapters 7 and 8), but none of these additional species are of any relevance to the Culburra Golf Course SIS.

The majority of the threatened species recorded on the subject land or on adjacent land (see *Bibliography*; Chapter 3) utilise woodland and forest environments – see Chapters 7 and 8 of this SIS.

# **Table 6.1**The relevance of threatened fauna species that have been recorded on the subject land<br/>or in the vicinity during the current and previous field investigations

Common Name	Scientific Name	TSC	Habitat	Relevance	
Birds					
Australasian Bittern	Botaurus poiciloptilus	V	Wetland edges	Marginal	
Black-tailed Godwit	Limosa limosa	V	Coastal/Estuarine	None	
Great Knot	Calidris tenuirostris	V	Coastal/Estuarine	None	
Sanderling	Calidris alba	V	Coastal/Estuarine	None	
Pied Oystercatcher	Haematopus longirostris	V	Coastal/Estuarine	None	
Sooty Oystercatcher	Haematopus fuliginosus	V	Coastal/Estuarine	None	
Lesser Sand Plover	Charadrius mongolus	V	Coastal/Estuarine	None	
Greater Sand Plover	Charadrius leschenaultia	V	Coastal/Estuarine	None	
Little Tern	Sterna albifrons	Е	Coastal	None	
Square-tailed Kite	Lophoictinia isura	V	Woodland/Forest	Yes	
Glossy Black Cockatoo	Calyptorhynchus lathami	V	Woodland/Forest	Yes	
Gang Gang Cockatoo	Callocephalon fimbriatum	V	Woodland/Forest	Likely	
Powerful Owl	Ninox strenua	V	Woodland/Forest	Yes	
Masked Owl	Tyto novaehollandiae	V	Woodland/Forest	Potential	
Little Eagle	Hieraaetus morphnoides	V	Woodland/Forest	Marginal	
Osprey	Pandion haliaetus	V	Coastal/Estuarine	None	
Eastern Curlew	Numenius madagascariensis	V	Coastal/Estuarine	None	
Sooty Owl	Tyto tenebricosa	V	Woodland/Forest	Potential	
White-fronted Chat	Epthianura albifrons	V	Heath/Saltmarsh	None	
Varied Sittella	Daphoenositta chrysoptera	V	Woodland/Forest	Potential	
Scarlet Robin	Petroica boodang	V	Woodland/Forest	Potential	
Mammals					
Yellow-bellied Glider	Petaurus australis	V	Woodland/Forest	Yes	
East-coast Freetail Bat	Micronomus norfolkensis	V	Woodland/Forest	Yes	
Common Bent-wing Bat	Miniopterus schreibersii	V	Woodland/Forest	Yes	
Little Bent-wing Bat	Miniopterus australis	V	Woodland/Forest	Yes	
Eastern False Pipistrelle	Falsistrellus tasmaniensis	V	Woodland/Forest	Yes	
Large-footed Myotis Myotis adversus		V	Riparian/Pools	Yes	
Greater Broad-nosed Bat	Scoteanax rueppellii	V	Woodland/Forest	Yes	
Yellow-bellied Sheath-tail Bat	Saccolaimus flaviventris	V	Woodland/Forest	Likely	
Grey-headed Flying Fox	Pteropus poliocephalus	V	Woodland/Forest	Potential	
Eastern Free-tail Bat	Mormopterus norfolkensis	V	Woodland/Forest	Yes	
Amphibians					
Green & Golden Bell Frog	Litoria aurea	E	Freshwater Ponds	None	

# 7 POTENTIAL THREATENED BIOTA - 'SUBJECT SPECIES'

# 7.1 Introduction and Scope

# 7.1.1 Matters to be Addressed

Section 110(2)(a) of the TSC Act requires an SIS to include a:

"general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action".

Similarly, Section 110(3)(a) of the TSC Act requires an SIS to include:

"a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action".

The DGRs for the SIS detail matters to be considered in addressing Section 110(2)(a) and Section 110(3)(a) of the TSC Act, and provide advice for identifying the relevant "*subject species*"<sup>7</sup> for the project (Appendix A).

A "general description" or initial consideration of the "subject species", on the basis of their habitat requirements, is provided in this Chapter of the SIS. A more detailed assessment and analysis of the "subject species", and a determination of those biota that are considered of actual relevance to the Cublurra Golf Course project, is provided in Chapter 8 of the SIS.

# 7.1.2 Subject Species and Endangered Ecological Communities

The DGRs provide a list (Table 1 of DGRs) of 65 "threatened species" (11 plant species and 54 fauna species) and 7 "endangered ecological communities" which "must be considered for inclusion in the list of subject species" (Table 7.1). These 'entities' are defined by the DGRs as "those threatened species, populations and ecological communities that **are known** or **considered likely** to occur in the **study area**".

As noted in Chapter 1.5, the "study area" is defined in the DGRs as "the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. The study area should extend as far as is necessary to take all potential impacts into account".

With respect to the "*study area*" as defined by the OEH, there is no likelihood of significant adverse impacts, if indeed any measurable adverse impacts, being imposed upon Lake Wollumboola or any of the ecosystems and/or native biota which are dependent upon it.

As discussed elsewhere in this SIS, the Culburra Golf Course proposal involves an array of measures which have been incorporated to its design, and which will be implemented during its construction, to ensure that adverse impacts upon the natural environment (including particularly Lake Wollumboola and its associated ecosystems) are negligible or non-existent.

<sup>&</sup>lt;sup>7</sup> The term "*subject species*" includes both "*species*" and "*endangered ecological communities*" – pursuant to Table 1 of the DGRs (except where otherwise described in this SIS).

Furthermore, the Culburra Golf Course project will involve the implementation of a comprehensive stormwater management regime (Martens Consulting Engineers – Appendix D1) and a comprehensive *Culburra Golf Course Plan of Management* (Golf by Design – Appendix D2). Both of these elements of the Golf Course project are designed specifically inter alia to ensure that no adverse impacts are imposed upon Lake Wollumboola or its associated watercourses, ecosystems and wildlife, as a result of any possible direct and/or indirect effects of the project.

As a consequence of those considerations, there is no likelihood that the Culburra Golf Course project, as currently designed and proposed, would involve the imposition of significant (if any) adverse impacts upon water quality or water flow regimes into Lake Wollumboola and/or its associated watercourses.

It is to be noted that the "*subject species … and ecological communities*" which have been identified in the DGRs (Table 7.1) are not restricted to those threatened species or endangered ecological communities that are likely to be (or could even conceivably be) "*affected by the action*" – being the Culburra Golf Course proposed on Long Bow Point.

As a consequence, the list of "*subject species*" contained in the DGRs and in Table 7.1 includes a significant number of threatened biota that are not, in fact, of relevance to this SIS (see Chapter 8).

For example:

- there is no possibility of the Culburra Golf Course project having any effect at all, under any circumstances, on the Little Shearwater or the Little Tern; and
- there is no vegetation present on the subject land or nearby which could conceivably constitute Littoral Rainforest or Illawarra Lowlands Grassy Woodland.

The DGRs state that "One of the roles of a SIS is to determine which species, populations or ecological communities may be utilising, or present, on a development site".

This Chapter of the SIS (Chapter 7) identifies all of the threatened biota that are or could be (according *inter alia* to the DGRs) relevant to the proposal on Long Bow Point – the "*subject species*".

Chapter 8 determines which of those threatened biota are "*likely to be affected*", and which therefore are the biota of actual relevance to this SIS – the "*relevant*" (or "*affected*") species.

As indicated above, the list provided in the DGRs includes:

- some threatened species "which are known or considered likely to occur in the study area" or are "known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action";
- many threatened species which occupy habitats which are either not present in the "subject site" or "study area", or which will not be affected (eg Lake Wollumboola);
- a number of threatened species for which there are no, or no recent, records in the "*study area*", or even in the vicinity or "*survey area*"; and
- *"endangered ecological communities"* (EECs) which are not present in the locality (at all) which will not be *"affected by the action"* (see Chapter 7.2 below, and Chapter 8)

# Table 7.1 Threatened biota identified by the Director-General which must be considered for inclusion in the list of "subject species" (Table 1 of the DGRs)

# BIRDS

#### **Forest and Woodland Species**

Powerful Owl Barking Owl Sooty Owl Masked Owl Regent Honeyeater Turquoise Parrot Little Eagle Spotted Harrier Square-tailed Kite White-fronted Chat

#### Marine, Coastal and Wetland Species

Beach Stone-curlew Sooty Oystercatcher Pied Oystercatcher Hooded Plover Greater Sand-plover Lesser Sand-plover Sanderling Curlew Sandpiper

#### MAMMALS

Large-footed Myotis Common (Eastern) Bent-wing Bat Eastern Freetail Bat Yellow-bellied Sheath-tail Bat Golden-tipped Bat Greater Broad-nosed Bat Eastern False Pipistrelle Large-eared Pied Bat

#### AMPHIBIANS

Green & Golden Bell Frog

#### PLANTS

Thick-lipped Spider Orchid Pretty Beard Orchid Illawarra Greenhood *Pterostylis ventricosa* Narrow-leafed Wilsonia Round-leafed Wilsonia

#### ENDANGERED ECOLOGICAL COMMUNITIES

Swamp Oak Floodplain Forest Littoral Rainforest Bangalay Sand Forest Freshwater Wetlands on Coastal Floodplains Illawarra Lowlands Grassy Woodland of the Sydney Basin Bioregion Swamp Sclerophyll Forest River-Flat Eucalypt Forest on Coastal Floodplains

- Olive Whistler Varied Sittella Glossy Black Cockatoo Gang Gang Cockatoo Little Lorikeet Orange-bellied Parrot Swift Parrot Pink Robin Scarlet Robin Flame Robin Hooded Robin
- Great Knot Broad-billed Sandpiper Black-tailed Godwit Terek Sandpiper Little Tern Little Shearwater Painted Snipe Osprey
- Tiger Quoll Southern Brown Bandicoot Long-nosed Potoroo White-footed Dunnart Eastern Pygmy Possum Squirrel Glider Yellow-bellied Glider Grey-headed Flying Fox

Bauer's Midge Orchid Tangled Bedstraw Leafless Tongue-orchid Magenta Lilly Pilly Eastern Australian Underground Orchid

# 7.1.3 Other Records

A search of the OEH (NPWS) Wildlife Atlas was conducted during the preparation of this SIS, to identify other threatened biota that might be present in the locality (Appendix J). That search provided a few additional threatened biota of potential relevance beyond those listed in the DGRs.

Additional species contained within the OEH Wildlife Atlas - which theoretically could be of relevance - included the Koala, Speckled Warbler, Diamond Firetail, Black-chinned Honeyeater (eastern subsp.) and Bush Stone-curlew.

Many other comprehensive investigations of fauna and fauna habitats have been undertaken in the immediate vicinity and general locality for an array of projects over a long period (Chapter 3; Appendices G and H), including for the recent proposal for residential and urban development at Culburra West (SLR Ecology 2013).

Other than the Little Bent-wing Bat (which is considered in further detail in this SIS), these investigations have not revealed any additional threatened biota (*ie* additional to those listed in Table 7.1 and above) which should be the subject of consideration in this SIS (see Appendices R and S).

The Threatened Species Officer of SSC has identified five additional threatened species "*for consideration*" – the East Lynne Midge Orchid, Giant Burrowing Frog, Stuttering Frog, Brush-tailed Phascogale and *Hibbertia stricta* subsp. *furcatula*.

All of these additional threatened species (Table 7.2) are considered in further detail in Chapter 8 of this SIS.

Table 7.2         Additional threatened biota identified for consideration as "subject specie	s"
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BIRDS	
Forest and Woodland Species Black-chinned Honeyeater (eastern subsp.) Speckled Warbler	Diamond Firetail Bush Stone-curlew
MAMMALS Koala Little Bent-wing Bat	Brush-tailed Phascogale
AMPHIBIANS Giant Burrowing Frog	Stuttering Frog
PLANTS East Lynne Midge Orchid	Hibbertia stricta subsp. furcatula

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# 7.2 Subject and Relevant 'Species'

# 7.2.1 General Habitat Characteristics

As noted above, the list of "*subject species*" provided in the DGRs (Table 7.1) includes an array of threatened biota which are not "*likely to be affected by the action*". As indicated in Chapter 7.1.3, there are an additional 11 threatened species which have been recorded in the locality, which have been included in the list of "*subject species*".

That list of "*subject species* ... and ecological communities" constitutes the list of "*threatened species*, *populations or endangered ecological communities*" from which the list of "*affected species*" is determined, as discussed in detail in Chapter 8 of this SIS.

There are a number of threatened species which will not be affected by the proposed Culburra Golf Course project – because of their habitat requirements (see Chapter 8), including the following.

- The Little Tern which nests on the sand bar between the ocean and Lake Wollumboola, and doubtless forages within the Lake. The proposed Golf Course will have no impact on this species, or its breeding, or any foraging habits or habitats.
- The Green & Golden Bell Frog which has been recorded at a few locations around Lake Wollumboola and at a farm dam in the southeast of the subject land (in 1994). However, there are no suitable habitats or resources present within or close to the proposed Golf Course (*ie* on the "*subject site*" or in the "*study area*"). Indeed, the proposed water features on the Golf Course will provide substantial additional potential habitat for this species.
- The Little Shearwater which is a marine or pelagic species, and for which there is no habitat whatsoever on the "*subject site*", or anywhere close to it.
- The array of 'Marine, Coastal and Wetland Species' in Table 7.1 which utilise estuarine habitats and/or lake shores of waterbodies as both foraging and roosting habitat. As noted above, the proposed Culburra Golf Course is located at some distance from the shoreline of Lake Wollumboola, and from any potential habitat (such as mudflats, shallow water (for waders) or beds of aquatic plants. The Golf Course project will not impose any adverse impacts upon the Lake or any ecosystems associated with it.
- Several of the "*endangered ecological communities*" which simply do not exist at this location (see Chapter 8.5)

The only threatened fauna species present or likely to be present on Long Bow Point at Culburra, and particularly on the "*subject site*" (*ie* the Culburra Golf Course development site), are species which are dependent principally upon open forest and woodland habitats. Much (although not all) of the Culburra Golf Course development footprint is located within native open forest and woodland vegetation, many parts of which are clearly recent regrowth. The remainder of the area to be affected is the degraded grassland/shrubland in the centre of Long Bow Point.

There are no freshwater wetlands on or close to the proposed Culburra Golf Course footprint in its current state, and threatened species which utilise such habitats and are known to occur nearby (such as the Large-footed Myotis and the Green & Golden Bell Frog) are not likely to be present within any area to be affected by the Golf Course project under current circumstances.

# 7.2.2 Relevant Threatened Biota

The DGRs note that the list provided in Table 7.1 is *"not exhaustive"*, and that *"other entities may also need to be included for assessment in this SIS on the basis of desktop and habitat analyses and the outcomes of fieldwork"*.

For that reason, reference has been made to the OEH Wildlife Atlas, as well as other studies undertaken on the subject land and in the survey area (Chapter 3). An additional eleven threatened biota of potential relevance have been identified beyond those listed in Table 7.1 (see Table 7.2) – although for most of these species the Culburra Golf Course is of no relevance.

Chapter 8 of this SIS provides a more detailed description of those threatened biota that are potentially *"affected"* by the proposed Culburra Golf Course, and determines which are the relevant (*"affected"*) species for the purposes of further detailed discussion in this SIS.

As noted above, consideration of the substantial array of investigations that have been undertaken on Long Bow Point and in the general locality, and the habitats and resources present within the area proposed for the Culburra Golf Course development, demonstrates that the most relevant (potentially at least) threatened species which are or could be associated with the project are threatened fauna species which depend on open forest and woodland habitats. All of the habitats and resources which will or may be affected by the Culburra Golf Course project consist of open forest and woodland vegetation or the degraded grassland and shrubland in the centre of the land - with the exception of the minor impacts on a very small section of Downs Creek.

It should be noted that those threatened species that are not included within the list of "affected species" (Chapter 8) but which could possibly or likely occur on the site will be considered *de facto* through the consideration of the "affected species":

- because of their shared use of open forest and woodland habitats and/or other habitats; and/or
- because of the avoidance of even potential habitat and resources for the relevant species.

Whilst there is no doubt some possibility that some threatened plant species could be present within the proposed development area, the very substantial, comprehensive and detailed investigations which have been undertaken on Long Bow Point have failed to demonstrate the presence of even a single threatened plant species in any area associated with the Culburra Golf Course project.

# 8 IDENTIFICATION of AFFECTED THREATENED BIOTA

# 8.1 Introduction and Scope

# 8.1.1 TSC Act Considerations

Pursuant to the TSC Act, an SIS must include:

• "an assessment of which threatened species or populations known or likely to be present in the area are likely to be affected by the action" - Section 110(2)(b).

Interestingly, there is no concomitant requirement in the TSC Act to make such an assessment with respect to "*endangered ecological communities*".

# 8.1.2 Director-General's Requirements

Chapters 5, 6 and 7 of the SIS have identified and considered the "*subject species .. and ecological communities*" (as required by the DGRs). This Chapter of the SIS (Chapter 8):

- addresses Section 110(2)(b) of the TSC Act (cited above) and determines which threatened biota "are [in fact] likely to be affected by the action" (ie which are the relevant or "affected" species);
- addresses Item 5.1 of the Director-General's Requirements (DGRs) which "allows refinement of the list of subject species and populations (given the outcome of survey and analysis of likely impacts) in order to identify which threatened species or populations may be affected, and the nature of the impact"; and
- provides further consideration with respect to "endangered ecological communities".

In assessing which of the "threatened species and populations" and "endangered ecological communities" are "likely to be affected" by the Culburra Golf Course, consideration has been given to:

- the history, nature and condition of the subject land and of the locality;
- the nature and specific design elements of the Culburra Golf Course proposal;
- the precise location of the Golf Course within the Long Bow Point "*subject land*" and with respect to Lake Wollumboola;
- the relevant impact amelioration and environmental management measures proposed (see Chapter 12); and
- the potential impacts of the proposal on relevant threatened biota as delineated in this SIS (Chapter 10).

#### 8.1.3 Endangered Populations

There are no listed "*endangered populations*" of any species listed in the TSC Act which are of any relevance to the Culburra Golf Course project. No further consideration of "*endangered populations*" is relevant to this SIS.

# 8.2 Assessment Criteria and Principles

# 8.2.1 Issues of Relevance

In assessing which of the "*subject species* .. *and ecological communities*" (see Chapter 7) are likely to occur within the "*subject site*" or "*study area*", and (most importantly) which threatened biota, known or likely to be present in the area, are "*likely to be affected by the action*" (*ie* which species, populations or communities constitute the relevant "*affected species*"), an array of issues are of relevance.

The issues of relevance to the proposed Culburra Golf Course on Long Bow Point include:

- whether the species, population or ecological community has been recorded on the subject land or within the "study area", or in the vicinity or general locality – at any relevant 'recent' time;
- whether the subject land and/or the "*study area*" support potentially suitable habitats or resources for those threatened biota;
- the distribution of potentially relevant resources or habitat features which are to be affected by the Golf Course – both on the subject land and "*subject site*", as well as in the locality and region;
- whether an area of "known habitat", and particularly a 'significant' area of "known habitat", for any threatened biota is "likely" to be modified or removed as a result of the proposed Golf Course development;
- the "life cycle" of the species and the resources and habitats important for its survival;
- the proportion of that habitat to be affected relative to that in the locality and/or home range of the relevant biota;
- whether the "*threatened species*" is likely to occur on the subject land or subject site on other than a transitory basis;
- the disturbance history and condition of the "*subject site*" and subject land particularly with respect to habitats or resources of relevance for threatened biota; and
- the nature of the proposed development, and the impact amelioration and environmental management measures which are proposed as part of the Culburra Golf Course.

Each of the "threatened species, populations and ecological communities" identified as **potentially** relevant (*ie* the "subject species" identified in Chapter 7 of this SIS) has been considered with respect to the potential or likely relevance of the "subject site" to their life cycles and distributions, and to the potential for the proposed activity to impose adverse impacts on their survival in the locality and the region.

In considering which threatened biota "are likely to be affected" (ie which threatened biota are 'relevant' to this SIS), it is appropriate to note that the proposed Culburra Golf Course development includes an array of elements which have been designed specifically to avoid and/or to ameliorate potential impacts which will or may arise as a consequence of the proposed Golf Course (eg design modifications and refinements to avoid hollow-bearing trees and feed trees, rehabilitation practices). Particular items or resources which could potentially be relevant for threatened biota (potential or real) have been the subject of special consideration in this SIS.

The Culburra Golf Course project has also been designed to ensure that there will be no nett loss of tree-hollows, and to provide supplementary habitat for some threatened species (*eg* the detention basins and irrigation lake – see Chapter 12).

Particular design and management features of the proposal which are of relevance to the determination of "*affected species*" (see Chapters 2 and 12) include:

- the specific design of the Golf Course, by the project ecologist and a professional golf course designer, *inter alia* to retain the maximum possible number of hollow-bearing trees and to protect other particular resources (*eg* Glossy Black Cockatoo feed trees, Yellowbellied Glider feed trees);
- the retention of native vegetation (including groundcover and shrublayers, as well as fallen timber and logs) between golf course fairways – in order to both retain habitat and to provide ongoing connectivity through the subject land;
- the particular and specific design of a stormwater management and re-use system (Appendix D1) - to ensure the maintenance of water quality, to maximise the re-use of stormwater for irrigation purposes, and to avoid the imposition of adverse impacts on overland flows, groundwater and/or Lake Wollumboola;
- the implementation of a *Hollow-bearing Tree Protocol* (see Chapter 12) to salvage and re-use any tree-hollows to be removed to ensure that there is no net loss of tree-hollows as a result of the Golf Course project;
- the installation of nest boxes within areas of retained vegetation to provide additional hollow-nesting resources - at a ratio of 2:1 to tree-hollows which cannot be relocated into retained trees;
- the implementation of a comprehensive management regime for the Golf Course, pursuant to a detailed *Culburra Golf Course Plan of Management* (GCPoM; Appendix D2) - which avoids or significantly minimises the discharge of fertilisers or pesticides in any water discharged from the Golf Course into the surrounding bushland or any groundwater aquifers (as relevant);
- the design, construction and maintenance of detention basins and ponds to provide supplementary habitat for native (including threatened) fauna species - such as the Green & Golden Bell Frog and the Large-footed Myotis;
- the implementation of a *Golf Course Ecological Management Plan* which will detail the management of elements of the Golf Course (such as wetlands, ponds, retained forest and woodland, roughs, hollow-bearing trees *etc*) for biodiversity conservation purposes, and the management of any re-introduced native species (such as Koalas) – if approved by OEH; and
- the dedication of a substantial area of the subject land for biodiversity conservation purposes, and the dedication of funds for its maintenance in the long-term (see Chapter 12).

Further detailed discussion of the impact amelioration and environmental management measures for the Culburra Golf Course is provided in Chapter 12 of this SIS.

# 8.2.2 Principles for Selection of Affected Biota

Sections 110(2)(b) and 110(3)(a) of the TSC Act require an SIS to determine which of the subject *"threatened species, populations or ecological communities"* are *"likely to be affected by the action"*. Whilst the relevant Sections of the TSC Act do not qualify the term *"affected"*, it is assumed for the purposes of this SIS that the term does not mean 'affected to any extent whatsoever', however insignificant.

Conversely, the consideration of which species is "*likely to be affected by the action*" does not appear to be restricted only to those species which are "*significantly*" affected, at least in terms of Section 110 of the TSC Act. Whilst Section 5A of the EP&A ACT contemplates the 'significance' of impacts (in terms of the likelihood or otherwise of "*a significant effect*" being imposed upon threatened biota or their habitats), Section 110(2)(b) and Section 110(3)(a) do not include such considerations.

On the other hand, it should be noted that the relevant assessment by which the need for an SIS is determined in the first instance is that of Section 5A of the EP&A ACT, which does require consideration of the 'significance' of possible impacts. Arguably, therefore, the term "*likely to be affected by the action*" should be interpreted as "*likely to be* [significantly] *affected by the action*".

In determining which "threatened species, populations" or "endangered ecological communities" are likely to be "affected by the action", in terms of Section 110(2)(b) and Section 110(3)(a) of the TSC Act, therefore, it is appropriate to exclude those biota which would or may be affected to only an inconsequential, minute or entirely insignificant degree.

Included in this group of threatened species, by way of example, is the Grey-headed Flying Fox – which has been recorded foraging in the tree canopy on Long Bow Point on only a single occasion. Whilst individuals doubtless could utilise the open forest and woodland on Long Bow Point for occasional foraging activities, the very high mobility of the Grey-headed Flying Fox and its very substantial home range indicates that the area of the proposed Golf Course on Long Bow Point could not conceivably be of significance for the survival of even an individual Grey-headed Flying Fox. As a consequence, this species is not included in the list of relevant ("*affected*") species (see below).

Similar types of considerations apply to many other threatened species, including species recorded on the subject land (such as Large-footed Myotis, Giant Burrowing Frog, Turquoise Parrot, Australasian Bittern and Osprey). The Golf Course either will not affect any habitat (or at least any significant habitat) for these species or the quantum of potential resources to be affect is miniscule compared to the extent of such resources in the immediate vicinity and locality and/or the high mobility of the relevant species.

#### 8.3 Identification of Affected Flora Species

No individuals of any threatened plant species listed in the *Threatened Species Conservation Act 1995* (TSC Act), which could potentially occur on the subject land (Table 7.1), have been recorded during any investigations within the "*subject site*" or the "*study area*" (see Chapter 5).

The only threatened plant species that has been recorded on or close to Long Bow Point is the Roundleafed Wilsonia *Wilsonia rotundifolia*. This species has been recorded (by SLR Ecology) in narrow bands along the Lake Wollumboola foreshore – on the northern side of Copper Cup Point and on the eastern and northeastern aspects of Long Bow Point (Figure 13B). There is no potential for the Roundleafed Wilsonia to be affected, either directly or indirectly, by the proposed Culburra Golf Course.

Despite the conduct of comprehensive surveys for an array of threatened flora species identified in the DGRs (see Table 7.1) throughout the subject land, and on other lands in the immediate vicinity (*eg* the Culburra West site to the near north), none of the threatened plant species listed in the DGRs (Table 7.1) have been recorded. There is no record of any of those threatened plants on Long Bow Point or on the Culburra West urban development project site, nor have any of those threatened plant species been recorded on any nearby lands, by any ecologists, over a period of 20+ years.

Furthermore, none of the areas proposed for the Culburra Golf Course development are regarded as unique or particularly likely to support individuals or populations of those threatened plant species known to occur in the locality and/or included as "*subject species*".

Moreover, even if any such threatened flora species are present on the subject land at Long Bow Point:

- none of the vegetation types which are present within the areas proposed to be cleared for the Culburra Golf Course are unique to the Golf Course footprint, or the subject land on Long Bow Point, or the immediate or general vicinity, or even the "*locality*";
- significant areas of such vegetation types are to be retained elsewhere on the subject land and on adjoining lands in the immediate vicinity and locality – thus retaining relevant potential habitat (assuming the "subject site" constitutes such habitat);
- it cannot reasonably be assumed that any threatened flora species would be confined to those areas of the subject land included in the Golf Course footprint given the extent of identical habitat in the immediate vicinity;
- specific management measures are provided within the Golf Course design and with respect to its long-term management to avoid the imposition of adverse impacts with respect to altered hydrologic regimes and/or the potential discharge of contaminants from the Golf Course; and
- development of the Golf Course will *inter alia* facilitate the dedication and long-term management of land for biodiversity conservation purposes including areas of vegetation which could potentially contain those threatened plants (see Chapter 12).

It is to be noted that the OEH has recently inspected the Culburra West Urban Development project land (to the north of Long Bow Point) in their consideration of that project. The OEH (including Mr Alan Stephenson – local orchid expert) has concluded that the Culburra West project lands are "*unlikely to be habitat for the threatened orchid species*".

The Culburra West project land contains similar and/or 'identical' vegetation types to the majority of those areas of vegetation which are to be affected for the Culburra Golf Course project. Consequently, it can reasonably be concluded that the majority of the Culburra Golf Course land (which is proximate and very similar or identical to the Culburra West land) would also not be "*likely to be habitat for the threatened orchid species*".

This conclusion is supported by the fact that no such orchids were recorded on the subject land despite the conduct of dedicated surveys (as required by the OEH) at appropriate times of the year.

Further, even if any of those threatened orchids, or other threatened open forest and woodland plant species, were present on the subject land at Long Bow Point, it cannot be assumed that they would be confined to the proposed Golf Course development footprint. Given the very substantial area of native open forest and woodland which is to be retained within the 'Golf Course land' and within the private Conservation Reserve on Long Bow Point, it must be assumed that significant areas of suitable habitat for those threatened species will be protected.

In addition, there are substantial areas of native private forest and woodland vegetation in the vicinity which are to be dedicated, in the near future, for biodiversity conservation purposes. There are also very substantial areas of suitable habitat for those species present within the extensive conservation reserves and State Forests in the immediate vicinity and general locality, including in the very substantial conservation reserves and State Forests present around Culburra and elsewhere at Jervis Bay.

# 8.4 Identification of Affected Fauna Species

# 8.4.1 Fauna Species Considerations

For the purposes of this SIS, the threatened fauna species which have been recorded on the subject land or in the vicinity (by various investigations), and/or which are recorded in the locality on the OEH Wildlife Atlas, and/or which have been included as "*subject species*" (Tables 7.1 and 7.2), have been divided into four groups (Appendix S).

# Not Relevant

These are threatened species (Chapter 8.4.2; Table 8.1; Appendix S):

- for which neither the subject site nor the subject land provide any relevant habitat (*eg* the Little Tern, Little Shearwater and other 'marine, coastal and wetland species', and the Ground Parrot and Beach Stone-curlew);
- which rely on the lacustrine and aquatic habitats in Lake Wollumboola; or
- which have not been recorded in the vicinity or locality for many decades (*eg* the Koala and Eastern Quoll).

# Unlikely

These are threatened species for which the subject site *per se* is not likely to provide habitat or resources or which are unlikely to be present or dependent on the subject site (Chapter 8.4.3; Table 8.2; Appendix S), including:

- an array of mammal and bird species that have never been recorded on the subject land or in the immediate vicinity; and
- species (such as the Large-footed Myotis and the threatened Frogs) for which there is no (or virtually no) relevant habitat within the subject site itself.

#### Potential

These are threatened fauna species which have been recorded on the subject land, or in the general vicinity, that could possibly utilise the forest habitats within the subject site, on occasions at least (Chapter 8.4.4; Table 8.3; Appendix S). These include:

- species recorded in the general vicinity, but not on the subject land, that could utilise vegetation present on the subject site (*eg* the Gang Gang Cockatoo);
- species that could potentially be present, but which have not been recorded in the vicinity (*eg* the Masked Owl, Swift Parrot and Turquoise Parrot); and
- species which have been recorded in the vicinity (but not on the subject land) on a single occasion, but for which there is no evidence of a "*viable local population*" being dependent on the site (*eg* the Sooty Owl, Scarlet Robin and Varied Sittella).

#### Definite

These are species that have been recorded on the subject land, and which are considered highly likely to utilise the vegetation and habitats within the subject site (Chapter 8.4.5; Table 8.4) - including species such as the Powerful Owl, Glossy Black Cockatoo, Square-tailed Kite, Yellow-bellied Glider and several threatened microchiropteran bats.

Of the threatened species that have been recorded on the subject site or in the immediate vicinity, it is those species dependent on open forest and woodland communities that are of most likely (or real) relevance to the proposed Culburra Golf Course project. The "*subject site*" (*ie* that area to be directly affected by the proposal) is characterised almost exclusively by open forest and woodland vegetation, with an area of cleared and slashed grazing land in the centre of Long Bow Point (Figures 2 and 11A).

There are no relevant freshwater wetlands or ponds within the Culburra Golf Course footprint. The only area of such habitat types to be affected by the Golf Course is the tiny part of Downs Creek where the proposed crossing and bridge is to be located (see discussion in Chapter 8.4.3).

The lacustrine and aquatic habitats around and adjacent to Long Bow Point are located to the east of the proposed Golf Course, and are separated from the project by 100 metres or more of retained bushland and vegetation (Figures 3A, 3B and 14). The relevant habitats along and within Lake Wollumboola will be shielded visually and physically from the Golf Course and its activities.

As a consequence of those considerations, not all of the threatened fauna which have been recorded in the immediate vicinity, or which are listed in Chapter 7 of this SIS (Tables 7.1 and 7.2), are of even potential relevance to the proposed Culburra Golf Course project. In this regard:

- there is no relevant habitat for the Green & Golden Bell Frog or the Large-footed Myotis on the proposed Golf Course development area - given the lack of freshwater wetlands on the "subject site";
- species associated with the lacustrine and aquatic habitats and the mudflats of Lake Wollumboola are of only marginal relevance to the proposal (at best) - because those areas of habitat are well outside of the Golf Course development footprint and are to be specifically protected from even indirect impacts; and
- there are an array of threatened fauna species which have been recorded in the general locality or even immediate vicinity of the subject site which are of extremely little or no relevance (such as the Osprey, Little Tern and other open water species).

Lake Wollumboola and its associated ecosystems and wildlife will not be adversely affected by the Culburra Golf Course project, by virtue of the Golf Course design, the stormwater management regime and the various *Plans of Management* for the construction and operation of the Golf Course (as discussed in Chapter 4.9).

There is no likelihood of any significant adverse impact (if any adverse impact at all) being imposed upon Lake Wollumboola and its ecosystems as a consequence of the construction and operation of the Culburra Golf Course on Long Bow Point. In particular, sensitive design of the Golf Course and careful long-term management of stormwater and other elements of the Golf Course are intended specifically *inter alia* to avoid imposing any adverse impacts upon water quality, water volumes or any other element of Lake Wollumboola and its associated habitats (Chapter 4.9).

As a consequence, the array of wetland and wading birds which are associated with Lake Wollumboola, including a number of threatened species, are not of relevance to this SIS in terms of any potential for a *"significant effect"* (or indeed any effect at all) to be imposed upon them.

The threatened fauna species of most relevance to the Culburra Golf Course project are essentially confined to those which are dependent or reliant upon open forest and woodland habitats. Whilst these

are separated into 'Definite' and 'Potential' (and even some 'Unlikely') species below, it is relevant to note that the 'Potential' and 'Unlikely' species have not simply been 'dismissed' in this SIS.

In that regard:

- it is acknowledged that individuals of those threatened species that have been recorded nearby, and which could occur on the "*subject site*", could be affected to the same or similar degrees as the relevant ("*affected*") species, in the event that they are present;
- even those species regarded as 'Unlikely' have been considered in the design and proposed long-term management of the Golf Course; and
- the impact amelioration, environmental management and offset measures for the Golf Course (as detailed in Chapter 12 of this SIS) would similarly prevent any "significant effect" upon any of these additional species – even if they did or do occur in the vicinity of the Culburra Golf Course.

The design of the Culburra Golf Course, and its long-term rehabilitation and management protocols and measures, have been developed in a 'precautionary' manner - in cognisance of the potential presence of those additional species.

When considering the likelihood of significant impacts to be imposed upon any threatened biota, as a consequence of the Culburra Golf Course project, it is essential that the following matters be taken into account.

- The dedicated and iterative design approach for the Golf Course which has resulted in an array of modifications to various Golf Course elements in order *inter alia* to preserve hollow-bearing trees and Glossy Black Cockatoo feed trees.
- The retention of all but approximately 5 mapped hollow-bearing trees on the Golf Course in retained vegetation between fairways and other elements of the Golf Course.
- The implementation of a *Hollow-bearing Tree Protocol* to ensure that there will be no nett loss of tree-hollows as a consequence of the Culburra Golf Course project.
- The implementation of a comprehensive and detailed stormwater management regime (Martens 2015; Appendix D1) which is intended *inter alia* to avoid the discharge of contaminated stormwater into Lake Wollumboola, Downs Creek or Wattle Creek, or into adjoining retained native vegetation around the Golf Course.
- A commitment to appropriate management of the Golf Course in the long-term *inter alia*, pursuant to a *Culburra Golf Course Plan of Management* (GCPoM; Appendix D2) to ensure that excessive quantities of nutrients, fertilisers, pesticides or other chemicals are not applied on the Golf Course and that consequently there will be no discharge of any such materials into the natural environment.
- A commitment to the provision of supplementary habitat and resources for threatened species such as specifically designed and planted detention basins and other wetland features for the possible use of the Green & Golden Bell Frog, and the provision of grassy woodland areas for the possible use of the Scarlet Robin pursuant to a *Golf Course Ecological Management Plan* (GCEMP) for the long-term.
- A commitment to the long-term management of 113 hectares of private Conservation Reserve on Long Bow Point.

# 8.4.2 Non-Relevant Threatened Fauna

A number of threatened species have been recorded within the *"locality"* around the subject site, and are included in the OEH Wildlife Atlas (Appendix J) and/or the DGRs (Tables 7.1 and 7.2), but are not regarded as relevant to the Culburra Golf Course project (Table 8.1; Appendix S).

Common Name	Scientific Name	Explanation
Blue-billed Duck	Oxyura australis	No suitable habitat
Ground Parrot	Pezoporus wallicus	No records on site or adjacent land; no suitable habitat (dense heath and low shrubland) present
Hooded Plover	Thinornis rubricollis	No suitable habitat on site (sandy ocean beaches)
Little Shearwater	Puffinus assimilus	No suitable habitat (marine and island habitats)
Providence Petrel	Pterodroma solandri	No suitable habitat (marine)
Wandering Albatross	Diomedea exulans	No suitable habitat (marine and island habitats)
Eastern Quoll	Dasyurus viverrinus	Species thought to be extinct on mainland Australia
Southern Right Whale	Eubalaena australis	No suitable habitat (oceanic species)
Sperm Whale	Physeter macrocephalus	No suitable habitat (oceanic species)
Beach Stone-curlew	Esacus neglectus	Potential habitat around periphery Lake Wollumboola only; no potential habitat to be affected
Black Bittern	Ixobrychus flavicollis	Little potential habitat (swamps and reed beds) along edge of Lake Wollumboola; all habitat to be retained
Broad-billed Sandpiper	Limicola falcinellus	No suitable habitat on site (Lake margins and mudflats)
Great Knot	Calidris tenuirostris	No suitable habitat on site (Lake margins and mudflats)
Terek Sandpiper	Xenus cinereus	No suitable habitat on site (Lake margins and mudflats)
Black-tailed Godwit	Limosa limosa	No suitable habitat on site (Lake margins and mudflats)
Sanderling	Calidris alba	No suitable habitat on site (Lake margins and mudflats)
Pied Oystercatcher	Haematopus Iongirostris	No suitable habitat on site (beaches)
Sooty Oystercatcher	Haematopus fuliginosus	No suitable habitat on site (beaches)
Lesser Sand Plover	Charadrius mongolus	No suitable habitat on site (Lake margins and mudflats)
Greater Sand Plover	Charadrius Ieschenaulti	No suitable habitat on site (Lake margins and mudflats)
Little Tern	Sterna albifrons	No suitable habitat on site (sand bar and Lake only)
Koala	Phascolarctos cinereus	Not recorded for many decades in the vicinity

**Table 8.1** Threatened fauna species recorded in the vicinity or locality of the subject site, which are not considered of relevance to the Culburra Golf Course project

#### **Coastal and Marine Species**

Species which are entirely dependent on coastal and/or marine resources (such as the Little Shearwater, Wandering Albatross and whales) are obviously of no potential relevance with respect to the Culburra Golf Course project.

Further, other species which utilise beaches and estuarine foreshores, and sometimes lake foreshores (such as the Little Tern, Hooded Plover and the Oystercatchers), will not be affected by the Culburra Golf Course project, even if they do utilise the foreshores of Lake Wollumboola around Long Bow Point. There is no potential for even indirect impacts to be imposed upon any of those species.

Species such as the whales clearly are of no relevance to the Culburra Golf Course project.

#### Koala

The Koala *Phascolarctos cinereus* is presumed to be locally extinct, as only two records exist within 10km of the subject site (OEH Wildlife Atlas – Appendix J). One of these records is from 1930, and the other (from 1995) is located to the west of Callala Beach, some distance to the south of the subject site.

A considerable array of surveys by an array of ecologists (see Chapter 3; Appendices G and H; *Bibliography*) have not revealed any evidence that this species exists in the locality, notwithstanding the presence of suitable preferred food tree species (such as Forest Red Gum and Swamp Mahogany).

The Koala is not a relevant ("affected") species for this SIS.

#### Ground Parrot

There is no habitat for the Ground Parrot on the subject land at Long Bow Point, and there are no recent records of this species in the vicinity.

This species is of no relevance to the Culburra Golf Course project.

#### Wetland and Estuarine Birds

With respect to the wetland and estuarine birds identified in Table 8.1, it is to be noted that:

- suitable potential habitat for these species in the vicinity of the Culburra Golf Course site is confined to Lake Wollumboola and (in some cases) to its shores;
- there is no suitable habitat for any of these species within the proposed Golf Course footprint, or close to it (Figures 2, 3A and 14A);
- the Golf Course will be separated by a vegetated band (of at least 100m width) from any habitat of relevance or potential relevance for any of these species;
- the stormwater management regime (Martens 2015; Appendix D1) has been designed specifically *inter alia* to protect Lake Wollumboola. This regime ensures that all water quality discharges will result in no significant changes (if indeed any changes at all) to

water quality and hydrologic regimes within Lake Wollumboola. The intervening vegetation will also buffer the Lake and its habitats from any potential impacts; and

 implementation of a Culburra Golf Course Plan of Management (GCPoM – Appendix D2) – to ensure that long-term management of the Golf Course does not involve any excessive use of pesticides, fertilizers or other chemicals, and that there is no adverse impact imposed on stormwater, groundwater or any ecosystems in the vicinity.

As discussed in detail in various parts of this SIS, the Culburra Golf Course project will not impose any relevant adverse impacts on Lake Wollumboola, or upon the ecosystems it contains and the associated wildlife.

The Culburra Golf Course:

- is separated by a vegetated buffer of at least 100m from Lake Wollumboola;
- constitutes just 1% of the (mostly forested) catchment of Lake Wollumboola, and consequently cannot be regarded as a significant source of either water or nutrients to the Lake;
- will remain predominantly pervious, and will therefore largely maintain existing hydrologic regimes; and
- is to be constructed and managed in a manner designed and intended to avoid any notable alterations to water quality and/or quantity discharges.

The Culburra Golf Course project is of no relevance for any of the wetland and estuarine birds recorded in the vicinity (Table 8.1), including those associated with Lake Wollumboola.

# 8.4.3 Unlikely Threatened Fauna

There are several threatened fauna species either which have never been recorded in the vicinity (Table 8.2; Figures 16A and 16B), or which have been recorded nearby but which are not likely to occur on the subject site or to be reliant upon the resources present within the Culburra Golf Course site, even if present on rare occasions.

Common Name	Scientific Name	Explanation
Australasian Bittern	Botaurus poiciloptilus	No potential habitat to be removed; very little potential habitat present along Lake Wollumboola and possibly lower reaches of Downs Creek; no habitat to be affected
Osprey	Pandion haliaetus	Potential foraging in Lake Wollumboola; never recorded on the site; no relevant habitat on the subject site <i>per se</i>
White-footed Dunnart	Sminthopsis leucopus	Not recorded in the vicinity; substantial potential habitat protected in locality and region
Brush-tailed Phascogale	Phascogale tapoatafa	Not recorded in the vicinity; substantial potential habitat protected in locality and region
Squirrel Glider	Petaurus norfolcensis	Not recorded in the vicinity; substantial potential habitat in locality and region
Tiger Quoll	Dasyurus maculatus	Not recorded in the locality; substantial potential habitat protected in locality and region
Southern Brown Bandicoot	lsoodon obesulus	Never recorded - despite appropriate surveys; substantial potential habitat protected in locality and region
Long-nosed Potoroo	Potorous tridactylus	Never recorded - despite appropriate surveys; substantial potential habitat protected in locality and region
Bush Stone-curlew	Burhinus grallarius	Never recorded in vicinity; substantial potential habitat in locality and region
Swift Parrot	Lathamus discolor	Favoured tree species not common; few recent records in the locality; never recorded on Long Bow Point or at Culburra; substantial habitat in locality and region
Turquoise Parrot	Neophema pulchella	No preferred foraging habitat; species never recorded at Culburra or on Long Bow Point; substantial habitat in locality and region
Green & Golden Bell Frog	Litoria aurea	No suitable habitat on the " <i>subject site</i> "; potential habitat to be created
Giant Burrowing Frog	Heleioporus australiacus	Never recorded in the vicinity; no suitable habitat on the "subject site"
Stuttering Frog	Mixophyes balbus	Never recorded in the vicinity; no suitable habitat on the "subject site"

Table 8.2	Threatened fauna sp	ecies which are unlike	ly to utilise the	Golf Course site
			<b>J</b>	

Several additional threatened bird species have been identified as potentially of relevance (the Blackchinned Honeyeater, Diamond Firetail, Speckled Warbler and the Rose and Hooded Robins) – all of which are reliant on open forest and woodland habitats and/or associated grasslands.

None of these species have been recorded on the subject land or in the vicinity. They are consequently not regarded as relevant ("*affected*") species for this SIS.

In any case, the Culburra Golf Course *in toto* will occupy only a minimal area of potential habitat for any of the forest-dependent species in Table 8.2 or discussed below, and no relevant habitat for the Osprey or Australasian Bittern. The proposed Golf Course occupies just 1% of the mostly forested catchment of Lake Wollumboola, and a miniscule proportion of the available (and mostly protected) habitat in the vicinity or locality.

Neither the Giant Burrowing nor the Stuttering Frog has been recorded in the vicinity of Long Bow Point. Further, there is no habitat within the subject site *per se* and there is no likelihood of any adverse impacts being imposed upon either of these species or their habitats. They are consequently not regarded as relevant (*"affected"*) species for this SIS.

#### Australasian Bittern

The Australasian Bittern *Botaurus poiciloptilus* has been recorded previously in the vicinity of Long Bow Point (Daly & Leonard 1996), although these authors did not specify the location of their record (most likely in dense vegetation fringing Lake Wollumboola). This species is also known from other records in the locality (Appendix J - OEH Wildlife Atlas; Birds Australia).

Although it has been recorded on or close to the Culburra Golf Course project site, no potential habitat for this species will be affected by the proposed Golf Course project.

The Australasian Bittern is not regarded as a relevant ("affected") species for this SIS.

#### Osprey

The Osprey *Pandion haliaetus*, although seen regularly along the coast around Jervis Bay and occasionally in Lake Wollumboola, has not been recorded on the subject site itself during any investigations undertaken to date.

There is no relevant habitat on the subject site itself, and Lake Wollumboola will be separated from the development by a vegetated buffer along the full length of the Culburra Golf Course project.

The Osprey is not regarded as a relevant ("affected") species for this SIS.

#### White-footed Dunnart

The White-footed Dunnart is a small terrestrial carnivorous marsupial, which feeds on a variety of invertebrates and small lizards (Lunney *et al* 1989; Lunney & Leary 1989; Menkhorst 1995; King 1980).

This species occupies xeric grassy woodlands and open forests, generally with relatively low densities of shrubs.

The most recent observation of the White-footed Dunnart *Sminthopsis leucopus* in the locality of the subject land was in 1988 (OEH Wildlife Atlas – Appendix J). The White-footed Dunnart has not been recorded on the subject site or in the vicinity, or anywhere else in the Culburra UEA or the Culburra West lands, despite intensive survey efforts using suitable methods over more than 20 years (*ie* Elliott traps, pitfall traps, hair funnels and predator scats).

Whilst the Culburra Golf Course project would remove some areas of theoretical or potential habitat for this species:

- there is no evidence that the White-footed Dunnart is present on the subject land or in the vicinity; and
- there are very extensive areas of potentially suitable habitat protected in the vicinity, locality and region.

The White-footed Dunnart is not regarded as a relevant ("affected") species for this SIS.

# **Brush-tailed Phascogale**

The Brush-tailed Phascogale is a small terrestrial carnivorous marsupial, which feeds on a variety of invertebrates and small lizards (Strahan 1995). The Brush-tailed Phascogale generally occupies xeric woodlands and open forests with abundant tree-hollows (particularly in the lower parts of tree boles).

The Brush-tailed Phascogale has not been recorded on the subject land or in the vicinity, or anywhere else in the Culburra UEA or the Culburra West lands, despite intensive survey efforts using suitable methods over a very long period (*ie* Elliott traps, pitfall traps, hair funnels and predator scats).

Whilst the Culburra Golf Course project would remove some areas of theoretical or potential habitat for this species:

- there is no evidence that the Brush-tailed Phascogale is present or has ever occurred on the subject land or in the vicinity; and
- there are very extensive areas of potentially suitable habitat protected in the vicinity, locality and region.

The Brush-tailed Phascogale is not regarded as a relevant ("affected") species for this SIS.

#### **Squirrel Glider**

This species inhabits dry sclerophyll forests and woodlands in southeastern Australia, although it is also found in coastal vegetation in northern and central NSW and in Queensland (Suckling 1995; Menkhorst *et al* 1988).

The Squirrel Glider *Petaurus norfolcensis* has not been recorded during any field investigations on the subject land or in the immediate locality (see Chapter 3), and only one record of the Squirrel Glider (from 1970) exists for the locality (OEH Wildlife Atlas – Appendix J).

Both the subject land and the subject site contain theoretically potential habitat for the Squirrel Glider, although the species has never been recorded in those locations. In any case, there are substantial areas of suitable potential habitat for that species in the locality and region, including in the extensive conservation reserves within the Shoalhaven LGA (Figures 7A and 7B).

The Squirrel Glider is not regarded as a relevant ("affected") species for this SIS.

# Tiger (Spotted-tailed) Quoll

This species is known to inhabit a range of forest and woodland environments (Edgar & Belcher 1995), although it prefers moist forest and rainforest habitats with a generally dense understorey and groundcover.

The Tiger Quoll *Dasyurus maculatus* has not been recorded during any current or previous field investigations at Culburra (the whole of the Culburra UEA), and has not been recorded on the subject land or in the immediate vicinity or general locality during any previous surveys (see Chapter 3). Only one record of its presence exists from the locality, dating back to 1980 (OEH Wildlife Atlas – Appendix J).

The Tiger Quoll preys on insects and small to medium-sized vertebrates, and utilises hollow logs, stags, caves or rock crevices for denning. Although some potentially suitable (limited or marginal) foraging and denning habitat is present on the subject site, the lack of any recent records of the species suggests that it no longer occurs in the locality.

Further, there are substantial tracts of potential habitat in the locality and region (particularly in the extensive conservation reserves and State Forests), and the Culburra Golf Course site cannot be considered of likely or even potential significance for this species.

The Tiger Quoll is not regarded as a relevant ("*affected*") species for this SIS.

#### Southern Brown Bandicoot

The Southern Brown Bandicoot *Isoodon obesulus* occurs essentially along the coastal fringe of NSW, from the southern side of the Hawkesbury River to the Victorian border (and thence into Victoria). This species occupies a variety of habitats in NSW, including heathland, shrubland, dry sclerophyll forest (generally with a heath understorey), sedgelands and woodland communities. This species also appears to be tolerant of bushfire, and appears to prefer the early seral stages of some vegetation communities following disturbance by fire.

There have been no records of the Southern Brown Bandicoot either on the Long Bow Point Golf Course site or on the Culburra West site, or in the general locality, despite the use of an array of appropriate techniques over a very long period (Chapter 3). Recent use of infra-red cameras for this SIS has failed to record any individuals of the Southern Brown Bandicoot.

Furthermore, as is the case for many of other terrestrial woodland and open forest species, there are very substantial areas of suitable habitats for this species (potentially or theoretically at least) in the
immediate vicinity and general locality, and throughout the extensive conservation reserves and State Forests within the Shoalhaven region (Figures 7A and 7B).

The Southern Brown Bandicoot is not regarded as a relevant ("affected") species for this SIS.

## Long-nosed Potoroo

The Long-nosed Potoroo *Potorous tridactylus* is distributed through the coast of NSW and into the adjoining coastal ranges, from southeastern Queensland to the Victorian border (and thence into Victoria and Tasmania). This species generally prefers coastal heaths and both dry and moist sclerophyll forests with a dense understorey.

There have been no records of the Long-nosed Potoroo on Long Bow Point or anywhere else in the general locality, despite the use of an array of appropriate techniques over a very long period (Chapter 3). Recent use of infra-red cameras for this SIS has failed to record any individuals of the Long-nosed Potoroo, on any site in the vicinity (Long Bow Point, Culburra West and Callala).

Furthermore, as is the case for many of other terrestrial woodland and open forest species, there are very substantial areas of suitable habitats for this species (potentially or theoretically at least) in the immediate vicinity and general locality, and throughout the extensive conservation reserves and State Forests within the Shoalhaven region (Figures 7A and 7B).

The Long-nosed Potoroo is not regarded as a relevant ("affected") species for this SIS.

#### Bush Stone-curlew

The Bush Stone-curlew *Burhinus grallarius* utilises open woodland communities, generally with a predominantly grassy understorey and scattered fallen trees, logs and leaf litter. Most of the open forest and woodland vegetation at Long Bow Point has an understorey and groundcover which is generally rather too dense for the Bush Stone-curlew.

The Bush Stone-curlew was once common along the east coast of NSW, but is now rarely seen, only in scattered locations. There are no recent records of this species in the general vicinity or survey area, and it is not considered likely to be extant at this location.

If habitat on Long Bow Point is suitable for the Bush Stone-curlew, then it must be accepted that there are substantial areas of suitable habitat for this species in the vicinity and/or locality. Indeed, it is arguable that the Culburra Golf Course project would provide improved habitat for the Bush Stone-curlew at this location (particularly given the commitment to removal of introduced predators).

The Bush Stone-curlew is not considered to be a relevant ("affected") species for this SIS.

#### Turquoise Parrot and Swift Parrot

Whilst individuals of the Turquoise Parrot *Neophema pulchella* and/or Swift Parrot *Lathamus discolour* could theoretically utilise some of the open forest and woodland vegetation on the subject site, on

occasions at least, neither of these species have been recorded from the subject site itself or from other lands in the immediate vicinity or locality (see investigations cited in Chapter 3). Both of these species are highly nomadic, and will move significant distances in response to the availability of foraging resources (flowering eucalypts in particular).

Given those circumstances, these species could potentially occur throughout the forests of the study area, although (as noted above) neither species has been recorded on the subject site or in the immediate vicinity during the substantial investigations that have been undertaken for development proposals on Long Bow Point and in the Culburra West project lands.

Further, as discussed elsewhere in this SIS, there are substantial areas of potential habitat for these species in the locality and region, particularly in the extensive conservation reserves and State Forests present in the Shoalhaven LGA (Figures 7A and 7B). Even if these species do occur on the subject site on occasions, the land to be affected by the Culburra Golf Course project represents only a minute fraction of potential habitat in the locality and region.

The Turquoise Parrot and Swift Parrot are not regarded as relevant ("affected") species for this SIS.

# Green & Golden Bell Frog

The Green & Golden Bell Frog *Litoria aurea* is a large, highly mobile and terrestrial amphibian species, which is considered a 'pioneer species' and a 'disturbance specialist'. This species is regularly recorded in artificial ponds and water bodies (*eg* detention basins, brick pits).

The Green & Golden Bell Frog breeds in either temporary or permanent ponds, dams and swamps, but does not utilise flowing streams or watercourses for breeding purposes. It prefers ponds with reeds and/or other emergent vegetation, as well as with rock piles or other substrates on which to bask and in which to shelter or hibernate.

Green & Golden Bell Frogs have been located at a variety of locations within the Shoalhaven LGA, including around Culburra (Figures 16A and 16B; Appendix T) - including:

- along the northern edges of Lake Wollumboola (on occasions);
- in several artificial ponds in the southwestern part of Culburra Beach, and
- once on the subject land in an overgrown artificial wetland on the southern tributary of Downs Creek (in 1994), but never since.

There are key populations of this species in the Coomonderry Swamp (DECC 2005) and at Worrigee (to the immediate east of Nowra). The DECC<sup>8</sup> had prepared a *Management Plan for the Green & Golden Bell Frog Key Population within the Crookhaven River Floodplain* (DECC 2007), which identifies a sub-population of the species in Lake Wollumboola and at Culburra. However, the *Management Plan* notes that Green & Golden Bell Frogs have not been recorded in the drains and roads in or adjacent to Culburra since between 2003 and 2006.

There is no suitable habitat for the Green & Golden Bell Frog within or close to the proposed Culburra Golf Course. The only record of this species in the immediate vicinity was of an individual (in 1994) in a

<sup>8</sup> The DECC is now relevantly part of the OEH.

farm dam on a tributary of Downs Creek. This feature is located in a separate sub-catchment, and is located outside of the Culburra Golf Course "*subject site*".

Furthermore, the Culburra Golf Course project will contain a number of detention basins and bioretention swales - for water quality treatment and flow control. These features have been designed *inter alia* to provide potential new supplementary habitat for the Green & Golden Bell Frog (as discussed in Chapter 12).

The Culburra Golf Course project will be consistent with the Green & Golden Bell Frog *Management Plan* (DECC 2007):

- by avoiding potential impacts on any even theoretical Green & Golden Bell Frog habitat; and
- by providing additional potential habitat in artificial wetlands and detention basins within the Golf Course footprint.

The Green & Golden Bell Frog is not regarded as a relevant ("affected") species for this SIS.

# 8.4.4 Potential Threatened Fauna

Several species of threatened fauna have previously been recorded in the locality (Figures 16A and 16B) – but either have not been recorded on the subject site *per se* during any investigations, despite the presence of potential habitat and despite the conduct of appropriate surveys (Table 8.3; Appendices G and H) or are considered peripheral to the Culburra Golf Course project (*eg* the Grey-headed Flying Fox and Large-footed Myotis).

Table 8.3	Additional threatened fauna species which could potentially or theoretically utilise
	the Culburra Golf Course site on occasions

Common Name	Scientific Name	Comments
Masked Owl	Tyto novaehollandiae	Potentially present, but never recorded; not recorded at Culburra West; high mobility and large home range; substantial habitat in locality and region
Large-footed Myotis	Myotis adversus	Recorded on Long Bow Point; BUT no suitable foraging habitat (ponds, pools) or prime roosting resources present; suitable resources are widely distributed and well protected in locality and region
Gang Gang Cockatoo	Callocephalon fimbriatum	Recorded only once (in Culburra township); substantial potential habitat in locality and region
Scarlet Robin	Petroica boodang	Recorded only once on the Culburra West site (in 2010); not recorded elsewhere or since; substantial potential habitat in locality and region; additional habitat to be created
Varied Sittella	Daphoenositta chrysoptera	Recorded only once on the Culburra West site to the north (in 2010); not recorded elsewhere or since; substantial potential habitat in locality and region
Little Eagle	Hieraaetus morphnoides	Recorded only once soaring over the Culburra West land; not recorded elsewhere; substantial potential habitat in locality and region
Sooty Owl	Tyto tenebricosa	Recorded only once (by call in 2010) north of the Culburra Road; no particular habitat or resources on the site; not recorded elsewhere; substantial potential habitat in locality and region
Grey-headed Flying Fox	Pteropus poliocephalus	Recorded flying over Long Bow Point on occasions, and one individual foraging on Long Bow Point - once; suitable resources are widely distributed and very well protected in locality and region

This is a group of eight threatened fauna species which have been recorded in proximity to the subject land at Long Bow Point or (in the case of the Large-footed Myotis) has been recorded along Downs Creek. Whilst an individual Grey-headed Flying Fox has been recorded (once) foraging on Long Bow Point, the "*subject site*" does not contain significant resources for this species (see below).

Other than the Large-footed Myotis, these are species which are dependent upon open forest and woodland habitats. Because they have not been recorded on Long Bow Point during the investigations which have been conducted over a very long period, or (in the case of the Grey-headed Flying Fox) recorded just once foraging on Long Bow Point, it has been determined that they are not *"likely*" to be adversely affected by the Culburra Golf Course project to any relevant extent.

Nevertheless, there is some potential for individuals or small groups of these species to occur on Long Bow Point and/or within the "*subject site*", on occasions at least. Conversely, it cannot be considered "*likely*" that a "*viable local population*" of any of these additional 'potential' threatened species would be dependent upon the resources and habitat features contained within the "*subject site*" per se.

The potential for even individuals of any of these "*potential threatened species*" to be affected to a significant or relevant degree is considered to be miniscule. They would not be "*affected*" to such a degree as to warrant their consideration in detail in this SIS.

Nevertheless, as discussed in subsequent Chapters of this SIS, the potential for impacts to be imposed upon those species has been considered in the detailed consideration of those other forest and woodland dependent threatened fauna species which have been recorded on Long Bow Point. Thus, whilst not regarded as particularly relevant (*ie "affected"*) threatened fauna, potential issues wth respect to these threatened species have been taken into consideration in the Culburra Golf Course project, and throughout this SIS.

# Masked Owl

The Masked Owl *Tyto novaehollandiae* is a large nocturnal predator of small and medium-sized terrestrial mammals. It was observed roosting, and heard calling, within Currambene State Forest - to the southwest of the subject land during previous fauna investigations (Gunninah 1999f). Although recorded frequently within the Shoalhaven LGA (NPWS 1996), this species has not been recorded on the Culburra West project site or on Long Bow Point (Figures 16A and 16B).

Being territorial, the Masked Owl will frequently respond to taped calls broadcast within its territory, and may compete with the Powerful Owl for large hollow-bearing trees for roosting and nesting.

The Masked Owl prefers to forage in open areas adjacent to forest and woodland vegetation with a sparse understorey (Higgins 1999). Whilst the subject land supports suitable foraging resources and some suitable tree-hollows for the Masked Owl, these resources are not restricted to the subject site or the locality, and are well represented regionally.

The Masked Owl is not regarded as a relevant ("affected") species for this SIS.

# Large-footed Myotis

The Large-footed Myotis *Myotis adversus* is distributed throughout eastern and northern Australia, and roosts in caves, tunnels and under bridges, and sometimes in hollow-bearing trees. This species has very large back feet to catch insects and small fish from the water, and narrow wings for fast flight. Individuals of the Large-footed Myotis forage over creeks and ponds.

This species has been recorded on Long Bow Point (see below), but there are no suitable ponds or waterbodies present within the Culburra Golf Course development footprint. Further, no critical or important roosting habitat is present, although this species does on occasion use tree-hollows for roosting.

The Culburra Golf Course site and "*study area*" is not regarded as of any significance for the Largefooted Myotis, and is considered of only low value for this species, because:

- the subject site does not contain relevant suitable habitat or resources for this species;
- this species is highly mobile and wide-ranging, and would not be restricted to the subject site or be likely to reside on the site; and
- there are substantial areas of suitable habitat and resources for this species in the substantial conservation reserves and State Forests in the vicinity, locality and region.

The Large-footed Myotis had previously been recorded along Downs Creek and near the southeastern corner of Long Bow Point, along the edge of the mudflats at Lake Wollumboola (Figures 16A and 16B). This species could also potentially utilise pools further upstream along Downs Creek (under suitable circumstances).

However, there is no suitable habitat or resources of relevance for the Large-footed Myotis on or even close to the proposed Culburra Golf Course on Long Bow Point. Indeed, the provision of a number of detention basins and the substantial irrigation lake around the Golf Course would likely provide supplementary habitat for the Large-footed Myotis.

On that basis, the Large-footed Myotis is not regarded as a relevant ("affected") species for this SIS.

# Gang Gang Cockatoo

The Gang Gang Cockatoo *Callocephalon fimbriatum* is listed as a vulnerable species in the TSC Act, and occurs from southern Victoria throughout the southern and central eastern parts of NSW. In NSW, it occurs from the southeastern coast of the state to the Hunter region, and westwards to the central tablelands and southwest slopes.

The Gang Gang Cockatoo occupies tall dense wet sclerophyll forest during the summer, but moves to lower altitudes and more xeric forests and woodlands during the winter. It would therefore be only a seasonal visitor to the area. This species, like the Glossy Black Cockatoo, requires tree-hollows in trunks or in large tree limbs, with breeding usually occurring in tall mature sclerophyll forest with a dense understorey, and occasionally in coastal forests (Scientific Committee 2005).

Individuals of the Gang Gang Cockatoo were recorded over Culburra in December 2010 (Figures 16A and 16B), but this species has not been recorded at Culburra since that time (or previously), despite intensive investigations conducted both on Long Bow Point and on the Culburra West site. Given its high mobility and its migratory habits, and the very considerable area of native forest within conservation reserves, State Forests and private lands in the locality and region, the forests of the Culburra Golf Course site are not regarded as of particular relevance or significance for the Gang Gang Cockatoo.

The Gang Gang Cockatoo is not regarded as a relevant ("affected") species for this SIS.

#### Scarlet Robin

The Scarlet Robin *Petroica boodang* occurs in southeastern Australia and southwest Western Australia. In NSW, this species occupies open forest and woodland habitats, generally preferring xeric eucalypt forest and woodlands with an open understorey of shrubs and grasses.

The *Final Determination* to list the Scarlet Robin as a vulnerable species notes that "*Abundant logs and coarse woody debris are important structure components of its habitat*", as this species feeds on invertebrates associated with those habitat features.

The Scarlet Robin was apparently recorded by Lesryk Consulting on the Culburra West site in 2010 (Figure 16A). However, no individuals of this species have been recorded during any of the subsequent field surveys within that land or on the Culburra Golf Course land (on Long Bow Point).

Whilst it is doubtless possible that individuals or a small population of the Scarlet Robin theoretically could be present within the subject site, there are very substantial areas of contiguous vegetated habitat to the south and southwest, which would provide suitable resources for, and essentially identical habitat for, the Scarlet Robin at Culburra (Appendix T).

Whilst the subject site provides some (theoretically) potentially suitable habitat:

- this species has never been recorded on Long Bow Point despite being highly visible and despite a very substantial number of dedicated and opportunistic surveys;
- there is no 'unique' habitat for the Scarlet Robin present on the "subject site";
- potential habitat for this species (if present on the site) is widespread throughout the general locality; and
- there are substantial areas of potentially suitable habitat (if the species is present) in the locality and region particularly in the substantial conservation resources and State Forests in the region.

Further, the Culburra Golf Course project would potentially provide additional suitable habitat (grassy woodland and areas with a shrubby understorey and logs) for the Scarlet Robin.

The Scarlet Robin is not regarded as a relevant ("affected") species for this SIS.

# Varied Sittella

The Varied Sittella *Daphoenositta chrysoptera* utilises open forests and woodlands, as well as tall shrublands, parks and golf courses. It occurs throughout much of Australia, except in the harsher desert environments of central and northwestern Australia, and on the Nullarbor Plain.

The Varied Sittella has been recorded on only one occasion in the vicinity – with a small group observed foraging in open forest to the east of the existing industrial area of Culburra in 2010, to the north of the Culburra Golf Course site (Figure 16A). This species has not been recorded previously or since, and there is no evidence for a "*viable local population*" of the Varied Sittella, either on the subject site or subject land or within the general vicinity.

The Varied Sittella is not regarded as a relevant ("affected") species for this SIS.

## Little Eagle

The Little Eagle *Hieraaetus morphnoides* is a wide-ranging raptore which utilises forests, woodlands and shrublands throughout much of Australia. This species occupies substantial home ranges, and pursues a range of prey including birds, reptiles and small mammals.

An individual Little Eagle was observed flying over the Culburra West land (north of Long Bow Point) in December 2010 (Figure 16A). This species is occasionally recorded in the general locality, but there have been no records of Little Eagle nests on Long Bow Point to date.

Given that the Little Eagle has only been recorded once, soaring over the Culburra West land to the north, the subject site is considered to be of only limited or marginal relevance to this species. The proposed Culburra Golf Course is not regarded as of any concern with respect to the Little Eagle, given:

- the minute area of even potential habitat on the Golf Course site by comparison to the substantial areas of habitat in the locality and region;
- the extremely high mobility of the Little Eagle; and
- the considerable extent of relevant habitats and resources contained within the extensive conservation reserves and State Forests in the Shoalhaven LGA.

The Little Eagle is not regarded as a relevant ("*affected*") species for this SIS.

# Sooty Owl

The Sooty Owl generally occupies tall moist forests and rainforest communities, and occurs along the eastern parts of NSW and into the greater Dividing Range. Whilst not as large as the Powerful Owl, the Sooty Owl also requires large tree-hollows for nesting purposes.

The Sooty Owl *Tyto tenebricosa* is represented by a single record near Culburra Road, to the north of the subject land (Figure 16A). That was an aural record obtained in December 2010, in response to call playback of the Powerful Owl. There are no other records of the Sooty Owl in the survey area, either as a result of any other field surveys undertaken over the last two decades or on the OEH Wildlife Atlas (Appendix G; Figures 16A and 16B).

It is not considered likely that the Culburra Golf Course site constitutes significant or important habitat (if indeed habitat at all) for the Sooty Owl, given the generally xeric and open nature of the forests present. Further, even if this species is present in the locality, the subject site itself is not regarded as of particular relevance, given:

- the habitat requirements of the Sooty Owl which are not typical of the subject site;
- the minute area of even potential habitat by comparison to the substantial areas of habitat in the locality and region;
- the high mobility of the Sooty Owl; and
- the considerable extent of similar habitats and resources contained within the extensive conservation reserves and State Forests in the Shoalhaven LGA.

The Sooty Owl is not regarded as a relevant ("affected") species for this SIS.

#### Grey-headed Flying Fox

The Grey-headed Flying Fox is a wide-ranging megachiropteran bat, which occupies dedicated 'camps' (involving a few to many tens of thousands of individuals), and which utilises a wide range of foraging resources throughout the year.

This species has been recorded flying over the Culburra Golf Course site and subject land on a number of occasions, and could potentially utilise foraging resources within the "*subject site*" on occasions (one individual was recorded foraging on Long Bow Point once – in 2013). The open forest and woodland canopy clearly does not provide significant foraging resources for the Grey-headed Flying Fox, and there are no special or 'high value' food resources (such as fig trees or other fruiting species) present on Long Bow Point.

However, there are no 'camps' of the Grey-headed Flying Fox in the immediate vicinity of the subject land, and the potential resources present on the project site are widespread, abundant and well protected within the substantial conservation reserves within the locality and region.

The Grey-headed Flying Fox is not regarded as a relevant ("*affected*") species for this SIS, even though it has been recorded once on the land.

#### Conclusions

It is doubtless possible, theoretically at least, that some individuals of some of the threatened fauna species considered in this sub-chapter of the SIS could utilise parts of the subject land and/or subject site, on occasions at least.

However, with respect to these species, the following considerations need to be taken into account:

- there have been no records of most of these species on Long Bow Point itself, despite the conduct of significant and substantial field investigations at this location over a very long period (approximately two decades);
- in many instances, the site is of only marginal potential value at best because of the habits and habitat preferences of the species;
- there are substantial areas of potentially suitable habitat and resources for those species that rely on forests and woodlands in the immediate vicinity and general locality, including in substantial conservation reserves (National Parks and State Forests) nearby (Figure 7A); and
- there are very substantial areas of suitable habitat and resources for these species in the Shoalhaven region considerable areas of which are protected in conservation reserves and other government lands (Figure 7B).

It is noted that many of the potential threatened fauna species that could occur on or around the Culburra Golf Course site (with the obvious exception of the Green & Golden Bell Frog) share an array of habitat requirements. A general reliance on open forest and woodland habitats, and the requirement for hollow-bearing trees for breeding purposes, are common factors for most of these species.

Even the Scarlet Robin relies on woodland and other similar forest types, although it does not depend on tree-hollows. Nevertheless, consideration of the impacts which may potentially be imposed upon species which are dependent upon forest and woodland would incorporate consideration of the likely or potential impacts which would be imposed upon the Scarlet Robin, if it were to be present.

As a consequence, the further consideration of the relevant ("*affected*") threatened species throughout the remainder of this SIS also addresses the potential for impacts upon these additional potential threatened species.

Furthermore, the impact avoidance, amelioration and environmental offset measures which are considered hereafter within the SIS are of relevance with respect to the additional potential threatened species listed in Table 8.3 of this SIS.

Given those circumstances, the proposed Culburra Golf Course project on Long Bow Point is not considered to be of significance or special value for any of those additional threatened fauna species (Table 8.3), as discussed in this sub-chapter of this SIS.

None of these species is considered to be a relevant ("affected") species for this SIS.

# 8.4.5 Definite Threatened Species

As noted above, several threatened fauna species have been recorded on the "*subject site*" and/or the "*subject land*" on a number of occasions during recent investigations. For these species (Table 8.4) the Culburra Golf Course "*subject land*" is acknowledged as existing functional habitat which is, or is likely to be, used by a "*viable local population*" of at least some of those species.

Table 8.4	Threatened fauna species that have been recorded 'regularly' on the subject land or in the
	immediate vicinity during current and recent field investigations

Common Name	Scientific Name	Comments
Square-tailed Kite	Lophoictinia isura	Recorded regularly soaring over the subject site; a single nest is present on Long Bow Point; highly mobile and wide-ranging, with a very large home range (100km <sup>2</sup> +)
Glossy Black Cockatoo	Calyptorhynchus Iathami	Recorded frequently and widely in the Jervis Bay region; recorded frequently on subject land; scattered patches of foraging resources on the land (mostly to be avoided); moderate density of potentially suitable tree-hollows (but never recorded breeding on Long Bow Point)
Powerful Owl	Ninox strenua	Recorded frequently and widely at Culburra, but not in the Golf Course footprint; widely distributed in the Shoalhaven; tree-hollows and foraging habitat present; suitable resources are widely distributed and well-protected in locality and region
East-coast Freetail Bat	Micronomous norfolkensis	Recorded on Long Bow Point and at Culburra West (to the north); suitable foraging habitat and possible roosting resources present (species occasionally roosts in tree- hollows); suitable resources are widely distributed and well protected in locality and region
Common Bent-wing Bat	Miniopterous schreibersii	Recorded on Long Bow Point and at Culburra West (to the north); suitable foraging habitat and roosting resources present; suitable resources are widely distributed and well protected in locality and region
Eastern Falsistrelle	Falsistrellus tasmaniensis	Recorded on Long Bow Point and at Culburra West (to the north); suitable foraging habitat and roosting resources present; suitable resources are widely distributed and well protected in locality and region
Greater Broad-nosed Bat	Scoteanax rueppellii	Recorded on Long Bow Point and at Culburra West (to the north); suitable foraging habitat and roosting resources present; suitable resources are widely distributed and well protected in locality and region
Yellow-bellied Sheath-tail Bat	Saccolaimus flaviventris	Recorded on Long Bow Point and at Culburra West (to the north); suitable foraging habitat and roosting resources present; suitable resources are widely distributed and well protected in locality and region
Little Bent-wing Bat	Miniopterus australis	Recorded once on Long Bow Point – in moist forest along Wattle Creek; suitable foraging habitat and roosting resources present; suitable resources are widely distributed and well protected in locality and region
Yellow-bellied Glider	Petaurus australis	Recorded on the Golf Course site – between Hole 1 and Lake Wollumboola; no feed trees in subject site <i>per se</i> ; substantial potential habitat in locality and region

These are the species considered by the author of this SIS to constitute the relevant ("*affected*") species for this SIS (*ie* those "*species that are likely to be affected by the action*").

As noted above, the consideration of the relevant ("*affected*") species identified in Table 8.4 of the SIS is also of consequence with respect to those other threatened biota that might potentially occur on the subject site (see Chapter 8.3 above). It is not considered likely that there are any threatened fauna species likely to be present on or around the Culburra Golf Course project footprint and which could theoretically be affected by the proposal that would not be dependent upon open forest and woodland habitats.

Consequently, the consideration of the relevant ("*affected*") threatened species – below and in further detail throughout the remainder of this SIS – is also relevant for other threatened fauna that might be present in the immediate vicinity.

#### Square-tailed Kite

The Square-tailed Kite *Lophoictinia isura* has been recorded flying over the *"subject site"* and elsewhere in the locality. In addition, an active nest of this species was located on Long Bow Point during the surveys for this SIS (Figures 16A and 17).

The Square-tailed Kite is a wide-ranging raptor which preys upon small birds and large insects. It is generally solitary, with breeding pairs requiring very large home ranges - of at least 100km<sup>2</sup> (Daly & Evison 1995; Debus & Czechura 1989). The subject land provides both foraging and nesting habitat for the Square-tailed Kite, but the Culburra Golf Course footprint *per se* would only form an extremely small part (less than 0.3%) of a much larger home range for even a pair of this species (see Appendices S and T).

In addition to having been observed on a number of occasions soaring over Long Bow Point and the Culburra West lands, the Square-tailed Kite has recently been recorded nesting on Long Bow Point, as noted above. An active nest of the species, with a pair and at least one chick, were observed during 2013, on the southern side of the upper reaches of Wattle Creek (Figure 17). As a consequence of that observation, a number of elements of the Culburra Golf Course project have been specifically redesigned (Figure 17) in order *inter alia* to retain and protect this Square-tailed Kite nest tree.

Further detailed consideration of the Square-tailed Kite is provided in subsequent chapters of this SIS.

#### Glossy Black Cockatoo

The Glossy Black Cockatoo *Calyptorhynchus lathami* is a large member of the cockatoo family. It is distributed widely throughout eastern Australia, particularly east of the Great Dividing Range. This species is highly mobile and sometimes nomadic, moving in response to the availability of suitable food resources.

Critical resources for the Glossy Black Cockatoo include:

• areas of dense she-oak stands (particularly the Black She-oak Allocasuarina torulosa and/or the Forest Oak A. littoralis) - on which the Glossy Black Cockatoo feeds; and

• hollow-bearing trees with 'pipes' or 'chimneys' - in which to nest and rear young.

The Shoalhaven Local Government Area (LGA) appears to be a stronghold for the Glossy Black Cockatoo in coastal NSW. This species is regularly recorded throughout the Shoalhaven LGA, including within the substantial State Forests, National Parks and private forested lands throughout the LGA (Appendix T; F Dominic Fanning *pers obs*).

The minimal records of this species in the extensive National Parks and Nature Reserves of the Shoalhaven LGA (Appendix T) should not be considered as demonstrating that the species does not occur in these areas. Rather, these limited records more likely reflect the inadequacy of detailed field investigations in those reserves (in contrast to the subject land and Culburra West).

The Glossy Black Cockatoo has been recorded regularly on Long Bow Point. The "subject land" contains moderate to large patches of she-oaks in which Glossy Black Cockatoos have been regularly recorded (F Dominic Fanning *pers obs*).

Evidence of Glossy Black Cockatoo foraging has also been obtained by Gunninah Environmental Consultants within lands which are now part of the Jervis Bay National Park (further to the south of the subject land). As noted elsewhere, this species is regularly recorded during field investigations in the Shoalhaven LGA, and the subject land is not unusual or particularly significant in this regard.

Whilst Glossy Black Cockatoos have been sighted frequently on Long Bow Point, over a very long period of field investigations, there has never been any record of breeding by Glossy Black Cockatoos on Long Bow Point (F Dominic Fanning *pers obs*; *Bibliography*). This is despite the array of apparently suitable hollow trees and stags.

The Glossy Black Cockatoo is undoubtedly a relevant (*ie* an "*affected*") species for this SIS.

# Powerful Owl

The Powerful Owl *Ninox strenua* is the largest of Australia's owl species, and has a distribution which includes the whole of the eastern part of Australia - from the Cape York Peninsula to Tasmania. This species inhabits tall, generally moist, forest communities, although it also utilises open dry forest and even patches of remnant trees in urban environments (F Dominic Fanning *pers obs*).

Important elements of the habitat requirements and behavior of the Powerful Owl include:

- a healthy population of arboreal mammals upon which this species primarily feeds noting that the Powerful Owl also takes Flying Foxes and some birds as prey;
- a substantial home range (of approximately 1000ha for a breeding pair) to provide suitable roosting and multiple nesting hollows, and a sufficient food supply;
- patches of suitable trees for diurnal roost sites such as Turpentines and other species with a dense canopy; and
- very large tree-hollows in which to nest and rear young.

The Powerful Owl has been recorded from a number of widely distributed locations at Culburra and in the surrounding forested lands (Figures 16A and 16B; Appendix T). Observations of the Powerful Owl

on and near the subject land have been obtained by Gunninah Environmental Consultants and Environmental InSites between 1995 and the present, although there are no recent records within the *"subject site"* (*ie* the Culburra Golf Course footprint) *per se*.

Notably, two roost trees and a very large nest tree for the Powerful Owl had been identified previously on the land to the immediate north of the Culburra Road (Figure 16A). The nest tree is located only about 25m from the Culburra Road, but no nesting activities have been observed for several years. However, an individual Powerful Owl was observed on Lot 51 in DP 1124845 (approximately 3km to the southwest) in February 2013 by SLR Ecology, during a survey of that land, and a Powerful Owl responded more recently (in 2013) to call playback – calling from south of Downs Creek.

In addition to the previous records obtained by Gunninah Environmental Consultants during investigations in the Culburra locality, there are substantial other records of Powerful Owls both in the immediate vicinity and in the general Jervis Bay area (Appendix J; Figure 16B; Appendix T).

The Powerful Owl is widespread in the Jervis Bay area, and the extensive naturally forested areas of the Shoalhaven LGA (including the very considerable extent of National Parks and State Forests – see Chapter 4) provide substantial resources for this species throughout the region (Figures 7A and 7B). There are 229,000 hectares of National Parks estate in the 'Shoalhaven LGA, as well as 52,000ha of State Forests and an additional 31,000ha of (mostly forested) Crown lands.

As noted above, recent surveys of the Culburra West Project site and Long Bow Point since 2010 by Environmental InSites and SLR Ecology have revealed no evidence of those (or any other) trees currently being used by Powerful Owls for nesting or breeding purposes.

On the basis of those considerations, the Powerful Owl is a relevant "affected" species for this SIS.

#### East-coast Freetail Bat

The East-coast Freetail Bat *Micronomus norfolkensis* is a small insectivorous bat which utilises dry eucalypt forest and coastal woodlands - although individuals have also been captured within riparian zones, wet sclerophyll forest and rainforest (Allison & Hoye 1995; Churchill 2008).

This species forages above the canopy or in unobstructed corridors in open areas (Strahan 1995), primarily on either winged or wingless ants (Allison 1989). Small colonies of the East-coast Freetail Bat roost in tree-hollows or under loose bark on large trees (Churchill 2008).

This species has been recorded within the subject land at Culburra, and on the Culburra West site to the north. It is likely to utilise much or all of the forested areas of the subject site, as well as surrounding lands and forests throughout the locality and region (Appendix T). There is a substantial supply of potential roosting habitat for this species (hollow-bearing and large trees) throughout the subject land, the overwhelming majority of which is to be retained (due to the careful design of the Golf Course). Any tree-hollows that need to be removed will be the subject of the *Hollow-bearing Tree Protocol* (see Chapter 12).

The East-coast Freetail Bat is a relevant "affected" species for this SIS.

#### Common (Eastern) Bent-wing Bat

The Common (Eastern) Bent-wing Bat *Miniopterus schreibersii* forages above dry and moist forest, and can be found in forested as well as urban areas. This species preferentially roosts in caves, although man-made structures (such as old mines, tunnels, bridges, and other similar structures) are also used, and occasionally hollow-bearing trees. Specific maternity caves are used by females during summer to give birth.

The Common Bent-wing Bat has been recorded within the subject land and on the Culburra West site to the north. Individuals can be expected to utilise much or all of the forested areas of the subject land and general locality, and throughout the region (Figures 7A and 7B), for foraging purposes. However, no significant roosting habitat is present on the subject site for this species, although individuals do utilise tree-hollows for roosting on occasions.

The Common (Eastern) Bent-wing Bat is considered to be a relevant "affected" species for this SIS.

# Little Bent-wing Bat

The Little Bent-wing Bat *Miniopterus australis* generally forages above dense moist forest, and generally roosts in caves, although man-made structures (such as old mines, tunnels, bridges, and other similar structures) are also used. Specific maternity caves are used by females to give birth, and only a few such sites are known in NSW.

The Little Bent-wing Bat was recorded once within the subject land – in moist forest along the lower part of Wattle Creek. Individuals are likely to utilise the moist forests on the subject land and in the general locality, and throughout the region (Figures 7A and 7B), for foraging purposes. No roosting habitat is present on the subject site for this species.

The Little Bent-wing Bat is considered to be a relevant *"affected"* species for this SIS, despite being recorded only once on the land (outside the Golf Course footprint).

#### Greater Broad-nosed Bat

The Greater Broad-nosed Bat *Scoteanax rueppellii* is found in a variety of habitats - ranging from woodlands to moist and dry eucalypt forest and rainforest (Hoye & Richards 1995; Churchill 2008). This species prefers open habitats in which individuals can fly straight and direct, and is known to utilise artificial openings in forests, with favoured habitats being river and creek corridors (Hoye & Richards 1995). Individuals have been recorded roosting in tree-hollows, cracks and fissures in the trunks and boughs of stags, and under exfoliating bark.

This species has been recorded within the subject land at Culburra, and in the vicinity and general locality. The Greater Broad-nosed Bat would be expected to utilise much or all of the forested areas of the subject land and surrounding lands.

There is a substantial supply of hollow-bearing trees as potential roosting habitat for this species, including in the substantial adjoining lands and National Parks lands (Figures 7A and 7B). Any removal

of tree-hollows or hollow-bearing trees for future development of the Culburra Golf Course will be subject to implementation of the *Hollow-bearing Tree Protocol* (see Chapter 12).

The Greater Broad-nosed Bat is considered to be a relevant "affected" species for this SIS.

## Yellow-bellied Sheath-tail Bat

The Yellow-bellied Sheath-tail Bat *Saccolaimus flaviventris* is found in a variety of habitats, ranging from grasslands and desert to woodlands, moist and dry eucalypt forest and rainforest (Churchill 2008). This species flies "*fast and straight usually above the canopy, but lower over open spaces and at the forest edge*" (Churchill 2008), and roosts in large tree-hollows.

The Yellow-bellied Sheath-tail Bat has been recorded on the subject land at Culburra, and elsewhere in the locality (Figures 16A and 16B). This species would be expected to utilise the forested areas of the subject site as well as the substantial areas of suitable habitat in the surrounding lands. There are substantial National Parks and State Forests in the vicinity and throughout the LGA (Figures 7A and 7B), and it is anticipated that significant areas of forest habitat will also be retained on private lands in the vicinity for conservation purposes.

The Yellow-bellied Sheath-tail Bat is considered to be a relevant ("affected") species for this SIS.

# Eastern Falsistrelle

The Eastern Falsistrelle *Falsistrellus tasmaniensis* has been recorded from coastal mallee and moist forest, generally with a dense understorey (Churchill 2008). This species is a "*swift and direct*" flier, generally targeting larger prey (Churchill 2008), and usually roosts in tree-hollows.

The Eastern Falsistrelle has been recorded on the subject land at Culburra, and in the locality. This species would be expected to utilise most or all of the forested areas of the subject site and surrounding lands, including the extensive forests in National Parks and State Forests, and substantial areas of private forested land zoned for conservation purposes.

Given the high mobility of this species and the retention of large areas of habitat containing suitable foraging resources within the vicinity, locality and region (Figures 1, 7A, 7B and 7C), the proposed Culburra Golf Course project is not likely to impose any significant adverse impacts upon any local population of the Eastern Falsistrelle.

The Eastern Falsistrelle is considered to be a relevant ("affected") species for this SIS.

#### Yellow-bellied Glider

The Yellow-bellied Glider *Petaurus australis* is a moderate-sized gliding marsupial which utilises an array of open forest and woodland vegetation in eastern NSW, as well as in Queensland and Victoria. This species utilises tree-hollows for nesting and breeding purposes, and is well known to incise the bark of trees (frequently bloodwoods) to induce the secretion of sap, upon which it feeds. Yellow-

bellied Gliders also feed on nectar and blossoms, but are generally reliant (particularly in the winter months) on sap.

The Yellow-bellied Glider has been recorded on or in close proximity to the "*subject site*" (*ie* the Culburra Golf Course project footprint) in recent surveys (2013) – in the forest 'buffer' between Hole 1 and Lake Wollumboola (Figure 16A). This species was recorded at similar locations on Long Bow Point in 1999 and 2001 (Figure 16B) as well further to the southwest (Figure 16B). It has not been recorded elsewhere on Long Bow Point or the subject land, nor has it been recorded in the Culburra West lands (to the north).

The Yellow-bellied Glider sightings at the end of Long Bow Point (Figure 16A) were of:

- 3 adults and one juvenile in January 2013; and
- 2 adults in April 2013.

The Yellow-bellied Glider is considered to be a relevant ("affected") species for this SIS.

# 8.5 Endangered Ecological Communities

# 8.5.1 Alleged Endangered Ecological Communities

The DGRs for this SIS provide a list of 7 "*endangered ecological communities*" (EECs) as "*subject ecological communities*" (or "*subject species*"), which need to be considered within the SIS (Tables 5.6 and 8.5; Appendix U).

An additional EEC is claimed (by Shoalhaven City Council) to be present around Long Bow Point – the Coastal Saltmarsh (CSM) community. However, it is also the opinion of the author of this SIS that the fringing vegetation around Lake Wollumboola, whilst floristically similar to the CSM community, does not conform to that EEC (see below).

In the first instance, it is necessary to determine whether any of those EECs is present on the "*subject site*" or at this locality. Subsequently, it is necessary to determine whether or not any EEC constitutes a relevant or "*affected*" EEC – on the basis of the likelihood or otherwise of a significant or any adverse effect upon any such EECs.

# 8.5.2 EEC Presence - Or Not

Detailed and thorough consideration by the author of this SIS has been given to the presence or otherwise of listed "*endangered ecological communities*" (EECs) – identified in the DGRs - which might be present on or adjacent to the subject land at Culburra.

It is the opinion of the author of this SIS (Mr F Dominic Fanning) that none of the vegetation types present on or around the subject land at Long Bow Point constitute an EEC - notwithstanding the fact that some of those communities satisfy the floristic criteria for one or other of the EECs included in the DGRs and/or listed in the TSC Act.

As discussed in detail below, whilst some of those vegetation types satisfy the floristic criteria for various EECs, they do not satisfy other criteria – in particular, relevant geographic location and/or geophysical characteristics (as discussed in detail below for each of the putative EECs).

Threatened Ecological Communities (TECs), of which EECs are a subset, are defined by the *Final Determinations* for each TEC made by the NSW Scientific Committee, and published in the NSW Government Gazzette. Those *Final Determinations* contain detailed descriptions of the TECs - which include *inter alia* the following.

- Floristic Descriptors the "assemblage of species" which constitute the community (including variations in that assemblage).
- Locational Descriptors which include:
  - the Biogeographic Region to which the TEC is confined;
  - the Local Government Areas in which the TEC is located; AND
  - "locational criteria" which refine the locations in which the TEC occurs.
- Edaphic, Topographic, Hydrologic and Structural Criteria which further refine the definition of the TEC.

All of these descriptors and criteria are, or at the very least may be, critical in determining whether or not a patch of vegetation in fact constitutes an example of a particular TEC.

There are two seminal cases in the NSW Land & Environment Court which demonstrate the role and relevance of the descriptors and criteria contained in the *Final Determinations* of TECs in establishing their presence (or otherwise) on a site – both being judgements by the Chief Judge of the L&E Court (Preston CJ):

- Motorplex (Australia) Pty Limited v Port Stephens Council [2007] NSWLEC 74
- Gales Holdings Pty Limited v Tweed Shire Council [2008] NSWLEC 209

Helpfully for the purposes of this SIS, both cases deal with several of the EECs claimed by some to exist on the subject land at Culburra – particularly communities located on or associated with "*coastal floodplains*".

And in both instances, Preston CJ explored (as relevant) the following criteria in order to determine the presence or otherwise of TECs:

- Floristic the "assemblage of species" and "characteristic species"
- Structural for example, the requirement for the Freshwater Wetlands EEC to contain "amphibious, emergent, floating or submerged forbs, grasses or sedges" (NSWLEC 209 paragraphs 100 and 101)
- Edaphic the soils on which the TEC occurs, as described in the *Final Determinations* (eg NSWLEC 209 paragraphs 107 and 108)
- Topographic for example, the Freshwater Wetlands EEC occurs "*in depressions, flats, drainage lines, backswamps, lagoons and lakes*" (NSWLEC 209 paragraphs 63 and 64)
- Locational whether the vegetation units mapped on the relevant land are "associated with coastal floodplains" (eg NSWLEC 209 paragraphs 86 and 115)
- Hydrologic whether the groundwater is *saline or sub-saline*" (*eg* NSWLEC 209 paragraphs 130 and 131) with respect to the Swamp Oak Floodplain EEC

A key criterion for the presence of the TECs that are identified in the *Final Determinations* as being located on or are "*associated with coastal floodplains*" is the presence of a "*coastal floodplain*" in the location or vicinity – with which the community might be "*associated*".

Critically, in the case of the Culburra Golf Course, there is no "*coastal floodplain*" present on or around Long Bow Point. As noted above (in Chapter 5.8), neither Downs Creek nor Wattle Creek possess the topographic or geomorphological features of a "*floodplain*" – notwithstanding the occasional flooding of parts of their lower reaches. The fact that a piece of land may occasionally become flooded does not mean that it is therefore a "*floodplain*".

Although swampy in places, and occasionally flooded, the low-lying parts of Downs Creek and Wattle Creek do not constitute "*floodplains*". These areas are simply 'sinks' or 'swamps' – into which overland stormwater flows and accumulates.

As a consequence, none of the mesic vegetation types on and around Long Bow Point satisfy the locational criterion of being located on or "*associated with coastal floodplains*". These vegetation types, therefore, are not EECs.

# 8.5.3 Consideration of Alleged EECs

Detailed and thorough consideration by the author of this SIS has been given to the presence or otherwise of listed "*endangered ecological communities*" (EECs) – identified in the DGRs and/or by the SSC - which have been asserted to be present or which might be present on or adjacent to the subject land at Culburra (Table 8.5).

EEC	Considerations		
Swamp Oak Floodplain Forest	There is vegetation on the subject land that conforms floristically to this EEC – Swamp Oak Forest (Map Unit M3)		
	<ul> <li>Patches of Swamp Oak Forest are located in the lower reaches of Wattle Creek, and as bands around Lake Wollumboola</li> </ul>		
	<ul> <li>However, there is no "coastal floodplain" on the subject land, or adjacent to it</li> </ul>		
Littoral Rainforest	• There is <b>no</b> vegetation community with the required floristics present on the subject land or in its vicinity		
Bangalay Sand Forest	There is <b>no</b> appropriate soil substrate (" <i>marine sands</i> ") on the subject land		
Freshwater Wetlands on Coastal Floodplains	• The only vegetation with the floristic characteristics of this community is located within a farm dam on a tributary to Downs Creek, to the southeast of the subject land (Map Unit W4)		
	• The Final Determination specifically excludes farm dams		
	<ul> <li>In addition, the farm dam is not located on, or "associated with", a "coastal floodplain"</li> </ul>		
Illawarra Lowlands Grassy Woodland	The <i>Final Determination</i> for this EEC states that it is present in only the Kiama, Wollongong and Shellharbour LGAs		
	• The EEC is <b>not</b> identified as being present in the Shoalhaven LGA		
Swamp Sclerophyll Forest or Coastal Floodplains	<ul> <li>There is vegetation on the subject land that may conform floristically to this EEC – Map Units M1a, M1b, M2a, M2b and M4</li> </ul>		
	<ul> <li>However, there is no "coastal floodplain" on the subject land, or adjacent to it</li> </ul>		
River-Flat Eucalypt Forest on Coastal Floodplains	There is vegetation on the subject land that conforms floristically to this EEC – Map Units M1a, M1b and M4		
	<ul> <li>However, there is no "coastal floodplain" on the subject land, or adjacent to it</li> </ul>		
Coastal Saltmarsh	<ul> <li>The bands of Sea Rush-Twig Rush Herbland (Map Unit W1b) around Long Bow Point conform floristically to this EEC</li> </ul>		
	<ul> <li>However, that vegetation type is <b>not</b> located in an "<i>intertidal zone</i>"</li> <li>– even when Lake Wollumboola is open to the sea</li> </ul>		

**Table 8.5** Endangered Ecological Communities (EECs) for consideration at Long Bow Point

# The full names of the EECs are contained in the *Glossary* to this SIS.

As noted above, it is the position of the author of this SIS that none of those EECs are present on or adjacent to the subject land at Culburra.

Furthermore, even if any of these EECs were deemed to be present on the subject land, it is the opinion of the author of this SIS that the proposed Culburra Golf Course project would not adversely affect any such EEC to any relevant extent (as discussed in Chapter 10). In particular, there is NO likelihood of a *"significant effect"* – because:

- the Golf Course is located at some considerable distance from the 'Floristic' Coastal Saltmarsh EEC; and/or
- the Golf Course design has been refined specifically to avoid most of the vegetation types that have floristic affinities with those EECs (*eg* the 'Floristic' Swamp Oak Floodplain Forest and 'Floristic' Swamp Sclerophyll Forest on Coastal Floodplains EECs); and/or
- the stormwater management system has been designed specifically *inter alia* to avoid any adverse impacts on those vegetation types.

# Swamp Oak Floodplain Forest

There are areas of Swamp Oak Forest on the subject land at Culburra, particularly in the lower parts of the Wattle Creek catchment and around the foreshores of Lake Wollumboola (see Chapter 5; Figures 11A and 13A). This vegetation type conforms floristically to the Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SOFF) community - which is listed as an EEC in the TSC Act (Appendix U).

However, there is no "*coastal floodplain*", nor any other type of "*floodplain*", on the subject land at Long Bow Point, nor adjacent to (nor indeed "*associated with*") it. The fact that a piece of land occasionally becomes flooded, does not mean that it is a "*floodplain*".

The lower parts of both Wattle Creek and Downs Creek certainly contain low-lying areas and swamp forest vegetation. However, there is no "*floodplain*" along either of these watercourses, nor around Lake Wollumboola. As noted in Chapters 5.8 and 8.5.2, these low-lying areas, and the periphery of the Lake, are doubtless flooded on occasions. However, these areas do not display the specific characteristics of the geomorphological or topographic features known as "*floodplains*".

Given that circumstance, the Swamp Oak Forest community on and adjacent to Long Bow Point at Culburra does not constitute the SOFF EEC. There is, consequently, no requirement to further consider the SOFF community in this SIS.

Furthermore, it should be noted that most of the Swamp Oak Forest community on the subject land is to be retained, protected, and enhanced - by virtue of the long-term management of vegetation on the subject land as a private Conservation Reserve (see Chapter 12), outside of the Golf Course development and/or between fairways.

Thus, even if the SOFF community was present on the subject land (which is not conceded by the author of this SIS), the Culburra Golf Course project would not involve the imposition of a "*significant effect*", or indeed any adverse effect, upon that community (see Chapter 10; Appendix X).

#### Littoral Rainforest

None of the vegetation on the subject land at Culburra conforms floristically to, or even vaguely resembles, the EEC known as Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions (Appendix U).

There is no Littoral Rainforest EEC present on the subject land or adjacent to it.

#### **Bangalay Sand Forest**

There are areas of vegetation on the subject land at Culburra which are dominated or co-dominated by the Bangalay *Eucalyptus botryoides*. Some of these patches could conform floristically to the Bangalay Sand Forest in the Sydney Basin and South East Corner Bioregions EEC (Appendix U).

However, none of the soil substrates on the subject land at Culburra are marine or aeolian sands. Consequently, any Bangalay vegetation on the subject land at Culburra does not satisfy the edaphic criterion for the Bangalay Sand Forest community.

There is no Bangalay Sand Forest EEC on the subject land at Culburra.

# Freshwater Wetlands on Coastal Floodplains

The *Final Determination* for the Freshwater Wetlands on Coastal Floodplains (FWCF) "*endangered ecological community*" (EEC) states *inter alia* that this community typically occurs "*in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains*" (Appendix U). In addition, the *Final Determination* specifically excludes artificial wetlands (such as farm dams) from the EEC.

The only area of vegetation with the floristic characteristics of the FWCF community adjacent to the subject land is vegetation associated with an artificial farm dam on a tributary to Downs Creek, to the southeast of the subject land. Given the terms of the *Final Determination* for the EEC (cited above), that vegetation does not constitute an example of the FWCF community - because it is a farm dam.

Furthermore, as discussed elsewhere in this Chapter of the SIS, there is no "coastal floodplain" either on or "associated with" the subject land at Long Bow Point.

On the basis of the considerations outline above, the Freshwater Wetlands on Coastal Floodplains EEC is not present on the subject land at Culburra.

In any case, as noted above, the Artificial Wetland/Sedgeland on the subject site is not to be affected in any way by the proposed Culburra Golf Course. That feature is located in a different catchment to any of the Golf Course elements, and there will be no impacts of any nature whatsoever imposed upon that community. It is, therefore, of no relevance even if it is deemed to constitute the FWCF community (which is not conceded).

#### Illawarra Lowlands Grassy Woodland

Some of the vegetation on the subject land at Culburra could potentially satisfy the floristic criterion of the EEC known as Illawarra Lowlands Grassy Woodland of the Sydney Basin Bioregion (ILGW) community (Appendix U).

However, any such vegetation which may be present fails to constitute the EEC - because:

- the groundcover of any vegetation which has an appropriate canopy does not have a predominantly grassy understorey but rather is characterised by a shrubby understorey with mat-rushes and only scattered grasses; and
- the Illawarra Lowlands Grassy Woodland EEC is identified in the *Final Determination* for this community as occurring in (and confined to) the Wollongong, Kiama and Shellharbour Local Government Areas (LGAs). As a consequence, the Illawarra Lowlands Grassy Woodland EEC cannot be present at Culburra - as the subject land is located in the Shoalhaven LGA.

The Illawarra Lowlands Grassy Woodland EEC is not present on the subject land at Culburra.

# Swamp Sclerophyll Forest on Coastal Floodplains

There are areas of Swamp Forest vegetation on the subject land at Culburra, particularly the M1a, M1b, M2a, M2b and M4 communities, along Wattle Creek and Downs Creek (Figures 11A, 11B and 13A). These vegetation types conform floristically to the Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SSFCF) community, which is listed as an EEC in the TSC Act (Appendix U).

However, as noted above, there is no "*coastal floodplain*", nor any other type of "*floodplain*", on the subject land at Culburra. Further, Long Bow Point is not "*associated with*" any "*coastal floodplain*" (*ie* there is no "*coastal floodplain*" around Lake Wollumboola, or otherwise "*associated with*" the subject land).

The lower parts of both Wattle Creek and Downs Creek certainly contain low-lying areas and swamp forest vegetation. However, neither of these watercourses, nor Lake Wollumboola, contains or is associated with a *"floodplain"* of any type.

Given those circumstances, the Swamp Forest vegetation on the subject land at Culburra does not constitute the SSFCF "*endangered ecological community*".

Furthermore, it should be noted that the overwhelming majority of the Swamp Forest communities on the subject land are to be retained, protected, and enhanced - by virtue of the long-term management of vegetation on the subject land and/or between golf course fairways as a private Conservation Reserve (see Chapters 10 and 12).

Thus, even if the SSFCF community was present on the subject land (which is not conceded by the author of this SIS), the Culburra Golf Course project would not involve the imposition of a "*significant effect*" upon that community (see Chapter 10; Appendix X).

#### **River-flat Eucalypt Forest on Coastal Floodplains**

There are also some areas of Swamp Forest vegetation on the subject land at Culburra (Figures 11A, 11B and 13A) that conform floristically to the River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (REFCF) community - which is listed as an EEC in the TSC Act (Appendix U).

As discussed above, however, there is no "coastal floodplain", or any other type of "floodplain", on the subject land at Culburra, and Long Bow Point is not "associated with" any "coastal floodplain".

Given that circumstance, the Swamp Forest vegetation on the subject land at Culburra does not constitute the REFCF "*endangered ecological community*".

As also noted above, the overwhelming majority of the Swamp Forest communities on the subject land are to be retained, protected, and enhanced - by virtue of the long-term management of vegetation on the subject land and/or between golf course fairways as a private Conservation Reserve (see Chapter 12).

Thus, even if the REFCF community was present on the subject land (which is not conceded by the author of this SIS), the Culburra Golf Course project would not involve the imposition of a "*significant effect*" (or indeed any "*effect*") upon that community (as discussed in detail in Chapter 10 and Appendix X of this SIS).

#### Coastal Saltmarsh

The Sea Rush-Twig Rush Herbland, which is located around the bays at the entrances of Downs and Wattle Creeks into Lake Wollumboola and along the shoreline on Long Bow Point (Figures 11B and 13A; Appendix M2), is not regarded by the author of this SIS as an example of the Coastal Saltmarsh (CSM) community.

Whilst a number of plant species present in that community (as listed in the *Final Determination* by the NSW Scientific Committee) are present within the Sea Rush-Twig Rush Herbland (Map Unit W1b), Lake Wollumboola does not satisfy a key and critical criterion for the CSM community (Appendix U).

Paragraph No. 1 of the Final Determination states that "Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Coast Bioregions is the name given to the ecological community occurring in the **intertidal zone** on the shores of estuaries and lagoons including when they are intermittently closed" (emphasis added).

In the first instance, Lake Wollumboola is not "*intermittently closed*". It is "*intermittently open*" (*ie* the Lake is predominantly **not** tidal),

Further, the "Coastal Saltmarsh" community cannot exist in Lake Wollumboola - because there is **no** relevant "intertidal zone" in Lake Wollumboola. When Lake Wollumboola is open to the ocean (which is only a very small fraction of the time), the Sea Rush-Twig Rush Herbland would be located well above any "intertidal zone" during the short periods that the Lake is open to the ocean.

As a consequence, the Sea Rush-Twig Rush Herbland vegetation around the edges of Lake

Wollumboola fails the first paragraph of the *Final Determination* of the Coastal Saltmarsh community – in terms of the locational criterion of the *Final Determination*. Vegetation within Lake Wollumboola, cannot therefore, constitute the CSM community.

In any case, the Sea Rush-Twig Rush Herbland is located at some considerable distance from any element of the Culburra Golf Course project, and will not be affected by the project, in any way whatsoever.

# 8.5.4 Conclusions

Some of the vegetation types on or around Long Bow Point conform to the floristic descriptions of a number of "*endangered ecological communities*" (EECs) listed in the TSC Act (as discussed above).

However, none of those EECs are regarded by the author of this SIS (Mr F Dominic Fanning) as being present on the subject land at Culburra - because they fail one or more of the necessary criteria for those EECs - locational, topographic, edaphic and/or structural (Appendix U).

As a consequence, none of those EECs are regarded as relevant (or "*affected*") "*ecological communities*" for the purposes of this SIS.

Nevertheless, the current design of the Culburra Golf Course (generated by the author of this SIS and a professional golf course designer) has adopted a highly 'precautionary' approach to the project.

Some elements of the earlier designs that had encroached significantly into those 'Floristic EECs' have been re-designed to avoid them or to limit such incursions. The only notable incursion into any mesic communities is to consist of a single crossing of Downs Creek for a golf buggy access to Holes 13 and 14, and minor incursions into 'Ecotone' vegetation at a few locations (Figure 14), as well as minor incursions into some Swamp Oak Forest along Wattle Creek. The overwhelming majority of vegetation which conforms floristically to any of the EECs discussed above will be enhanced within the proposed private Conservation Reserve on Long Bow Point.

This 'precautionary' approach does not involve a concession from the author of this SIS (Mr F Dominic Fanning) that any of those EECs are actually present. However, even if they were, the Culburra Golf Course has now been designed, and will be managed in the long-term, to ensure that vegetation that conforms to those 'Floristic EECs' will not be adversely affected by the Culburra Golf Course project to any significant or relevant extent.

### 8.6 Affected Species, Populations and Ecological Communities

Section 110(2)(b) of the TSC Act requires "an assessment of which threatened species or populations known or likely to be present in the area are likely to be affected by the action".

Similarly, 110(3)(a) requires "a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to affected by the action".

Those "threatened species" and "endangered ecological communities" which could potentially occur on the Culburra Golf Course site or in the vicinity have been considered in detail above with regard to:

- the nature and condition of the subject site;
- the nature of the proposed development activities on the site (*ie* a golf course with associated features such as wetlands and detention basins);
- the habits and habitat requirements of the species; and
- the extent of habitats and resources of relevance for each those biota within the area to be affected by the proposed development, and within the general locality.

On the basis of those considerations, the list of *"subject species"* provided by the OEH, and other biota which could be relevant, has been refined to provide a list of *"affected species"* (Table 8.5). These threatened biota are the subject of further detailed consideration in the following Chapters of this SIS.

AFFECTED SPECIES	
Powerful Owl	Common Bent-wing Bat
Glossy Black Cockatoo	Little Bent-wing Bat
Square-tailed Kite	East Coast Freetail Bat
Yellow-bellied Glider	Eastern Falsistrelle
	Greater Broad-nosed Bat
	Yellow-bellied Sheath-tail Bat

 Table 8.6
 Relevant threatened biota considered in detail in this SIS

As discussed in several instances above, the array of additional threatened fauna species which could potentially occur on the Culburra Golf Course site would likely be dependent on essentially the same or similar habitats and resources as those of the relevant ("*affected*") threatened species identified above (in Table 8.6).

Thus, any potential additional threatened fauna which are dependent on open forest and woodland habitats, and on hollow-bearing trees, would be subject to the same or similar impacts which might be imposed upon the relevant (*"affected"*) species, and would also benefit from the array of impact avoidance, amelioration and environmental management measures which are proposed as this part of the Culburra Golf Course project.

Such species (as discussed above in Chapter 8.4.3) would include several additional microchiropteran bats, a few additional threatened birds (forest owls and other species recorded nearby on occasions) and the Grey-headed Flying Fox. All of these species would, if present on the Culburra Golf Course site, utilise the open forest and woodland canopy of the site.

Notwithstanding the proximity of the proposed Culburra Golf Course to Lake Wollumboola, and its ecosystems and dependent fauna, the Golf Course project has no likelihood of imposing any significant (if indeed any) impact upon Lake Wollumboola, its associated ecosystems, or any of the biota which depend upon them.

As discussed in several parts of this SIS, the Culburra Golf Course project is located at least 100 metres away from Lake Wollumboola. Further, the Culburra Golf Course project has been designed and is to be managed in a manner which imposes no adverse impacts upon Lake Wollumboola, its associated watercourses and other ecosystems, or any biota which depend upon it (for details – see Chapter 12 of this SIS, and Appendices C, D1 and D2).

For other species included in the list of 'potential' threatened species (such as the Green & Golden Bell Frog and the Large-footed Myotis), there are no relevant resources or habitat features present within the Culburra Golf Course footprint at present. Conversely, some proposed features of the Golf Course (particularly the detention basins and the irrigation lake) will ultimately provide suitable habitat for both of these species throughout the Culburra Golf Course project – on the basis both of their basic feature (freshwater ponds) and specific design elements.

As also discussed above, there are no "*endangered ecological communities*" (EECs) located either on or immediately adjacent to the Culburra Golf Course project land. None of the EECs which have been identified by either the OEH or the TSO of the Shoalhaven City Council are present on or around Long Bow Point. Further, even if they were present (which is not conceded), the Culburra Golf Course project will avoid any likelihood of any significant effects upon any such ecosystems.

## 9.1 Introduction and Scope

Section 110 of the TSC Act defines the contents of an SIS, including *inter alia* information required with respect to the biology, distribution and habitat requirements of "*threatened species*" and "*endangered ecological communities*".

# 9.1.1 Threatened Species

Three sub-sections of Section 110(2) of the TSC Act specify information to be provided with respect to relevant or possibly relevant "*threatened species*":

• Section 110(2)(c) - which requires:

"for each species or population likely to be affected, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it".

• Section 110(2)(d) - which requires:

"an estimate of the local and regional abundance of those species or populations".

• Section 110(2)(f) - which requires:

"a full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region".

The threatened species which have been determined to be relevant to this SIS (*ie* which will or are likely to be "*affected*" by the Culburra Golf Course project) have been identified in Chapter 8.6 of the SIS. The relevant ("*affected*") threatened biota for the purposes of this SIS with respect to the Culburra Golf Course project are all threatened ("*vulnerable*") fauna species (Table 8.5), and include:

- threatened birds the Powerful Owl, Glossy Black Cockatoo and Square-tailed Kite;
- the Yellow-bellied Glider; and
- several threatened microchiropteran bats the Common Bent-wing Bat, Little Bent-wing Bat, East Coast Freetail Bat, Eastern Falsistrelle, Greater Broad-nosed Bat and Yellowbellied Sheath-tail Bat.

Chapter 8 of this SIS, in determining which are the relevant ("*affected*") species, provides an array of information regarding the general characteristics of those species, as well as of a substantial number of additional threatened fauna (see previous Chapter). These include species which have the potential of occurring (either as individuals or in small flocks) on the subject land, but which are not regarded as likely to be "*affected*" by the Culburra Golf Course project to any significant or relevant extent (*eg* the Grey-headed Flying Fox, Scarlet Robin, Masked Owl and several additional threatened microchiropteran bats).

It should be noted that essentially all of those additional species are dependent upon forest and woodland habitats and resources (which characterise the Culburra Golf Course project area). The Culburra Golf Course "*subject site*" (*ie* the area which will be affected by the proposal) is typical of a very substantial area of similar and identical forest and woodland vegetation within the locality and

region, a considerable proportion of which is contained in the existing conservation reserves and State Forests (Figures 7A and 7B), as well as within and joining private land.

None of the threatened species which depend on Lake Wollumboola are regarded as of relevance to this SIS (see Chapter 8) – because of the specific design of the project and because of the lack of any adverse impacts which could be imposed on any relevant habitats or resources, given the design and long-term management of the Culburra Golf Course (Appendices C, D1 and D2).

It is to be noted (as discussed in Chapter 12 of this SIS) that an *Environmental Offsets Strategy* is proposed by the proponent and landowner as an integral element of the Culburra Golf Course project. That *Strategy* includes an array of measures which would limit adverse impacts and/or benefit any threatened species which might also occur on the subject land – in addition to those species considered in detail in this Chapter of the SIS (see Chapters 7 and 8).

Similarly, the long-term management of the Culburra Golf Course, pursuant to the dedicated *Culburra Golf Course Plan of Management* (GCPoM – Appendix D2) and to a detailed *Golf Course Ecological Management Plan* (GCEMP), will avoid and/or ameliorate any potential adverse impacts and/or will benefit some of the additional threatened species which might occur on the subject land.

# 9.1.2 Endangered Ecological Communities

Three sub-sections of Section 110(3) of the TSC Act specify the information to be provided with respect to relevant or possibly relevant "*endangered ecological communities*":

• Section 110(3)(a) - which requires:

"a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to affected by the action".

• Section 110(3)(b) - which requires:

"for each ecological community present, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it".

• Section 110(3)(c) - which requires:

*"a full description of the type, location, size and condition of the habitat of the ecological community and details of the distribution and condition of similar habitats in the region".* 

As documented in considerable detail in Chapter 8.5 of this SIS, there are no "*endangered ecological communities*" (EECs) present on the subject site (*ie* the Culburra Golf Course project site itself) or the subject land at Long Bow Point.

Furthermore, as discussed elsewhere in this SIS, the Culburra Golf Course has been designed, in any case, to avoid the overwhelming majority of vegetation which has floristic affinities with any of the potential EECs that have been identified or raised by others (*ie* predominantly the swamp forest and mesic forest communities). Consequently, it is not "*likely*" that a "*significant effect*" would be imposed upon any EECs as a consequence of the Culburra Golf Course project, even if any EECs were present (which is not conceded).

Nevertheless, this SIS includes consideration of potential impacts on those 'Floristic EECs' – as detailed in Chapter 10. As also discussed and detailed throughout this SIS, the Culburra Golf Course

project has involved an exhaustive and iterative process of refinement – *inter alia* to reduce, limit and/or avoid the imposition of adverse impacts on threatened biota (including even theoretical 'EECs').

# 9.1.3 The Director-General's Requirements

The DGRs for this SIS also identify, in Item 5 of the DGRs, additional information (where relevant) to satisfy those sub-sections of the TSC Act quoted above.

The DGRs request a range of specific information regarding "*affected species*" and "*ecological communities*" – including:

- details of other local populations;
- specific information regarding habitat use and population structure;
- detailed measures of abundance;
- detailed information on other areas of relevant "ecological communities"; and
- distribution patterns of biota and habitats.

In most instances, however, these data are either not available with respect to the "*affected species*" or are only available at a very general or broad scale. Indeed, such data are rarely available for any native species, threatened or otherwise, in respect of a specific location or site.

#### Note

It cannot be a reasonable requirement of an SIS that detailed studies be undertaken of the "affected" species throughout the whole of the locality or region to establish accurate distribution patterns and/or population sizes. It is necessary therefore to rely on other sources of information – such as records from the OEH Wildlife Atlas (see Appendices S, T and V), other surveys in the vicinity and Locality (see Chapter 3) and the distribution and extent of suitable habitat (see Figures 7A, 7B and 7C; FDF *pers obs* during over 20 years of studies in the Shoalhaven).

Where information is available regarding these elements of the life cycles of the individual "*affected*" species (*eg* from the OEH website), they are reproduced in Appendices S, T and V of this SIS. Brief consideration of the matters raised above in the DGRs is provided below.

#### Other Local Populations

- There are no known specific details or data available regarding "other local populations" of any of the relevant ("affected") threatened species or any of the 'potential' threatened species, either in the general vicinity or locality of the subject land at Long Bow Point.
- The only information available is that obtained from other previous investigations and from the OEH website which is documented in Appendices S and T of this SIS.
- In general terms, it is noted that all of the relevant, and most of the 'potential', threatened species are widely distributed in the Shoalhaven LGA (Appendix T). It should be assumed that "other local populations" of those biota are also widespread throughout the region given the extent of potential or likely habitat in the vicinity and locality and the vast areas of suitable forest and woodland in the LGA (Figures 7A, 7B and 7C) and region.

 Indeed, for most such species the 'populations' throughout the Shoalhaven LGA (and even well beyond the LGA) would reasonably be considered a single "viable local population" – given the mobility of most such species, the contiguity or near contiguity of habitats and resources, and the distribution of records (Appendix T).

# Habitat Use by Threatened Biota

- The habitat requirements of the relevant ("*affected*") and 'potential' threatened species have been identified and discussed in Chapters 7 and 8 of this SIS.
- The habitat requirements of those species is also identified in Appendices S and V of this SIS, and consists predominantly of open forest and woodland vegetation.
- As discussed throughout this SIS, tree-hollows are an essential habitat requirement of many (but not all) of the relevant and/or potential threatened species. This resource has been selectively targeted in the design refinements of the Culburra Golf Course, and the project will implement a 'no net loss' policy for tree-hollows on the land.

# Specific Information Regarding Population Structure

- There are no readily available relevant data regarding the "*population structure*" of any of the relevant (*ie* "*affected*"), or 'potential', threatened species at Long Bow Point, or in the general Culburra area.
- The only available data regarding the "*population structure*" of those species, in a general or generic sense, is available in various publications which are identified in the *Bibliography* to this SIS, or in the relevant extracts from information contained on the OEH website (Appendix V).
- As noted above, it cannot be a reasonable requirement of an SIS that detailed studies be undertaken of the "affected" species throughout the whole of the locality or region to determine the population structure of any such species.

# Detailed Measures of Abundance

- As is the case for the other data requested above, there are essentially no "*detailed measures of abundance*" which could reasonably be expected to be of any significance (if indeed any relevance at all) for any of the threatened biota known or likely to occur on the subject land at Long Bow Point.
- Most of the threatened species at Long Bow Point and/or Culburra are likely to be present in small numbers (*eg* the Powerful Owl and Square-tailed Kite) or in relatively modest levels of abundance (the microchiropteran bats and Glossy Black Cockatoo).
- Conversely, a few species (*eg* the Green & Golden Bell Frog) can experience 'population explosions' (*eg* the substantial numbers of Green & Golden Bell Frogs at Worrigee in about 2010).
- On a regional scale, it is clear that many of the relevant (*ie "affected*") and/or 'potential' threatened species are relatively to highly abundant throughout the Shoalhaven LGA (Appendices S, T and V).

Relevant "Ecological Communities"

• As discussed in considerable detail elsewhere in this SIS (Chapters 5.7 and 8.5), there are no "*relevant*" threatened or endangered ecological communities at this location.

# Distribution Patterns of Biota and Habitats

- The only relevant data on "*distribution patterns of biota*" are those provided on the OEH website (Appendices T and V).
- The relevant distribution of "*habitats*" for threatened species ("*affected*" and/or 'potential') is provided in Chapters 7 and 8 of this SIS, in Figures 7A, 7B and 7C, and in Appendix T.
- There are very substantial (vast) areas of suitable habitat and resources for those biota in the locality and region (Figures 7A, 7B and 7C) – including in (but not restricted to) the 229,000ha of National Parks reserves, 52,000ha of State Forests and 31,000ha of Crown Lands, as well as very substantial areas of private forested lands.
- The scarcity of records of threatened biota in the very substantial conservation reserves in the locality, LGA and 'Bioregion' (see Appendix T) should not be construed as demonstrating that those biota (or suitable habitats) are not present. They rather demonstrate the inadequacy of relevant surveys in those conservation reserves.
- As noted above, and as demonstrated in Appendix T, the relevant threatened biota (and most of the potential species) are very widely distributed throughout the locality and region.

As noted above, much of the information requested either in the relevant sub-sections of the TSC Act or in the DGRs for this SIS with respect to threatened biota is simply not available.

The information contained below is extracted from that which is available on the OEH website and/or the EPBC Act website, or generally from the scientific and published literature on threatened biota. This information is of a general nature, and has little bearing on the Culburra Golf Course project. Nevertheless, it is provided as required by the relevant sub-sections of the TSC Act and/or the DGRs.

# 9.2.1 Conservation Status

The Federal conservation status (EPBC Act) and the State conservation status (TSC Act) of the relevant (*"affected"*) and of the 'potential' threatened species is provided in Appendices J and K (the OEH and EPBC lists).

There are no relevant (from a statutory point of view) designations of conservation status for any of the threatened biota considered in this SIS at a local or any other (LGA or regional) level.

# 9.2.2 Key Threatening Processes

The *Key Threatening Processes* identified in the TSC Act have been addressed in Chapter 1 of this SIS, as well as with respect to individual threatened species (in Chapter 10 and in Appendix X).

The relevance of any "*Key Threatening Processes*" (KTPs) with respect to the potential for a "*significant effect*" to be imposed upon any threatened biota (relevant or 'potential') has been considered in detail in the *Section 5A Assessments of Significance* for each of those threatened biota (see Chapter 10; Appendix X). Given the nature of the project, and of the threatened species of relevance, only a few of the KTPs are of even potential relevance (see Table 1.1), and most of those will not be exacerbated by the Golf Course project.

Relevant considerations in this regard include:

- the Golf Course project will involve "the clearing of native vegetation" amounting to approximately 27.84ha of open forest and woodland;
- that area of vegetation clearing represents less than 1% of the Lake Wollumboola catchment (most of which is native open forest and woodland), and constitutes a miniscule proportion of the available (and mostly protected) open forest and woodland in the vicinity, locality and region;
- only about 5 identified hollow-bearing trees will need to be removed, and all of the treehollows are to be salvaged and re-deployed and/or replaced by nest boxes. There will be no nett loss of tree-hollows as a result of the Culburra Golf Course proposal, and this KTP will therefore not result in the imposition of significant (if any) adverse impacts upon any hollow-dependent fauna; and
- there will be only limited loss of dead wood and dead trees but all such resources will be salvaged and used in rehabilitations activities on the Golf Corse and Conservation Reserve lands at Long Bow Point.

There is no likelihood that the imposition of or the exacerbation of any KTPs on Long Bow Point as a consequence of the Culburra Golf Course project would result in the imposition of a "*significant effect*" on any threatened biota. No threatened species will be "*placed at risk of extinction*", nor will the survival of any threatened species on Long Bow Point be threatened, by the imposition of any KTP.

Furthermore, the Culburra Golf Course project will facilitate the reduction or elimination of several of KTPs on Long Bow Point (*eg* invasion by Bitou Bush, Lantana and/or introduced grasses, predation by foxes and feral cats, grazing by rabbits).

# 9.2.3 Habitat Requirements

The habitat requirements of the relevant (*ie* the "*affected*") threatened species are addressed in Chapters 5 to 8 and 10 of this SIS, as well as in Appendices S, T, V and X.

In broad terms, the habitat requirements of the relevant ("*affected*") threatened species with respect to the Culburra Golf Course are confined to the open forest and woodland vegetation present on Long Bow Point. The forest and woodland canopies on the subject land provide foraging habitat for the threatened microchiropteran bats, and for both the Square-tailed Kite and Powerful Owl. There are also small patches of She-oak in parts of the open forest and woodland of Long Bow Point - which provide foraging resources for the Glossy Black Cockatoo.

For most of the relevant ("*affected*") threatened species (all but the Square-tailed Kite), tree-hollows are also a necessary resource:

- for nesting and breeding purposes for the Powerful Owl and Glossy Black Cockatoo;
- for denning (shelter) and breeding for the Yellow-bellied Glider; and
- for roosting and breeding purposes for most of the microchiropteran bats (except the Bentwing Bats which breed in caves or other such structures).

Specific habitat requirements of the relevant ("*affected*") threatened species are detailed in Chapter 8.4.5 (above), and in the relevant *Section 5A Assessments of Significance* for each species (Appendix X).

In addition, as discussed elsewhere in this SIS, those threatened species that are considered "*potential*" visitors to Long Bow Point are also dependent on open forest and woodland vegetation for their survival. As noted in Chapters 10 and 12:

- the refinement of the Golf Course design will also have limited the likelihood of any adverse impacts upon any such species by the retention of potential habitat and resources;
- · there are substantial such resources in the vicinity and locality, in any case; and
- the impact amelioration and environmental management measures which have been designed into and/or are part of the Culburra Golf Course project will also benefit any of these additional "*potential*" species as well.

# 9.2.4 Recovery Plans and Threat Abatement Plans

Relevant *Recovery Plans* and *Threat Abatement Plans* are addressed in Chapters 1 and 10 of this SIS, and also (where relevant) in the relevant *Section 5A Assessments of Significance* (Appendix X) for each of the relevant (*ie "affected*") and/or 'potential' threatened biota (see Chapter 10).

## Threat Abatement Plans

The DGRs state that "There are no threat abatement plans relevant to the key threatening processes associated with the proposal".

#### **Recovery Plans**

As indicated in Chapter 1.5.2 of this SIS, there are three relevant *Recovery Plans*:

- the approved Recovery Plan for the Yellow-bellied Glider (DECC 2003);
- the approved Recovery Plan for Large Forest Owls (DECC 2006); and
- the Management Plan for the Green & Golden Bell Frog Key Population within the Cookhaven River Floodplain (DECC 2007).

The *Green & Golden Bell Frog Management Plan* is not of particular relevance to this SIS, because there is currently no habitat for the *Green & Golden Bell Frog* within the subject land or, in particular, with the "*subject site*". As also discussed in this SIS, supplementary habitat will be created within the Culburra Golf Course project - which may potentially be utilised by the *Green & Golden Bell Frog*.

The approved *Recovery Plan for Large Forest Owls* and the approved *Recovery Plan for the Yellowbellied Glider* are addressed with respect to these species in Chapters 10 and 12, and in Appendix X, of this SIS.

#### 10.1 Introduction and Scope

#### 10.1.1 Threatened Species and Endangered Populations

With respect to "threatened species" and "endangered populations", Section 110(2)(g) of the TSC Act requires a Species Impact Statement (SIS) to include:

"a full assessment of the likely effect of the action on those species and populations, including, if possible, the quantitative effect of local populations in the cumulative effect in the region".

The Director-General's Requirements (DGRs) for this SIS (in Item 5) state that "For all subject species, populations and ecological communities, the SIS shall describe the following":

- "the location, nature and extent of habitat removal or modification which will result from the action proposed";
- the "likely and potential direct and indirect impacts of the removal of habitat" including four specific points to which "particular attention shall be given" (see below); and
- "any indirect impacts of the proposal" including a list of fourteen specific matters included in the DGRs under that heading.

Item 5.1 of the DGRs states that:

- Section 110(2)(b) of the TSC Act "allows refinement of the list of subject species or populations (given the outcome of survey and analysis of likely impacts) in order to identify which threatened species or populations may be affected, and the nature of the impact"; and
- the "remaining requirements in this section (5.2 5.5) need only be addressed for those threatened species and populations that are likely to be affected by the proposal".

It is interesting to note that "*endangered ecological communities*" (EECs) are not mentioned by the OEH in Item 5.1 of the DGRs.

#### 10.1.2 Endangered Ecological Communities

As detailed in Chapters 5.7 and 8.5 of this SIS, there are no "endangered ecological communities" (EECs) located on the "subject land" (ie the southern part of Lots 5 and 6 in DP 1065111 at Long Bow Point). Further, the Culburra Golf Course has been designed specifically inter alia to avoid (wherever possible) and/or to minimise the removal of vegetation which has floristic affinities with several EECs (see Chapters 2, 8 and 12).

Nevertheless, for 'abundant caution' (or on a 'precautionary' basis), this Chapter of the SIS considers the potential for adverse impacts to be imposed upon vegetation which conforms floristically to those EECs which are asserted (by some) to be present on the subject land at Culburra (see Chapter 8.5).
As is evident from the considerations below, specific efforts have been made by the project ecologist and the golf course designer to locate most of the elements of the Culburra Golf Course outside those areas of vegetation which have floristic affinities with the alleged EECs. In addition:

- the stormwater treatment regime (Appendix D1) has been designed *inter alia* to ensure that there are no discharges of contaminants or elevated nutrients from the Culburra Golf Course into any adjoining vegetation or ecosystems – including into any of those 'Floristic EECs'; and
- a Culburra Golf Course Plan of Management (GCPoM) has been prepared, in draft form (Appendix D2), to ensure that the long-term management of the Golf Course avoids any potential for the over-use of fertilisers, pesticides or other chemicals (noting that excessive use of such products, beyond that actually required, would be economically unsound, and would not be tolerated).

As a consequence, none of the vegetation types with floristic affinities to any EECs will be adversely affected to a "*significant*" extent, if at all, by the Culburra Golf Course project.

# 10.1.3 Relevant Threatened Biota

As discussed in detail in Chapter 8 of this SIS, the only "threatened species, populations or ecological communities" which are in reality regarded as "likely to be affected by the action" to any significant or even notable extent are the threatened fauna species listed in Table 8.6 (repeated below in Table 10.1).

Table 10.1	Threatened biota tha	t are regarded as	s the relevant (	" <i>affected</i> ") s	pecies for this SIS
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AFFECTED SPECIES	
Powerful Owl	Common Bent-wing Bat
Glossy Black Cockatoo	Little Bent-wing Bat
Square-tailed Kite	East Coast Freetail Bat
Yellow-bellied Glider	Eastern Falsistrelle
	Greater Broad-nosed Bat
	Yellow-bellied Sheath-tail Bat

As discussed in Chapter 8, and in the ensuing parts of this Chapter of the SIS, a number of additional threatened species (particularly fauna species) could potentially occur on the Culburra Golf Course project site, or elsewhere on the subject land. A number of additional threatened birds and microchiropteran bats have been recorded in close proximity to the subject land, and individuals of several such species could potentially occur on the subject land, on occasions at least (see Chapter 8.4.4; Table 8.3).

However, as also discussed further in this Chapter of the SIS, any such additional species (with the exception of the Green & Golden Bell Frog and Large-footed Myotis) would likely be subjected to the

same or similar impacts as the relevant (*ie* the "*affected*") threatened species – at least in most instances.

As a consequence, the consideration of potential adverse impacts for those possible additional species is essentially addressed by the consideration of the relevant ("*affected*") species below. Further, the impact amelioration and environmental management measures which have been incorporated into the Culburra Golf Course project will also apply to those species, should they occur on the subject site.

It is to be noted, as discussed at several points in this SIS, that the threatened and migratory species which utilise Lake Wollumboola and its foreshores will not be affected by the proposed Culburra Golf Course. In this regard:

- all elements of the Golf Course are located at least 100m from the Lake Wollumboola foreshore;
- there is no proposal for access to Lake Wollumboola to be provided from the proposed Golf Course – although it is not conceded by the author of this SIS that any such access would constitute a relevant (much less a "*significant*") effect on the Lake or any relevant biota, in any case;
- the stormwater management regime for the Golf Course is designed specifically inter alia to avoid discharging contaminants of any sort into Lake Wollumboola or its associated watercourses (see Chapter 10.4.4; Appendix D1) – either directly (by overland flow) or through discharge into the groundwater table; and
- the *Culburra Golf Course Plan of Management* (GCPoM), prepared by Golf by Design (Appendix D2), is designed specifically to control and manage nutrients, fertilisers, pesticides and ongoing golf course management activities to prevent any contamination of or effects on Lake Wollumboola and its ecosystems and dependent fauna (see also Chapter 2.4 regarding the management and impacts of golf courses).

There is no objective or factual basis on which it can be asserted that the Culburra Golf Course, properly managed according to the stormwater management regime (Appendix D1) and the GCPoM (Appendix D2), would be *"likely"* to have any material impact on Lake Wollumboola, given:

- the separation of the Golf Course from the Lake by at least 100m of native vegetation;
- the dedicated management of stormwater on and around the Golf Course (Appendix D1);
- the long-term management of the Golf Course pursuant to the *Culburra Golf Course Plan* of *Management* (GCPoM; Appendix D2) particularly with respect to pesticide and fertiliser use; and
- the lack of any known, or likely, mechanism by which significant (or any notable) quantities
  of such contaminants could enter Lake Wollumboola given the management regime to
  be implemented on the Culburra Golf Course.

## 10.1.4 Impact Assessment

The remainder of Chapter 10 of the SIS documents the likely (or potential) impacts of the proposed Culburra Golf Course development at Long Bow Point upon relevant threatened biota (*ie* upon the *"affected species"*) identified in Chapter 7 (Table 10.1).

- Chapter 10.2 provides initial consideration of the matters raised in Item 5 of the DGRs
- Chapter 10.3 identifies the "location, nature and extent of habitat removal or modification"
- Chapter 10.4 addresses the potential for adverse impacts to be imposed upon the relevant (or potentially relevant) "*threatened species*" as a consequence of habitat removal or modification
- Chapter 10.5 provides a summary of the potential or likely impacts of habitat removal that will (or may) arise as a result of the Culburra Golf Course project
- Chapter 10.6 addresses the potential indirect impacts of the Culburra Golf Course project on threatened biota and their habitats
- Chapter 10.7 considers the specific impacts on relevant threatened biota
- Chapter 10.8 considers the likelihood of a "*significant effect*" being imposed on the relevant or potentially relevant threatened biota pursuant to Section 5A of the EP&A Act.

The first part of Item 5 of the DGRs provides a requirement for the description of a number of matters regarding habitat removal or modification, and the potential direct and indirect impacts of the removal of habitat of the proposal, on "*subject species, populations and ecological communities*".

As discussed above (Chapter 10.1), the list of "*subject species, populations and ecological communities*" has been analysed and assessed with respect to those likely to be "*affected*" by the proposed Culburra Golf Course on Long Bow Point. The list of threatened biota to which Item 5 of the DGRs therefore applies (Table 10.1 - above) includes the Powerful Owl, Glossy Black Cockatoo, Square-tailed Kite, Yellow-bellied Glider and an array of threatened microchiropteran bats.

Other species which could theoretically or potentially be affected by the proposal (Table 10.2) have also been considered in Chapters 8, 9 and 10 of this SIS, noting that:

- virtually all of the other threatened species that could potentially occur (Table 10.2) would (if present) likely be affected in a similar manner to those addressed in detail below;
- there are no EECs present on the subject land. However, the majority of those vegetation types which conform floristically to one or other of the potential (or 'Floristic') EECs (see Chapters 5.7 and 8.5) are confined to those parts of the subject land which predominantly are not to be developed for the Golf Course;
- the majority of the subject land is not proposed for golf course activities with substantial areas of open forest and woodland to be retained between and around the golf holes, and 113ha (or 56.2% of the subject land) is to be reserved and managed in perpetuity (as a private 'Conservation Reserve') for biodiversity conservation purposes. As a consequence, habitat and resources for threatened biota, including the relevant ("affected") species and potential threatened species, will be retained in the immediate vicinity;
- there are very considerable areas of the same or similar habits and resources for all of the threatened biota that could potentially occur on the "*subject site*" in the extensive conservation reserves and private forested lands in the vicinity, locality and region; and
- the impacts or potential impacts on threatened biota need to be considered *inter alia* in light of the proposed *Environmental Offsets Strategy* for the Culburra Golf Course (see Chapter 12.5) – which will involve the dedication of native vegetation and habitats on the subject land (within the private 'Conservation Reserve' on Long Bow Point), as well as land at Worrowing Heights and at East Crescent, for biodiversity conservation purposes.

POTENTIAL SPECIES		
Masked Owl	Grey-headed Flying Fox	
Gang Gang Cockatoo	Little Eagle	
Large-footed Myotis	Green & Golden Bell Frog	
Varied Sittella	Sooty Owl	
Scarlet Robin		

 Table 10.2
 Threatened biota that are regarded as 'potential affected' species for this SIS

## 10.3 Habitat Removal or Modification

The first matter in Item 5 of the DGRs requires a description of:

a. "the location, nature and extent of habitat removal or modification which will result from the action proposed".

The total area of native open forest and woodland vegetation to be removed for construction and maintenance of the Culburra Golf Course is approximately 27.84 hectares (Figures 11C and 14A; Table 10.3). That area includes all infrastructure (including roads, structures, golf buggy tracks and detention basins) as well as the golf course tees, fairways and greens. A small additional area will require management for the provision of *Asset Protection Zones* (APZs) – primarily along the access road - but these areas will remain as native vegetation (albeit somewhat modified).

Area	Stage 1	Stage 2	Total (ha)	Irrigation
Greens	0.496	0.425	0.921	0.921
Collars	0.102	0.095	0.197	0.197
Tees	0.51	0.45	0.96	0.96
Green Surrounds	1.00	0.90	1.900	1.90
Fairways	6.548	4.934	11.482	11.482
Short Roughs	5.150	4.181	9.331	9.331
Revegetated or Landscaped Areas *	2.122	1.914	4.036	-
Bunkers	0.143	0.134	0.277	-
Buggy and Maintenance Paths	0.269	0.328	0.597	
New Freshwater Lakes	1.525	-	1.525	-
New Freshwater Wetlands and Retention Basins	0.57	0.901	1.471	-
Clubhouse, Car Park, Entry Road & Associated Facilities	2.151	-	2.151	0.10
Maintenance Facilities	0.345	-	0.345	0.06
Total	20.931	14.262	35.193	24.951

## TABLE 10.3 Breakdown of elements of the Culburra Golf Course

\*Includes planting and landscaping in some of the outer rough ('out of play') areas of the Golf Course and also in the buffer zones to the edge of new retention basins. These areas will predominantly involve native plants. It excludes planting to be undertaken within new water bodies (*ie* lakes/wetlands, retention basins). These areas are listed separately in the above Table. Of the total 35.19 hectares of the Culburra Golf Course footprint (Figure 14A; Tables 10.3 and 10.4; Appendix C1):

- approximately 7.2ha is already cleared and regularly slashed, or consists of a dense regrowth Tick Bush and tea-tree shrubland – following previous clearing (Table 10.5);
- approximately 4ha is to be rehabilitated as native grasslands and/or shrublands;
- approximately 3ha will become part of the stormwater management regime for the project (detention basins and the large irrigation lake). These are to be designed, constructed and managed so as to provide habitat for an array of native biota, including threatened species (such as the Green & Golden Bell Frog) – as indicated in Appendix W; and
- approximately 20.81ha will become fairways or adjoining short roughs which, although mostly of introduced grasses, will provide foraging habitat for an array of native biota (macropods, bandicoots, the Maned Duck, the Willie Wagtail, Galahs and possibly the Scarlet Robin).

Golf Course Element	На	Comments		
	201	<ul> <li>More than 95% is native vegetation and habitats (including mudflats and Lake shoreline)</li> </ul>		
Subject Land		<ul> <li>Less than 5% is Cleared and Disturbed land or seriously modified (tracks <i>etc</i>)</li> </ul>		
		Miniscule % of habitats in vicinity and locality		
	35.19	• 17.5% of the subject land		
Total Golf Course footprint		Miniscule % of habitats in vicinity and locality		
		• 7.2ha is Cleared and Disturbed land		
	27.84	• 25.04ha of xeric vegetation (89.9% of the native vegetation to be removed)		
Native open forest and woodland to be removed		<ul> <li>1.92ha of mesic vegetation (6.9% of the native vegetation to be removed)</li> </ul>		
		13.9% of the subject land		
New petities hereitet to be exected	7.0	20% of the Golf Course footprint		
outer roughs and ponds/basins/swales		<ul> <li>Additional habitats of potentially high value for some threatened species - ponds and basins</li> </ul>		
	3.1	• 1.5% of the subject land		
'Urban' elements of the Golf Course		<ul> <li>access road, carpark, greenkeepers shed and maintenance area, turf nursery, golf buggy paths</li> </ul>		

Table 10.4	Elements of the	Culburra	Golf Course	- Summary
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The only parts of the proposed Culburra Golf Course project that will not be of potential value for native (including threatened) species will be the access road and associated carpark, the greenkeepers shed and maintenance area, turf nursery and golf buggy paths. These facilities, however, would occupy a total of approximately 3.1 hectares over the whole of Long Bow Point (see Table 10.3; Appendix D2).

These are the only elements of the Culburra Golf Course project that could reasonably be termed *"urban"* development – involving artificial surfaces and physical structures (*ie* 'impervious' areas). This represents just 1.5% of the subject land and a mere 0.09% of the Lake Wollumboola catchment.

The overwhelming bulk of the Golf Course is more "*rural*" in character than urban – involving extensive areas of grassland (native and/or introduced) and a sensitive management regime (Appendices D1 and D2). That approach will *inter alia* avoid any discharge of contaminants (including pesticides, nutrients and/or fertilisers) into Lake Wollumboola and its associated watercourses.

Most rainfall will simply infiltrate into the ground (as is currently the case), and provide upper level soil water for plant transpiration. The impervious parts of the Golf Course represent no more than approximately the paved portion of East Crescent in the Culburra Village.

The areas of each vegetation type to be removed for the Culburra Golf Course (Figure 14) are identified in Table 10.5 (below).

As discussed elsewhere in this SIS, the majority of the vegetation to be removed or modified for the Golf Course project is of a xeric nature. Further, the Culburra Golf Course has been specifically designed (by the project ecologist and golf course designer) *inter alia* to avoid the overwhelming majority of hollow-bearing trees on the subject land – requiring the removal of just 5 or fewer identified hollow bearing trees for the project (Appendix C1).

	Vegetation Type	Total #	Remove		Retain	
D1a	Grey Ironbark – Rough-barked Apple Open Forest	11.55ha	3.21ha	27.8%	8.34ha	72.2%
D1b	Grey Ironbark – Woolybutt Open Forest	12.29ha	2.04ha	16.6%	10.25ha	83.4%
D2	Bangalay Woodland/Open Forest	0.38ha	0.14ha	36.8%	0.24ha	63.2%
D3	Blackbutt Open Forest	55.74ha	14.37ha	25.8%	41.37ha	74.2%
D4	Bangalay – Woolybutt – Rough-barked Apple Open Forest	8.03ha	0ha	0%	8.03ha	100%
D5	Forest Red Gum Open Forest	1.52ha	0ha	0%	1.52ha	100%
D6	Hard-leaved Scribbly Gum Woodland	34.19ha	5.38ha	15.7%	28.81ha	84.3%
E	Ecotone	2.08ha	0.88ha	42.3%	1.2ha	59.7%
M1a	Swamp Oak – Eucalypt Open Forest on Flats	9.17ha	0.005ha	0%	9.165ha	100%
M1b	Eucalypt - Swamp Oak Open Forest on Slopes	3.32ha	1.41ha	42.5%	1.91ha	57.5%
M2a	Swamp Paperbark Closed Forest	6.29ha	0.16ha	2.5%	6.13ha	97.5%
M2b	Swamp Paperbark – Swamp Oak Closed Shrubland/Closed Forest	7.44ha	0.12ha	1.6%	7.32ha	98.4%
M3	Swamp Oak Closed Forest	3.79ha	0ha	0%	3.79ha	100%
M4	Swamp Mahogany Open Forest	8.21ha	0.22ha	2.1%	7.99ha	97.9%
W1b	Sea Rush-Twig Rush Herbland	8.35ha	0ha	0%	8.35ha	100%
CD	Cleared and Disturbed	19.31ha	7.2ha	37.3%	12.11ha	62.7%

## Table 10.5 Vegetation to be removed for the Culburra Golf Course or retained on the Subject Land

# The remainder of the subject land (~9ha) consists of mudflats, Lake and cleared tracks

As indicated in Table 10.5 - almost all of the vegetation which is to be affected by the proposed Culburra Golf Course is of a xeric nature (25.04ha or 89.9% of the native vegetation to be removed). Only very limited areas of moist vegetation types will be affected – along the northern side of the Golf Course (Holes 2, 3 and 4) and at the golf buggy crossing of Downs Creek. Just 1.92ha of mesic vegetation (or ~5% of the total on the subject land) will be removed.

No relevant indirect adverse impacts will be imposed on retained mesic vegetation adjacent to the northern part of the Golf Course (as discussed elsewhere), however, and the golf buggy crossing of Downs Creek will be via a carefully located and constructed bridge (see Chapter 12).

Thus, even if any of the moist vegetation types on the subject land did constitute an "*endangered ecological community*" (EEC) – which is not conceded by the author of this SIS – the extent of direct (or indirect) impacts upon any such vegetation would be miniscule (Figure 13A; Appendix X).

It is to be noted that in constructing the Culburra Golf Course, a clearing and construction regime is to be implemented – to be detailed in a dedicated *Construction Environmental Management Plan* (CEMP). The associated measures will be designed to minimise and/or avoid impacts on vegetation to be retained (see Chapter 2 of this SIS).

A detailed *Tree & Vegetation Protection Protocol* will be prepared and implemented, as part of the CEMP, to ensure that:

- all felling of trees and vegetation is contained within the Golf Course footprint;
- all earthworks are undertaken within the development footprint avoiding any activities within adjoining vegetation to be retained;
- the full extent of permissible disturbance will be identified by orange safety mesh fencing to be installed under the supervision of a project ecologist and/or project environmental manager, prior to any works occurring;
- all construction yards, maintenance areas and stockpiles are to be located within the existing cleared land in the centre of Long Bow Point and/or on cleared areas during the construction program (*eg* golf course fairways *etc*);
- no hollow-bearing trees are removed without prior inspection by the project ecologist, and without salvaging tree-hollows for re-deployment; and
- all native vegetation removed from the Golf Course footprint is retained for re-deployment and use within conservation areas - for rehabilitation purposes and for the provision of additional habitat features (such as logs and woody debris).

All other areas of native vegetation which are to be 'modified' as part of the Culburra Golf Course will be maintained as native vegetation (albeit modified), and will involve a management regime designed specifically to prevent any weed infestations. In this regard:

- any areas of vegetation required as *Asset Protection Zones* (APZs), adjacent to future buildings and relevant parts of the access driveway, are to be established by the selective removal of trees and shrubs, and the maintenance of a native groundcover layer;
- any hollow-bearing trees within APZs are to be retained on a preferential basis; and
- vegetation beyond the edge of designated fairways (*ie* outer parts of the 'short roughs') is to consist of slashed native groundcover species and reduced litter (by raking) again to ensure that these areas consist predominantly of a native groundcover.

In addition, there is a potential requirement for some limited thinning of small areas of tree canopy - to increase solar insolation onto parts of the Golf Course during the winter. Any such thinning would involve the lopping of small trees and the trimming of some tree canopies on the northern side of golf course holes (predominantly around the greens), but the retention of all hollow-bearing trees.

Any such works (if required) would be undertaken under the supervision of a project ecologist or project environmental manager – to ensure that only minimal impacts on native vegetation ensue. In particular, there would be no requirement for the removal of trees (thinning of the canopy or lopping would be satisfactory), and no need to remove or affect the understorey.

#### 10.4 Impacts of Habitat Removal

The second matter raised in Item 5 of the DGRs is for a description of "*the likely and potential direct and indirect impacts of the removal of habitat*", with "*particular attention*" to:

- the loss of habitat for three "*endangered ecological communities*" (the SOFF, SSFCF and REFCF communities);
- the loss of "hollow-bearing trees, Yellow-bellied Glider feed trees and other trees known to be utilised for breeding, roosting or denning" and of particular "food resources"; and
- changes to biota and habitat "as a result of altered hydrology and increased nutrient loads occurring within Lake Wollumboola and associated watercourses".

Indirect impacts are addressed in Chapter 10.5.

## 10.4.1 Endangered Ecological Communities

As discussed in detail in Chapters 5.7 and 8.5 of this SIS, there are no "*endangered ecological communities*" (EECs) present on the subject land at Culburra. As there are no "*coastal floodplains*" on or associated with the subject land, the three potentially relevant EECs identified in this matter by the OEH (the SOFF, SSFCF and REFCF communities) are simply not present.

Furthermore, even if these EECs were present on or around Long Bow Point (which is not conceded), they would be restricted to the lower areas along Downs Creek and Wattle Creek, or around the periphery of Lake Wollumboola. The overwhelming majority of those areas of vegetation are to be retained around the proposed Culburra Golf Course and on Long Bow Point, and none would be affected by the project to any significant or notable degree.

Notwithstanding the lack of the requisite 'locational' or 'physiographic' criterion for those EECs ("*coastal floodplains*"), those areas of vegetation which have floristic affinities with the various EECs alleged by others to occur on and around Long Bow Point at Culburra have been taken into account in the iterative design process for the Culburra Golf Course project.

As a consequence of that process, most elements of the Culburra Golf Course have been removed from areas of vegetation which, floristically at least, conform to those EECs – including the Swamp Forest communities on the subject land. This approach has been adopted on a 'precautionary' basis, and ensures that the Culburra Golf Course project will not impose any adverse direct or indirect impacts upon any such communities so as to even potentially impose a "*significant effect*" upon any such EEC – even if present (which is not conceded).

## 10.4.2 Habitat Trees

## Hollow-bearing Trees

As described elsewhere in this SIS, the Culburra Golf Course has been designed specifically (by the project ecologist in consultation with the golf course designer) *inter alia* to minimise the need to remove hollow-bearing trees. Most of the Golf Course has been walked by the project ecologist and golf course designer together, and minor refinements have been made to the locations of tees, fairways, greens

and water features - in order to avoid or minimise the necessity for the removal of hollow-bearing trees.

As a consequence of that iterative and collaborative process, fewer than 5 mapped or recorded hollowbearing trees have been identified as requiring removal over the whole of the Culburra Golf Course out of a total of over 200 hollow-bearing trees which are located close the Golf Course footprint (see Figure 15; Appendices C and Q).

It is possible, no doubt, that some hollow-bearing trees were not identified during the field investigations, given that not all tree-hollows are visible from the ground. However, the overwhelming majority of identified hollow-bearing trees are to be retained - by virtue of deliberate design parameters for the Culburra Golf Course.

Furthermore, the Culburra Golf Course development includes, as an integral element of the project, the implementation of a *Hollow-bearing Tree Protocol*, as detailed in Chapter 12 of this SIS. There will be **no** nett loss of tree-hollows as a consequence of the Culburra Golf Course project.

That *Protocol* requires *inter alia* the segmental dismantling of hollow-bearing trees that cannot be retained, with the salvage of tree-hollows wherever possible. All salvaged tree-hollows will be relocated into large trees retained between fairways or elsewhere within the private 'Conservation Reserve' proposed on the subject land. In addition, artificial nest boxes will be deployed (on a 2:1 basis for every tree-hollow lost) – to ensure that there is a nett increase in the number of tree-hollows on the subject land following construction of the Culburra Golf Course.

## Yellow-bellied Glider Feed Trees

No Yellow-bellied Glider feed trees have been located within the Culburra Golf Course footprint.

The Yellow-bellied Glider was recorded on the "*subject site*" in early 2013 – in the forest 'buffer' between Hole 1 and Lake Wollumboola (this coincides with two *Wildlife Atlas* records).

Given the extensive areas of open forest and woodland to be retained on the subject land (and in the vicinity), it is not likely that the Golf Course would significantly affect this resource.

## Breeding, Roosting or Denning Trees

A few of the trees which will be removed for the Culburra Golf Course project could potentially "*be utilised for breeding, roosting or denning by threatened fauna such as microchiropteran bats, gliders, threatened parrots and large forest owls*". These predominantly are hollow-bearing trees, although they also include large trees with exfoliating back.

However:

 the quantum of such resources which will be removed for the proposed Golf Course (fewer than 5 identified hollow-bearing trees) is extremely minor - compared to the substantial extent of existing resources and habitat for such biota on the subject land itself, and present in the vicinity, locality and region;

- the overwhelming majority of the hollow-bearing trees on the land have been identified for retention throughout the Golf Course project (as discussed above); and
- implementation of the *Hollow-bearing Tree Protocol* will ensure that there is no nett loss of tree-hollow resources on the subject land (indeed, there will be a nett increase in such resources on Long Bow Point).

## 10.4.3 Food Resources

Most of those parts of the subject land which have been identified for the Culburra Golf Course project are not particularly notable in respect of foraging resources for the Glossy Black Cockatoo. Areas of relatively high density feed trees for the Glossy Black Cockatoo (*eg* along the existing access road into the site) are to be retained as part of the Golf Course proposal, and none of the Golf Course elements will require the removal of dense *Allocasuarina* stands which have been identified as significant for the Glossy Black Cockatoo.

As noted above, no feed trees of the Yellow-bellied Glider have been identified within the Culburra Golf Course footprint. In the event that any such trees are identified, minor modifications will be sought to preferentially retain such trees.

Similarly, there are no particularly dense areas of "*nectar-rich tree and shrub species*" on the subject land or within the "*subject site*" (*ie* in the Culburra Golf Course footprint). None of the vegetation to be removed or modified for the proposed Culburra Golf Course is likely to be of particular or special value as a food resource for any of the potentially relevant threatened species.

In this regard, threatened species which depend on such resources (*eg* the Eastern Pygmy Possum and Squirrel Glider) have not been recorded on Long Bow Point over the last 20 years.

Doubtless, the removal of some of the native tree canopy, as is required for the Culburra Golf Course project, will remove some foraging habitat for species such as the Powerful Owl and microchiropteran bats, and for other birds which forage in the tree canopy.

However, none of the tree canopy to be removed could be regarded as of particular or special value in this regard. Further, the quantum of such resources to be removed from Long Bow Point is extremely small relative to the substantial home ranges of most such species, and relative to the substantial extent of such habitats and resources in the vicinity and locality.

As is the case with respect to other resources for threatened biota (real or potential), such as hollowbearing trees, the proposed Culburra Golf Course development involves the removal of only a miniscule proportion of those resources and habitat features in the vicinity and locality (Figures 1, 7A and 7B). In addition, implementation of the *Environmental Offsets Strategy*, as proposed (see Chapter 12.5), will offset (or compensate for) any loss of food resources for any relevant threatened biota.

It is not *"likely"* that a *"significant effect"* would be imposed with respect to the loss of or upon any threatened biota as a result of the Culburra Golf Course project. Where relevant, consideration of these matters for individual threatened species is contained in subsequent parts of this Chapter of the SIS, and in the detailed *Section 5A Assessments of Significance* (Appendix X).

## 10.4.4 Impacts on Lake Wollumboola and Associated Watercourses

The stormwater management regime for the Culburra Golf Course project (Martens 2015; Appendix D1) has been designed specifically *inter alia* to avoid the imposition of adverse impacts on Lake Wollumboola and/or Downs or Wattle Creeks.

The Culburra Golf Course project has been designed specifically *inter alia* to capture and treat stormwater runoff, and to re-use stormwater draining from the golf holes and golf course infrastructure for irrigation and other purposes. Stormwater quality will be managed and monitored (during construction activities and during the ongoing use of the Golf Course) to ensure that no adverse impacts are imposed upon Lake Wollumboola or upon either Downs or Wattle Creeks - as detailed in the *Report* by Martens Consulting Engineers 2015 (Appendix D1) and in the *Culburra Golf Course Plan of Management* (Appendix D2).

As also noted elsewhere in this SIS, construction activities will be undertaken in a particularly sensitive and careful manner – pursuant to detailed controls identified in the *Integrated Management Plan* of Martens 2015 (Appendix D1), the *Golf Course Plan of Management* (GCPoM) of Golf by Design 2014 (Appendix D2), and a detailed and dedicated *Construction Environmental Management Plan* (CEMP) – which is to be prepared following approval of the Golf Course.

Specific controls for construction activities will include:

- the identification, fencing and protection of any areas of native vegetation to be retained;
- the tagging and fencing of hollow-bearing trees at all locations throughout and adjacent to the Golf Course;
- the use of sediment fencing in association with any works to be undertaken at any location on the Golf Course;
- the felling of trees into areas which are to be developed for Golf Course activities or into existing open land;
- the location of all stockpiles, vehicle parking areas, compounds, site offices *etc* within areas of existing disturbed land or land to be developed for the Golf Course (*eg* fairways *etc*);
- strict controls on potential contaminants to avoid any discharge of contaminants or pollutants into any element of the natural environment or into the soil; and
- implementation of a detailed Waste Management Plan.

Specific features of the stormwater management regime for the Culburra Golf Course project (Appendix D1) include:

- the capture (using drainage swales and overland flow paths) of all stormwater runoff from the Golf Course fairways, tees and greens, and from the golf driving range (Appendix D1);
- the treatment of stormwater runoff in detention basin wetlands and bioretention swales around the Golf Course - to remove nutrients, sediments and/or other contaminants (Appendix D1);
- the re-use of stormwater for irrigation of the Golf Course to re-cycle and further treat any nutrients contained within captured stormwater (Appendix D1);

- the implementation of a long-term monitoring program, as an integral element of the *Draft Culburra Golf Course Plan of Management* (GCPoM - Appendix D2) – to ensure that any stormwater discharged into Downs Creek, Wattle Creek or Lake Wollumboola is of such a quality as to impose no adverse impacts upon those 'receiving waters'; and
- the establishment of a Water Quality Response Protocol as part of the GCPoM which will ensure that any accident or misadventure is detected immediately, and that any possible contaminant-laden stormwater is captured and treated, and not released into Lake Wollumboola or its associated watercourses.

It is noted that no such protective mechanism or approach currently applies to the substantial area of intensive urban development in the Culburra township – which occupies an area of approximately 80ha and which drains essentially untreated into Lake Wollumboola.

Further, it should be noted that the proposed Culburra Golf Course occupies only a miniscule fraction of the catchment of Lake Wollumboola (Figure 18) – approximately 1% of the total 3,410 hectares of the catchment. Further, as noted above, the Golf Course is predominantly pervious (other than approximately 1.5ha or less than 0.05% of the catchment). Most of the incipient rainfall will soak into the soil, and thus generally maintain soil hydrology.

Given all of the above, even if the Culburra Golf Course project was to impose some changes to hydrologic regimes and/or nutrient input into Lake Wollumboola (which is not accepted as likely – see Appendices D1 and D2), those alterations would be so minimal as to be incapable of resulting in any relevant or measurable alterations to volumes, flows or water quality within Lake Wollumboola. Any possible or likely inputs into Lake Wollumboola from the Culburra Golf Course (if any) would constitute only a miniscule fraction of the water entering the Lake, and would be 'swamped' by the totality of other inputs from the other 99% of the Lake catchment.

As discussed in Chapter 4.10 of this SIS, Lake Wollumboola is NOT a *Groundwater Dependent Ecosystem* (GDE) – notwithstanding the deliberations of Scanes *et al* (2013). In any case, there will be no significant or relevant adverse impacts on groundwater associated with the Culburra Golf Course – given the proposed stormwater management regime and golf course management actions (such as the use of foliar fertilisers).

No other adverse impacts (direct or indirect) are anticipated or likely to be imposed upon Lake Wollumboola as a result of the Culburra Golf Course project.

There is no proposal to provide access to Lake Wollumboola from the Golf Course, although the author of this SIS does not accept that any such access (properly managed) would be problematic. A forested buffer of at least 100m is to be provided along the Lake Wollumboola foreshore between any element of the Golf Course project and the Lake itself. As a consequence, there are not likely to be any visual impacts upon the Lake, or any impacts associated with disturbance of the wetland birds which utilise Lake Wollumboola and its ecosystems (minimal though those would be).

Only very minimal impacts will be imposed upon Downs Creek and/or Wattle Creek as a result of the Culburra Golf Course project. In this regard:

 the Golf Course has been refined (as part of the iterative design process) to avoid crossing Wattle Creek;

- Wattle Creek for most of its length is a broad shallow drainage swale, without any formed channel, bed or banks; and
- Downs Creek is to be crossed permanently only by a carefully designed and constructed bridge – capable of use by golf buggies and small golf course maintenance vehicles. Any works associated with this activity will be addressed in a detailed subsequent design program and in the dedicated *Construction Environmental Management Plan* (CEMP) and *Golf Course Ecological Management Plan* (GCEMP). The bridge over Downs Creek will avoid impacts on the Creek channel or banks, and the paths at each end of the bridge will be located and constructed so as to avoid significant tree or vegetation removal. The GCPoM and GCEMP will also document the rehabilitation of any disturbed areas.

There will also be a requirement for a temporary crossing of Downs Creek for the construction of golf holes 13 and 14. That crossing will be located and designed so as to limit adverse impacts on native vegetation and on the watercourse itself. Further, all areas affected (other than for the footprint of the permanent crossing) will be rehabilitated following the construction of holes 13 and 14.

Given all of the circumstances cited above, the potential adverse impacts which would be imposed as a result of the Culburra Golf Course project on Downs Creek and/or Wattle Creek are extremely limited, and of no concern with respect to any threatened species.

Similarly, as discussed at length throughout this SIS, there is no likelihood of any relevant adverse impacts to be imposed on Lake Wollumboola or upon any threatened (or other) biota which depend upon it.

## 10.5 Impacts of the Removal of Habitat – Summary

The likely or potential impacts of the Culburra Golf Course project on individual relevant ("*affected*") threatened species is addressed for each of those species in Chapter 10.7 of this SIS, and in the *Section 5A Assessments of Significance* which have been prepared for those threatened species (Appendix X).

It is acknowledged that the Culburra Golf Course project will require the removal of some habitat for those (and potentially individuals of some other) threatened species, involving a total area of approximately 27.84ha of open forest and woodland vegetation (Table 10.2). However, as documented throughout this SIS:

- that loss constitutes only a very small proportion of those habitat types and resources on the subject land (less than 14%) and a miniscule proportion of such resources in the vicinity (Figure 18);
- those areas are insignificant with respect to the home ranges and foraging extent of the relevant ("*affected*") and/or potentially relevant threatened species; and
- as discussed in further detail below, and for those reasons, that removal of habitat will not impose a "*significant effect*" upon any of those threatened biota.

Further, as discussed elsewhere in this Chapter of the SIS, and in Appendix X, that removal of habitat:

- represents only a minute fraction of the available habitat and resources for those threatened biota in the immediate vicinity, general locality and region;
- will not result in the fragmentation or isolation of any habitat or resources for any of those threatened biota;
- represents an isolated activity near the periphery of a very large band of native forest and woodland vegetation (Figures 1 and 7C), substantial areas of which are already contained within the extensive conservation reserves and State Forests in the locality and region (Figures 7A and 7B) – including approximately 229,000 hectares of National Park estate, 51,000ha of State Forests and 32,000ha of Crown Lands;
- will be offset by the dedication of additional native forest and woodland for biodiversity conservation purposes – as part of the *Environmental Offsets Strategy* for the Culburra Golf Course project (see Chapter 12.5);
- will further be offset in part by the active long-term management of substantial areas of land on Long Bow Point for biodiversity conservation purposes involving *inter alia* the removal of substantial areas of weeds, and the implementation of a comprehensive feral pest eradication program;
- will also be offset by the adoption of a 'no nett loss of tree hollows' policy (employing the *Hollow-bearing Tree Protocol*) and the creation of supplementary habitat for some species (*eg* freshwater wetlands); and
- does not constitute an activity which is "*likely*" to impose a "*significant effect*" upon any threatened biota. In particular, it is not "*likely*" that any of the relevant ("*affected*") threatened species, nor indeed any other potential threatened species, would be "*placed at risk of extinction*" by the Culburra Golf Course project (Appendix X; Chapter 10.8).

#### 10.6 Indirect Impacts of the Proposal

The third matter raised in the first part of Item 5 of the DGRs requires a description of "*any indirect impacts of the proposal*", and includes a list of fourteen matters to be considered. Where particularly relevant for individual threatened species, these matters are considered in detail with respect to those individual species (see Chapter 10.7). However, most of those matters are addressed in this sub-chapter of SIS, so as to avoid repetition.

This approach is regarded as valid because most of these indirect impacts would affect most (or all) of the relevant "*affected*" species in a similar manner, to the extent that they might or will affect those species at all. Further, other potentially relevant (likely) threatened species would be similarly affected – again where these indirect impacts are relevant.

## 10.6.1 Item 5c(i) – Fragmentation and Isolation

"The fragmentation or isolation of local populations and/or local occurrences, and the increased distance required for the movement of individuals/genetic material between habitat patches"

For the relevant ("*affected*") threatened fauna species considered in detail in this SIS, this issue is not regarded as of particular concern - given:

- the small areas of potential or known habitat and resources to be removed or modified in absolute terms, and relative to those resources available both now and into the future;
- the retention of intact forest and woodland habit and resources (including the overwhelming majority of hollow-bearing trees) in vegetated bands between the golf course fairways and other infrastructure elements;
- the high mobility, wide-ranging habits and large to very large home ranges of the relevant ("*affected*") threatened species;
- the very extensive areas of potential or known habitat and resources present in the vicinity and locality, both in private ownership and in existing conservation reserves and State Forests (approximately 280,000 hectares in total); and
- the substantial area of potential and known habitat and resources for such species to be dedicated for biodiversity conservation purposes as detailed in the *Environmental Offsets Strategy* for the project (see Chapter 12.5).

The Culburra Golf Course will not result in the fragmentation or isolation of habitat for any relevant or potential threatened species.

## 10.6.2 Item 5c(ii) – Edge Effects

"Edge effects from creating gaps in contiguous woody vegetation, including incursion of weeds, dieback from Phytophthera cinnamomi and the potential impacts of aggressive overabundant species such as the Noisy Miner Manorina melanocephala that are favoured by clearing and simplification of habitat structure"

#### Gaps in Contiguous Woody Vegetation

The creation of "*gaps in contiguous woody vegetation*" on Long Bow Point will not, in the opinion of the author of this SIS, result in any relevant adverse indirect impacts on any threatened biota.

As most of the vegetation to be affected is xeric in nature, "*edge effects*" are generally of minimal concern. Further, the long-term management of the Golf Course will avoid many of the potential adverse "*edge effects*" – such as weed invasion or nutrient discharges.

In addition, the creation of such "*gaps*" and of 'edges' will provide additional and alternative habitats for an array of native (including threatened) species. For example, several threatened microchiropteran bats preferentially utilise forest edges for foraging, and the Square-tailed Kite often utilises forest edges for foraging. The Scarlet Robin also utilises grasslands associated with forest or woodland edges.

The issue of "*edge effects*" associated with golf courses has been addressed in Appendix 2.4 by the author of this SIS. The extent of such effects beyond the golf course/woodland and open forest interface is negligible.

Given the extent of open forest and woodland vegetation on the subject land, and in the locality and region, any "*edge effects*" associated with the creation of "*gaps in contiguous woody vegetation*" are considered negligible.

## Incursion of Weeds

There is no likelihood of any "*incursion of weeds*" into retained native vegetation as a result of the proposed Culburra Golf Course – principally because *inter alia* the Golf Course project will involve the implementation of dedicated long-term *Management of Plans* to control and remove weeds (see Chapter 12; Appendix D2).

Indeed, implementation of the Culburra Golf Course project will involve a significant and substantial reduction in weeds at this location, including within the environs of the Golf Course itself, as well as within the private Conservation Reserve which is proposed around the Golf Course and around Lake Wollumboola (Figure 19). In particular, substantial existing areas of Lantana and Bitou Bush infestation will be removed as part of that program.

It is the opinion of the author of this SIS that the eradication and control of weeds on Long Bow Point is far better achieved (and is far more likely to be achieved given historical precedents) through the private Conservation Reserve (see Chapter 12) than would the case under any other management of Long Bow Point (either by Council or by the OEH).

# Phytophthera cinnamomi

Both the *Construction Environment Management Plan* (CEMP) and the *Culburra Golf Course Plan of Management* (GCPoM) proposed for the long-term management of the Golf Course (see Chapter 12; Appendix D2), will involve the implementation of an array of specific measures to prevent the introduction of *Phytophthera cinnamomi*.

A specific element of both of those management regimes will be implementation of a specific *Phytophthera Cinnamomi Management Plan* (PCMP) – designed specifically to prevent its introduction to the site, including:

- a requirement for the cleaning of all golf course maintenance equipment prior to being brought on to the subject land;
- a requirement that any vehicles delivering golf course materials are appropriately treated and cleaned; and
- a requirement that any soils or plant material imported onto the Golf Course land are free of *Phytophthera*.

## Aggressive Over-abundant Species

Whilst it is possible that species such as the Noisy Miner may be favoured by the creation of a golf course, in general terms, it is to be noted that the Culburra Golf Course will be located within a bushland rather than an 'urban' setting, and will involve the retention of substantial areas of native bushland. This circumstance ensures that species which might otherwise be out-competed by the Noisy Miner will be able to find shelter and suitable resources on the subject land, and will enable natural predators and competitors of the Noisy Miner to survive.

In addition, as discussed elsewhere, the Culburra Golf Course project occupies only an extremely small proportion of the very substantial areas of native forest and woodland in the immediate vicinity and general locality. As detailed in Chapter 12.5, the project also facilitates the dedication of substantial areas of private forest and woodland for biodiversity conservation purposes. This approach will ensure that there are considerable areas of other suitable habitat for species which might be affected by the Noisy Miner and other such species, in the event that this issue actually arises.

As an additional measure, the annual reporting program for the Culburra Golf Course could readily incorporate a monitoring program for species such as the Noisy Miner, and a range of measures to address that issue could readily be developed – if it arises.

## 10.6.3 Item 5c(iii) – Pest Animals

"Ingress of pest animal species and possible consequential increase in predation pressure, loss of habitat condition or displacement of habitat arising from habitat clearance and fragmentation"

As discussed above, the Culburra Golf Course project will involve the implementation of:

- a dedicated *Culburra Golf Course Plan of Management* (GCPoM Appendix D2), for land specifically associated with the Golf Course;
- a detailed Golf Course Ecological Management Plan (GCEMP) to be prepared following consent for the project; and
- a dedicated *Conservation Area Plan of Management* (CAPoM) for the balance of the subject land the proposed private Conservation Reserve.

These *Plans of Management* will contain specific and detailed regimes for the control and eradication of all feral pests (Rabbits, Foxes, Feral Cats, Dogs *etc*) on Long Bow Point.

In fact, the operation of the Culburra Golf Course project will facilitate and guarantee far more intensive and ongoing control measures for "*pest animal species*" (such as Rabbits, Foxes, Feral Cats *etc*) than either is currently the case or would be likely under any other tenure of the land (including if Long Bow Point were to be dedicated to the OEH – given historical precedents).

# 10.6.4 Item 5c(iv) – Vegetation Changes

# "Change in vegetation floristics and structure resulting from edge effects"

Observations on the subject land do not indicate or demonstrate that there have been any notable or significant changes "*in vegetation floristics and structure resulting from edge effects*" currently (*ie* where there is existing clearing on the subject land). Similarly, observations by the author of this SIS on an array of golf courses (Chapter 2.4) do not support the contention that golf courses inevitably or necessarily impose "*edge effects*" of any consequence on adjoining retained native vegetation or wildlife habitats.

Given the xeric nature of the majority of the vegetation which occupies the Culburra Golf Course project area, and given the implementation of the GCPoM, the GCEMP and the *Conservation Reserve Plan of Management* (as discussed above), it is not considered likely that there will be any significant or notable changes "*in vegetation floristics and structure resulting from edge effects*" as a result of the Culburra Golf Course project.

In any case, any such changes which might possibly occur are not considered likely to adversely affect any of the relevant ("affected") threatened species considered in this SIS (as discussed above). Any such minor changes which might occur would have only a negligible impact (at worst) upon foraging, breeding or other activities of the Square-tailed Kite, Powerful Owl, Glossy Black Cockatoo, Yellowbellied Glider or microchiropteran bats, and may indeed benefit some threatened species.

Such minimal impacts would not be likely to adversely affect any other threatened species that might occur at Long Bow Point.

# 10.6.5 Item 5c(v) – Altered Hydrology

"Altered hydrology regimes to the Lake Wollumboola catchment (including increased runoff and raising or lowering of the water table, increased nutrient loads)"

As documented in the *Integrated Water Management Report* of Martens Consulting Engineers (2015 – see Appendix D1), there will be no significant or notable changes to hydrologic regimes or nutrient loads in Lake Wollumboola as a result of the proposed Culburra Golf Course. The total quantum of changes to the hydrology of Lake Wollumboola will be so small as to be essentially immeasurable.

In addition, the Culburra Golf Course project will not involve the discharge of any significant, notable, or even measurable *"increased nutrient loads"* into Lake Wollumboola, or into any of its associated watercourses.

In respect of hydrologic regimes and water quality:

- the stormwater management regime for the Culburra Golf Course project (Appendix D1) is designed specifically *inter alia* to involve minimal impacts on water volume discharges from the subject site into Lake Wollumboola;
- the water quality management regime (Appendices D1 and D2) are also designed specifically *inter alia* to avoid the discharge of additional nutrient loads into Lake Wollumboola or its associated watercourses;
- the Culburra Golf Course project area (approximately 35.19ha) is only a minute fraction (approximately 1%) of the Lake Wollumboola catchment (approximately 3,410ha);
- the impervious elements of the Golf Course will occupy a total area which is less than 0.05% of the Lake Wollumboola catchment; and
- implementation of the GCPoM (Appendix D2) will ensure that there is no discharge of fertilisers, pesticides or other chemicals into Lake Wollumboola.

In any case, any adverse impacts which could even potentially be imposed by the Culburra Golf Course project would be insignificant in respect of Lake Wollumboola, given (Appendices D1 and D2):

- the measures to be implemented to minimise and/or to avoid impacts with respect to runoff, water tables and nutrient loads;
- the limited potential for any changes in hydrologic regimes or nutrient loads given that the Golf Course constitutes just 1% of the whole Lake Wollumboola catchment, and that the majority of the Golf Course will have no relevant or meaningful impact on the behaviour of water (including groundwater flows); and
- the appropriate long-term management of the Golf Course as documented in Chapter 12 and in the GCPoM (Appendix D2).

There will be no modifications to water tables (other than on an extremely localised level around detention basins), and no relevant adverse impacts upon any habitat for any of the relevant ("affected") or even potential threatened biota.

None of the threatened biota which utilise Lake Wollumboola are regarded as relevant "affected" species for the purposes of this SIS - because there will be no adverse impacts upon Lake Wollumboola or its ecosystems, or upon the waterbirds and other biota which utilise the Lake. In this regard:

- all elements of the Golf Course are located 100m or more from Lake Wollumboola and its associated mudflats at the mouth of Downs Creek and Wattle Creek;
- the Golf Course project does not propose any access to Lake Wollumboola; and
- the *Integrated Water Management Plan* of Martens Consulting Engineers (Appendix D1) and the GCPoM (Appendix D2) will ensure that there will be no discharge of contaminants or pollutants into Lake Wollumboola or its associated watercourses.

## 10.6.6 Item 5c(vi) – Endangered Ecological Communities

"Altered hydrology regimes to the Endangered Ecological Communities known to occur both onsite and adjacent to the development and the predicted impacts to these communities"

As discussed in some detail in Chapters 5.7 and 8.5 of this SIS, there are no "*endangered ecological communities*" (EECs) present on the subject site or subject land, or around Lake Wollumboola.

Those vegetation types that conform floristically to the various EECs claimed by some to be present at Long Bow Point are located in the low-lying parts of the subject land, including in the lower parts of Wattle Creek and Downs Creek and around the Lake Wollumboola foreshore. However, none of those EECs (even if they were present – which is not conceded) will be subjected to any significant adverse impacts as a consequence of the Culburra Golf Course project.

The *Integrated Water Management Plan* of Martens Consulting Engineers (2015 – Appendix D1) is designed *inter alia* to ensure that no adverse impacts will be imposed upon Lake Wollumboola or its associated watercourses, with respect either to water quality or water volumes and discharges. In addition, long-term management of the Culburra Golf Course through the GCPoM (Appendix D2) is designed *inter alia* to avoid or, at the very worst, minimise any potential for adverse impacts to be imposed on any of those 'Floristic EECs'.

Management of the Golf Course (including *inter alia* the use of foliar fertilisers and the strict management of nutrients and other chemicals) will ensue that there is no adverse impact on the water quality of stormwater runoff or groundwater associated with the Culburra Golf Course.

# 10.6.7 Item 5c(vii) – Soil Erosion and Pollution

## "Soil erosion and pollution"

The construction program and the ongoing management of the Culburra Golf Course will be undertaken in a manner which prevents and avoids any potential for "*soil erosion*".

The construction program will be the subject of strict controls - pursuant to a detailed and comprehensive *Construction Environment Management Plan* (CEMP) - which is to be prepared for the project. All construction activities are to be undertaken in a manner which protects all retained vegetation and soils - by the use of silt fences and temporary sediment basins to contain any sediment which could be discharged from exposed soil surfaces (Chapter 3; the *Integrated Water Management Plan* – Appendix D1; the GCPoM – Appendix D2).

No discharge of sediment or any contaminants into the natural environment or into any retained vegetation will be permitted – either during construction or during subsequent maintenance of the Culburra Golf Course.

The Culburra Golf Course is to be managed in the long-term in such a manner as to avoid any potential for the discharge of any pollutants or contaminants into the natural environment. The *Culburra Golf Course Plan of Management* (GCPoM – Appendix D2) details measures to avoid or minimise the discharge of contaminants (including fertilisers, chemicals and pesticides), on the basis *inter alia* that such discharges would in essence constitute a waste of money and resources.

The combination of careful management of stormwater – pursuant to the *Report* by Martens (Appendix D1) and the GCPoM (Appendix D2) – is intended specifically to avoid any "*pollution*" of the watercourses and Lake Wollumboola, or of any groundwater aquifers that might be present. Any excess application of fertilisers or pesticides would be both economically wasteful and environmentally unacceptable. The use of foliar fertilisers will be of assistance in this regard.

## 10.6.8 Item 5c(viii) – Feeding, Nesting and Breeding

"Disturbance to feeding or nesting/breeding of species"

There is some limited potential for "*disturbance to feeding or nesting/breeding of* [some threatened] *species*" as a consequence of the Culburra Golf Course project.

However, this potential is considered of minimal relevance - because:

- most of the relevant ("affected") species are nocturnal (golf course activities are predominantly diurnal);
- only a very small proportion of the resources for either "*feeding or nesting/breeding*" of any of the relevant ("*affected*") threatened species, or indeed any other potential threatened species, will be removed as a result of the proposed Culburra Golf Course;
- there are vast areas of appropriate and necessary resources for "feeding or nesting/breeding of species" in the substantial existing conservation reserves and State Forests in the vicinity and locality (approximately 280,000 hectares), as well as in the areas of private forest which are to be dedicated for biodiversity conservation purposes;
- there will be no nett loss of tree-hollows as a result of the Culburra Golf Course project; and
- the subject site for the Culburra Golf Course project is only an extremely small (miniscule) proportion of suitable habitat and resources for any such species in the vicinity and locality.

Specific comment in this regard is contained in Chapter 10.7 of this SIS for each of the relevant ("affected") threatened species.

## 10.6.9 Item 5c(ix) – Human Access

"Trampling or other impacts due to increased use of the area by humans, particularly on endangered ecological communities"

As noted elsewhere in this SIS, it is not accepted that there are any "*endangered ecological communities*" (EECs) present on the subject land at Culburra (see Chapter 8.5). There will, consequently, be no impacts imposed upon any such EECs.

Furthermore, most of the vegetation which conforms floristically to some of the EECs identified in the DGRs is located in the low-lying parts of Downs Creek and Wattle Creek, and/or around the Lake Wollumboola foreshore. The overwhelming majority of these areas of vegetation are at some distance from any elements of the proposed Culburra Golf Course. There will, therefore, be no relevant or significant "*trampling or other impacts due to increase the use of the area by humans*" in these areas.

There is no reason for incursions by humans into the majority of the retained vegetation within the subject land, and golfing activities would generally not involve any such additional *"trampling*" at any distance from the golf course fairways.

Whilst there will doubtless be some minor "*trampling*" of retained vegetation immediately adjacent to golf course fairways on occasions (by golfers searching for balls from wayward shots), such impacts will be extremely minor, highly localised and temporary. No adverse impacts of any relevance are anticipated with respect to any EECs (even if any such communities were present, which is not conceded) nor with respect to any relevant habitat or resources for any threatened species.

Furthermore, with respect to the relevant ("affected") threatened species, "trampling or other impacts due to increased use of the area by humans" is not likely to involve the imposition of any adverse effects at all. All of the relevant ("affected") species, (and indeed most of the potential threatened species) are aerial/arboreal. The majority of the relevant resources and habitat features are to be retained for these species throughout the subject land.

## 10.6.10 Item 5c(x) – Mortality Rates

## "Increased mortality rates due to road deaths"

None of the relevant ("*affected*") threatened species, nor any of the potential species, are particularly susceptible to "*road deaths*".

Furthermore, road speeds throughout the whole of the Culburra Golf Course project area will be low (less than 40km/h), and most vehicle movements will be during the day – when visibility is high.

It is not considered likely that any native biota, including any actual, relevant or even potential threatened species, would be subjected to any significant increase (if indeed any increase at all) in road mortality as a result of the Culburra Golf Course project.

## 10.6.11 Item 5c(xi) – Wildlife Movement Corridors

"Habitat fragmentation and disruption of wildlife movement corridors and pollination mechanisms"

The proposed Culburra Golf Course will not involve any relevant "*habitat fragmentation*" or any "*disruption of wildlife movement corridors*" or "*disruption of pollination mechanisms*" - given:

- the nature, habits and habitat preferences of the relevant ("affected") threatened species;
- the high mobility of those threatened biota that are, or could even potentially be, present on the subject site at Culburra;
- the retention of substantial bands of native forest and woodland vegetation between fairways and other elements of the Culburra Golf Course project;
- the substantial band of contiguous native vegetation which will be maintained around the peripheries of Long Bow Point and through the subject land; and

• the very considerable areas of native forest and woodland habitat to be retained in the general vicinity and locality.

There is no conceivable likelihood that any relevant "*Habitat fragmentation*" will occur as a result of the Culburra Golf Course project – as documented throughout this SIS.

In addition to the retention of bands of vegetation through the subject land and around Long Bow Point, it is to be noted that there are no relevant broad scale "*wildlife movement corridors*" at this general location. Lands to the immediate north and northeast of the proposed Culburra Golf Course are already occupied by existing residential development and/or will be developed in the future for the Culburra West Urban Development project, and Lake Wollumboola is located to the immediate east.

The vegetation on Long Bow Point does not constitute a "*wildlife movement corridor*" for any native (including threatened) species - because it is located at the northeastern periphery of the broad bands of open forest and woodland through the general vicinity and locality (Figures 1 and 7C).

On a broader scale, there is no relevant north-south "wildlife movement corridors" through this general locality. As discussed with respect to the Culburra West project, the extensive areas of estuarine habitats from the Crookhaven River northwards, as well as areas of existing residential development and areas of cleared agricultural land to the north, mean that there is no meaningful north-south corridor in this location.

The only native fauna species which could conceivably move across the very wide gap created by the Crookhaven River estuary and cleared and/or developed lands to its north would be highly mobile species (such as birds and some bats). Such species will not be affected at all in this regard by the Culburra Golf Course.

# 10.6.12 Item 5c(xii) – Fire Behaviour

"Change in fire behaviour as a result of clearing of native vegetation"

It is not anticipated that there will be any changes in fire behaviour as a result of the "*clearing of native vegetation*" within the Culburra Golf Course project area.

In the first instance, bushfires are not a major feature of the subject land or the "*subject site*". Further, it is not anticipated that the Culburra Golf Course would have any relevant impact upon (*ie* with respect to the habitat requirements of any threatened species) the frequency, intensity or "*behaviour*" of bushfires through the subject land.

It must also be noted that the Culburra Golf Course *per se* would provide significant benefits for the community of Culburra Beach, by providing enhanced opportunities for fire fighting and for the protection of the Culburra township from bushfires emanating from the south.

The construction and ongoing management of the Culburra Golf Course could potentially reduce the intensity of broad-scale fires at this location, thus reducing potential impacts upon significant features (such as hollow-bearing trees and dead trees). Alternatively, a dedicated and active bushfire regime could be developed (in consultation with the OEH and RFS), and implemented through the GCPoM (Appendix D2) and other *Plans of Management*.

## 10.6.13 Item 5c(xiii) - Light and Noise

## "Altered light and noise regimes"

It is not considered likely that the Culburra Golf Course would involve notable "altered light regimes" on the subject land, because the overwhelming majority of the project (*ie* the 18 holes and the practice drive) would not be used at night. Even if the driving range was to be used at night, any impacts would be highly localised and miniscule – given the very substantial areas of native open forest and woodland in the vicinity and general locality.

The only likelihood for "*altered light regimes*" would potentially be use of the access driveway and the clubhouse (the future clubhouse is not part of this DA) for evening functions. This would be an infrequent occurrence, and is not in any case part of this application.

It is anticipated (and/or recommended) that the access road will have low level bollard lighting – to guide visitors and/or staff when leaving the Golf Course at or around dusk. However:

- such lighting would be located near ground level to minimise 'light spill';
- lighting levels would be low sufficient to illuminate the road; and
- the lights would not be left on all night thus ensuring that only natural light (or darkness) predominates.

The total 'footprint' of any potential or likely "*altered light regimes*" (*ie* imposition of light into the subject site) would be extremely minor, and would not be likely to have any notable or significant effect upon any potential or known threatened biota.

Similar considerations apply with respect to "*altered noise regimes*". Whilst the use of a golf course doubtless will involve the imposition of some human noise in an environment which currently is little exposed in this regard, the potential for any such increased noise to impose adverse impacts upon the relevant ("*affected*") threatened species is regarded as negligible – given the nature of the project.

In this regard:

- the levels of increased noise would be very minor (associated with use of a golf course) and/or highly localised; and
- most of the species of relevance are nocturnal, and would therefore be essentially unaffected.

Some further consideration of this issue, where relevant, is contained in the impact assessment for each relevant threatened species (see Chapter 10.7).

## 10.6.14 Item 5c(xiv) – Threatening Processes

"The likely contribution of the action proposed to the threatening processes already acting on populations of those subject species or populations and occurrences of subject ecological communities in the locality"

As discussed elsewhere in this SIS, there are no EECs present on the subject land or the subject site at Culburra. The Culburra Golf Course project, therefore, will not have any impact upon any potential "*key threatening processes*" acting upon those EECs. Even if any EECs were present (which is not conceded) the extent of adverse impacts which could be imposed would not exacerbate the relevant "*threatening processes*" to any significant extent, even on and around Long Bow Point.

With respect to the relevant ("*affected*") threatened species (*ie* the Square-tailed Kite, Glossy Black Cockatoo, Powerful Owl, Yellow-bellied Glider and microchiropteran bats), and other threatened species that could potentially occur, the relevant "*key threatening processes*" which would act upon them are:

- the clearing of native vegetation; and/or
- the loss of hollow-bearing trees; and/or
- the loss of dead wood and dead trees.

The potential impacts of the proposed Culburra Golf Course with respect to those "*key threatening processes*" are substantially similar for all of the relevant "*affected*" threatened species, and indeed for those additional 'potential' or 'likely' threatened species – (see Chapters 10.3, 10.4, 10.7 and 10.8).

In respect of those "key threatening processes":

- the quantum of native vegetation to be cleared for the Culburra Golf Course project is extremely small by comparison with the extent of native vegetation in the immediate vicinity, general locality and region (see Chapter 10.3);
- the area of native vegetation to be cleared, even within the Lake Wollumboola catchment, is a minute fraction of the native vegetation which is present (just 1% of the Lake catchment);
- a substantial proportion of potential or real habitat and resources are already protected in the Jervis Bay National Park and other conservation reserves and State Forests;
- the quantum of native vegetation to be cleared is extremely small with respect to the home ranges and/or extent of distribution of any of the relevant (*"affected"*) threatened species;
- the Culburra Golf Course project has been designed specifically *inter alia* to minimise the removal of hollow-bearing trees for the project;
- in addition, the Culburra Golf Course project is committed to a 'zero nett loss' outcome with respect to tree-hollows by implementation of the *Hollow-bearing Tree Protocol* and by the use of artificial nest boxes, where necessary; and
- the Golf Course similarly has been designed *inter alia* to retain dead stags and hollowbearing trees wherever possible – as potential habitat for Glossy Black Cockatoo, Yellowbellied Glider and other hollow-nesting species.

None of the other "*key threatening processes*" listed in the TSC Act will be imposed or exacerbated as a consequence of the Culburra Golf Course project (see Table 1.1 in Chapter 1; discussion above in Chapter 10.6). In this regard:

- measures to prevent the importation of *Phytophthora cinnamomi* are to be implemented as part of the *Golf Course Ecological Management Plan* (GCEMP) – to be prepared following approval of the Golf Course;
- the Culburra Golf Course project will reduce infestations of invasive native grasses and weeds such as Lantana and Bitou Bush, rather than increasing the incidence of those impacts;
- the GCEMP will include a program of control and eradication of feral pest species (such as foxes, rabbits and rodents) – thus reducing the impact of those "key threatening processes"; and
- there is no likelihood that the Culburra Golf Course project would exacerbate any of the other "*key threatening processes*" listed in the TSC Act.

Given all of those circumstances, the proposed Culburra Golf Course project will involve only an extremely minor or insignificant contribution (at worst) to the "*threatening processes already acting on populations*" of those relevant ("*affected*") threatened species. In most instances, the project will in fact reduce those "*processes*".

Where relevant, further consideration of these matters is contained within the consideration of impacts on relevant threatened species in Chapter 10.7 and in the individual *Section 5A Assessments of Significance* (Chapter 10.8 and Appendix X) of this SIS.

#### 10.7.1 Introduction

The relevant or potentially relevant impacts on those threatened species considered likely to be *"affected*" by the proposed Culburra Golf Course, as outlined in the initial part of Item 5 of the DGRs, are discussed in detail above.

As is noted in Chapter 10.2 of the SIS, the potential impacts on the relevant ("*affected*") threatened species (the Powerful Owl, Square-tailed Kite, Glossy Black Cockatoo, Yellow-bellied Glider and microchiropteran bats) are substantially the same, or at least very similar (although the Square-tailed Kite does not require tree-hollows). The relevant impacts on these threatened biota will be:

- the removal of native vegetation (approximately 27.84ha) from the golf course footprint which will mostly involve the removal of foraging habitat for those species, and potential roosting and/or nesting (for the Square-tailed Kite) resources; and
- the very limited removal of hollow-bearing trees noting that the *Hollow-bearing Tree Protocol* will ensure that there is no nett loss of tree-hollows on the subject land. Fewer than 5 identified hollow-bearing trees are to be removed.

For all of the relevant ("*affected*") threatened species, however, and for other potential threatened species, those potential adverse impacts are ameliorated and/or mitigated by virtue of:

- the substantial home ranges of the relevant species;
- the generally wide-ranging habits of those species;
- the implementation of measures to ensure that there is no nett loss of tree-hollows;
- the careful construction of and the long-term environmentally sensitive management of the Golf Course (see Chapters 2.4 and 12); and
- the *Environmental Offsets Strategy* proposed which will involve *inter alia* the dedication of private native forest on Long Bow Point, in Culburra Beach and at Worrowing Heights for biodiversity conservation purposes (see Chapter 12).

Additional specific comments for the individual threated species or individual groups of threatened species are provided below.

## 10.7.2 Powerful Owl

As discussed in Chapters 8 and 9, the Powerful Owl has been recorded at various locations in the vicinity and locality, including just once on the subject land – albeit to the south and/or southwest of any proposed golf course elements (Figures 16A and 16B).

Given the size of the home range of a single pair of the Powerful Owl (up to 1000 hectares), and given the distribution of records, the subject land at Culburra would doubtless form part of the home range of a pair of this species. There is a known very large nest tree for the Powerful Owl on the northern side of Culburra Road, to the west of the proposed Culburra Golf Course (although that does not appear to have been used in recent years). As discussed in some detail above, the proposed Culburra Golf Course will involve the removal of approximately 27.84 hectares of native forest and woodland vegetation, which doubtless provides foraging habitat for an incumbent pair of Powerful Owls. That loss of vegetation, however, constitutes only a very minor reduction in available habitat.

Further, that loss of vegetation is not likely to significantly affect the survival of the pair of Powerful Owls, given the extent of suitable habitat remaining in the locality, and the limited and confined development activities proposed. Further relevant considerations include the nature of the Golf Course proposal, and the limited use of the relevant parts of the subject land by Powerful Owls.

No trees with hollows suitable for nesting by the Powerful Owl are located within the Culburra Golf Course project area, and there will consequently be no loss of suitable resources for breeding by this large forest owl. Similarly, the small area of potential foraging habitat which would be removed relative to the home range of the Powerful Owl does not suggest that it is likely that even an individual pair of this species would be adversely affected to any significant extent by the Culburra Golf Course project.

The proposed Culburra Golf Course is not considered likely to adversely affect the behaviour or survivability of the Powerful Owls which occur at this general location. As discussed below (Chapter 10.8 and in Appendix X), it is not considered *"likely"* that the proposed Culburra Golf Course will involve the imposition of a *"significant effect"* upon the Powerful Owl.

These same considerations would apply to any other large forest owl that might forage or nest on or near to Long Bow Point (*eg* the Masked Owl, Barking Owl or Sooty Owl), noting that no such additional threatened owls have been recorded on Long Bow Point in 20 years of surveys.

## 10.7.3 Glossy Black Cockatoo

The Glossy Black Cockatoo is recorded widely in the Culburra area (F Dominic Fanning *pers obs*), as noted in Chapters 8 and 9 of this SIS. As for the other relevant (*"affected"*) species, the proposed Culburra Golf Course will involve the removal of some native forest vegetation, which will potentially impose some adverse impacts upon this species – with respect to foraging resources and/or hollow-bearing trees (for nesting).

It should be noted, however, that:

- the proposed Golf Course has avoided areas of high density she-oaks displaying evidence of Glossy Black Cockatoo feeding – and will thus not significantly affect (if indeed affect at all) the availability of food resources for the Glossy Black Cockatoo;
- the Golf Course has been specifically designed *inter alia* to avoid the removal of hollowbearing trees to the greatest extent possible – including specimens that could potentially be used by Glossy Black Cockatoos for nesting purposes;
- no nesting or breeding by Glossy Black Cockatoos has been recorded on Long Bow Point or in its immediate environs – despite two decades of field investigations at this location; and
- there are substantial areas of native forest and woodland in the vicinity and general locality

   including extensive areas already protected in existing conservation reserves and State
   Forests, and additional areas which will be protected through the *Environmental Offsets Strategy* for the Culburra Golf Course, and on other private lands in the vicinity and locality.

Given those circumstances, and given the high mobility and wide-ranging habits of the Glossy Black Cockatoo, the proposed Culburra Golf Course project is not likely to adversely affect individuals or sub-populations of this species such that a *"significant effect"* would be imposed upon the Glossy Black Cockatoo (Appendix X).

## 10.7.4 Square-tailed Kite

As discussed in Chapters 8 and 9, the Square-tailed Kite has a very substantial home range (of approximately 100km<sup>2</sup> or 10,000ha). Individuals of this species have been recorded soaring over the subject land and subject site on a number of occasions (including during investigations for this SIS), and a single nest tree of the Square-tailed Kite has been located - in the northwestern part of the subject land, near the proposed Fairway No. 5 (Figure 17).

As for the other relevant ("*affected*") threatened species, the proposed Culburra Golf Course project will involve the removal of native vegetation which would constitute part of the foraging resource for this species within its substantial home range. However, given the very small area of open forest to be removed (approximately 27.84ha) compared to the substantial home range of the species (approximately 100 km<sup>2</sup>), the loss of potential foraging habitat (0.28% of a single home range) is not regarded as of significance or relevance.

The Culburra Golf Course has been re-designed (by the golf course designer in consultation with the author of this SIS) to ensure the retention of the Square-tailed Kite nest tree on the subject land at Long Bow Point (Figure 17).

It is doubtless possible that the activities of golfers around the nest might result in its abandonment by the current pair of breeding Square-tailed Kites. Even if the nest were to be abandoned, however, there is a substantial resource of suitable trees within the home range of this species, including at Long Bow Point and throughout substantial parts of the subject land and surrounding lands.

The loss of a single nest tree under natural circumstances (*eg* in a storm) would not likely lead to the "*extinction*" of a "*local population*" of the Square-tailed Kite. Similarly, even if abandoned, the single nest tree On Long Bow Point cannot be considered likely to be crucial to the survival of the species within its extensive home range.

Given those circumstances, it cannot be considered "*likely*" that a "*significant effect*" would be imposed upon the Square-tailed Kite – either as a species or in respect of the local pair of this species (Appendix X). The quantum of habitat and resources to be removed or affected is insignificant with respect to the home range and life cycle of the Square-tailed Kite.

## 10.7.5 Yellow-bellied Glider

The Yellow-bellied Glider occupies open forest and woodland vegetation in eastern Australia, and is dependent on tree-hollows for denning and shelter purposes. This species lives in small family groups, and makes incisions into tree bark (particularly in Bloodwoods) in order to obtain sap – as part of its normal diet. Yellow-bellied Gliders also eat flowers, some fruit, nectar and insects.

Yellow-bellied Gliders had been recorded previously (in 1991 and 2001) at the end of Long Bow Point. During the specific surveys for this SIS in 2013, Yellow-bellied Gliders were also recorded at the end of Long Bow Point – in the forested 'buffer' between Hole 1 and Lake Wollumboola.

There are substantial numbers of suitable tree-hollows on Long Bow Point, within and around the Golf Course lands – suitable for denning by Yellow-bellied Gliders. As discussed in the SIS, only about five hollow-bearing trees need to be removed for the Golf Course, and the project has adopted a 'no nett loss of tree-hollows' policy. Thus, denning resources for the Yellow-bellied Glider will not be reduced as a consequence of the Culburra Golf Course project.

No incised Yellow-bellied Glider feed trees were identified within the Culburra Golf Course footprint. It would appear that the Yellow-bellied Gliders previously, and currently, occupy the open forest between the Golf Course and Lake Wollumboola, and potential foraging resources for the species will be retained within the private Conservation Reserve on and around Long Bow Point.

As discussed in detail throughout this SIS:

- the Culburra Golf Course has been designed specifically *inter alia* to retain virtually all of the hollow-bearing trees present;
- there is, in addition, both a *Hollow-bearing Tree Protocol* (which will ensure the salvage and re-use of any tree-hollows which need to be removed) and a 'no nett loss of tree-hollows' policy; and
- whilst no Yellow-bellied Glider feed trees were located within the Golf Course footprint, the proposed Golf Course would remove only a very small proportion of potential Yellow-bellied Glider feed trees (*ie* Bloodwoods) at this general location, in any case.

Given those circumstances, it is not *"likely"* that a *"significant effect"* would be imposed upon the Yellowbellied Glider (Appendix X) – as a consequence of the Culburra Golf Course project.

# 10.7.6 Microchiropteran Bats

As is the case for the threatened birds discussed above, the relevant concern with respect to the proposed Culburra Golf Course is the removal of some areas of native open forest and woodland vegetation from the subject land.

With respect to the relevant threatened microchiropteran bats (*ie* those species likely to be "*affected*" by the proposal), and other threatened microchiropteran bats that could potentially utilise the subject land, the following considerations apply.

• The extent of native forest canopy (*ie* foraging habitat) to be removed is a very small proportion of that available in the immediate vicinity – both on the subject land and elsewhere in the locality.

- There are very substantial areas of suitable foraging habitat for those threatened microchiropteran bats protected in the vicinity and locality including in the very substantial existing conservation reserves and State Forests.
- There is no likelihood of further substantial reductions in the forest canopy in this locality in the future - given the considerable extent of existing conservation reserves in the locality (Figure 7A), and the zoning proposed in the *Draft Shoalhaven Local Environmental Plan* 2013 for substantial areas of private forested land – which would result in considerable such areas being protected.
- The threatened microchiropteran bats which are or which could be of relevance on the subject land and highly mobile and wisely distributed in the locality and general region – which means that the potential impacts of the Culburra Golf Course on those species will be highly localised.
- The Culburra Golf Course has been carefully designed *inter alia* specifically to minimise or avoid the removal of roosting resources (*ie* tree-hollows):
  - by virtue of the retention of the overwhelming majority of hollow-bearing trees by designing the golf course elements around the hollow-bearing trees wherever possible; and
  - by virtue of implementation of the *Hollow-bearing Tree Protocol* which will ensure that there is no nett loss of tree-hollows on the subject land.

Given those circumstances, the proposed Culburra Golf Course is not likely to adversely affect the survival of any microchiropteran bat species that do or may occur on the subject land at Long Bow Point (Appendix X).

# 10.7.7 Other Potential Threatened Species

As discussed in Chapters 8 and 9 of this SIS, there are a number of other threatened species which are known to occur in the vicinity of the subject land - particularly as recorded on lands to the immediate north associated with the Culburra West project (SLR Ecology 2013).

Those species (Table 8.3; Figures 16A and 16B) include a few threatened microchiropteran bats that have not actually been recorded on Long Bow Point or in its immediate environs, as well as a number of additional threatened bird species, some of which could potentially occur on Long Bow Point (*eg* the Gang Gang Cockatoo, Varied Sittella, Scarlet Robin, Little Eagle and possibly the Sooty Owl).

The same considerations as are discussed above with respect to the Powerful Owl, Glossy Black Cockatoo and Square-tailed Kite and/or known threatened microchiropteran bats are relevant to most of those potential threatened species – given that the other potential threatened species would also be reliant substantially (if not exclusively) on the same open forest and woodland habitats.

Even with respect to species such as the White-footed Dunnart or Southern Brown Bandicoot (neither of which have been recorded anywhere at Culburra at any time during the last 20+ years despite appropriate trapping and other survey methods), the Culburra Golf Course project is not likely to be of any significance or concern. This conclusion is based on the small area of potential habitat to be affected compared to the large tracts of suitable habitat to be retained on the subject land and/or which is already protected in the vicinity, locality and region – as discussed throughout this SIS.

Relevant considerations regarding these additional potential threatened species include the following.

- The extent of native forest canopy (*ie* foraging habitat) to be removed is an extremely small proportion of that available in the immediate vicinity, on the subject land and elsewhere in the locality.
- The extent of open forest and woodland to be removed is an extremely small proportion of that available in the immediate vicinity, on the subject land and elsewhere in the locality.
- There are very substantial areas of suitable foraging habitat for those threatened microchiropteran bats protected in the vicinity and locality including in the very substantial conservation reserves and State Forests in the Shoalhaven LGA.
- There is no likelihood of substantial further reductions in the open forest and woodland habitats and resources in this locality in the future as discussed above.
- The threatened species which are or could be relevance on the subject land are mostly highly mobile, wide-ranging and widely distributed in this general locality.
- The Culburra Golf Course has been very carefully designed specifically *inter alia* to minimise or avoid the removal of roosting resources (*ie* tree-hollows):
  - by virtue of the retention of the overwhelming majority of hollow-bearing trees throughout the Golf Course land; and
  - by virtue of implementation of the *Hollow-bearing Tree Protocol* which will ensure that there is no nett loss of tree-hollows on the subject land.

Indeed, it is conceivable that the Culburra Golf Course could actually benefit the Scarlet Robin – which utilises grassland and open woodland habitats (in part), noting that it has only been recorded once in the vicinity (in the Culburra West land to the north).

Similarly, the basins and ponds on the Golf Course will offer specialist habitat and resources for other threatened species (such as the Green & Golden Bell Frog, Large-footed Myotis and some other microchiropteran bats) – as full habitat or as a foraging resource.

## 10.8.1 Introduction

The Director-General's Requirements (DGRs) for this SIS include (in Item 7) a requirement that an "assessment of significance (in accordance with section 5A EP&A Act) is to be provided for each of the affected threatened species, population or ecological community identified in the SIS, and must incorporate relevant information" included in the SIS.

The Section 5A Assessments of Significance which have been prepared for this SIS (Appendix X) have been applied to determine "whether, based on more detailed assessment through the SIS process and consideration of alternatives and/or ameliorative measures proposed in the SIS, the proposal is still considered likely to have a significant effect on threatened species, populations or ecological communities or their habitats".

It is to be noted that the author of this SIS (Mr F Dominic Fanning) had concluded, in the original *Flora* & *Fauna Assessment Report* for the Culburra Golf Course Project (InSites 2011), that there was **not** "*likely*" to be a "*significant effect*" imposed upon any threatened biota as a consequence of the Culburra Golf Course project.

That conclusion was reached on the basis of the evidence presented in the FFAR in 2011, and as a result of the application of Section 5A of the *Environmental Planning* & *Assessment Act 1995* (EP&A Act) to the relevant threatened species, at that time. It is to be noted that the measures which have now been applied to the Culburra Golf Course project (such as refinement of the design by a professional golf course designer, selective retention of hollow-bearing trees *etc*) were foreshadowed in that FFAR, and formed the basis of the original *Section 5A Assessments of Significance*.

This Species Impact Statement (SIS) has not been prepared on the basis that the author has ever conceded that it was, in fact, "likely" that a "significant effect" would be imposed upon any "threatened species, populations or ecological communities, or their habitats". The SIS was prepared, rather, on the basis that the consent authority (Shoalhaven City Council) had indicated that it required the preparation of an SIS for the DA, before it could determine the DA.

Further to those considerations, it is of particular relevance to note that the Culburra Golf Course project has subsequently been the subject of considerable further iterative 'fine-tuning' by the project ecologist and a professional golf course designer, in order to refine the original DA and concept design. That iterative process has resulted in:

- clarification of the extent of native open forest and woodland vegetation to be removed or affected by the proposal (to about 27.84ha – or less than half of the original area which conceptually was to be 'cleared' or 'affected');
- the retention of all but approximately 5 identified hollow-bearing trees over the whole of the 18-hole golf course and its associated infrastructure; and
- further refinement of the stormwater management regime and features.

As a consequence of that carefully focussed iterative design process (which had been originally described in the InSites 2011 *Report* as the basis for subsequent detailed analysis of and design of the Golf Course), the potential for adverse impacts to be imposed upon threatened biota as a result of the Culburra Golf Course project are less than even those originally proposed (which were deemed not to

constitute a "*significant effect*", in any case). As noted above, it was the basis of that previous analysis that the further iterative design process that has now been undertaken would have occurred for the final Golf Course design (with essentially the same outcomes).

The relevant factors of Section 5A of the EP&A Act have been applied (Appendix X) to the threatened species discussed above (Table 10.1). The relevant factors of Section 5A of the EP&A Act have also been applied by the author of this SIS, on a theoretical basis, to other threatened biota that could potentially occur on the subject site, and those threatened biota associated with Lake Wollumboola, as well as the EECs which are claimed (by others) to be present at this location (see below).

# 10.8.2 Affected Species

The Section 5A *Assessments of Significance* prepared for the relevant ("*affected*") threatened species (Table 10.1; Chapter 8) conclude that there is not "*likely*" to be "*a significant effect*" imposed upon any of those "*threatened species*" or "*endangered ecological communities*"<sup>9</sup> (Appendix X).

This conclusion is reached because of the following considerations.

- The habitats present within the proposed Culburra Golf Course development area (*ie* the "*subject site*") represent only a minute proportion of the extent of the available habitats for those "*threatened species*" in the locality and/or within their home ranges.
- Most of the threatened fauna recorded on (or likely to occur on) the subject site are wideranging and highly mobile.
- A golf course development, if carefully, and properly, and thoughtfully, and intelligently designed (and managed), is not inimical to the survival of any of those species. Microchiropteran bats can continue to use the site (including the golf course fairways and detention basins/wetlands) for foraging, and the important resources for those species, and for the relevant or potentially relevant threatened birds, will be preferentially retained. Some threatened species (such as the Scarlet Robin, Large-footed Myotis and Green & Golden Bell Frog, and even some wading birds from Lake Wollumboola), could even benefit from the project.
- The Culburra Golf Course has been specifically designed *inter alia* to limit the loss or removal of habitat features and resources of particular value for relevant (*"affected"*) threatened species. In this regard:
  - most of the Golf Course holes (those where hollow-bearing trees are present) have been re-designed and/or refined by the project ecologist (the author of this SIS) and the golf course designer (Mr James Wilcher) - so as to avoid the requirement (wherever possible) to remove hollow-bearing trees. Just 5 identified hollow-bearing trees will be removed for the project;
  - the Culburra Golf Course has also been designed to avoid stands of she-oak which are regularly used by Glossy Black Cockatoos for foraging; and
  - the Culburra Golf Course has been designed specifically to retain native vegetation (including hollow-bearing trees) between fairways, and to avoid the

<sup>9</sup> As noted elsewhere in this SIS, it is not conceded by the author that any of those EECs are present, in any case.
necessity for the removal of hollow-bearing trees for any associated infrastructure.

- The Culburra Golf Course project will facilitate the implementation of a comprehensive *Environmental Offsets Strategy* (see Chapter 12.6) which will deliver an array of significant environmental benefits on Long Bow Point and in the immediate vicinity.
- The Golf Course is to be managed in the long-term pursuant to a dedicated Culburra Golf Course Plan of Management (GCPoM – Appendix D2) – which will inter alia ensure that biodiversity and ecosystems, and habitat for threatened biota, on and around the Golf Course are protected and maintained.
- A Golf Course Ecological Management Plan (GCEMP) will be prepared to ensure the implementation of ecological outcomes (eg vegetation protection, no nett loss of treehollows, ongoing removal of weeds and feral pests, monitoring programs and habitat enhancement) – as documented in this SIS.
- Implementation of the *Hollow-bearing Tree Protocol* (see Chapter 12) will ensure that there is no nett loss of tree-hollows on the subject land as a result of the proposed Culburra Golf Course.
- Substantial areas of suitable habitat and resources for those threatened biota are to be retained on the subject land, and appropriately managed in the long-term (Chapter 12.3).

As discussed in detail in Chapter 12 of this SIS, it is proposed to dedicate areas of existing forest and woodland on Long Bow Point (in a dedicated 113ha Conservation Reserve), as well as at East Crescent, Culburra Beach (approximately 3.4ha) and at Worrowing Heights (approximately 6.1ha), for biodiversity conservation purposes as an offset (in part) for the removal of vegetation for the Culburra Golf Course (see details of the *Environmental Offsets Strategy* in Chapter 12). These are in addition to the areas of native vegetation to be retained in and around the Golf Course (of approximately 30ha).

With respect to the relevant ("affected") species (see Appendix X):

- it is not "*likely*" that "a viable local population" of any of those threatened species would be "placed at risk of extinction" as a result of the proposed Culburra Golf Course project - on the basis of the substantial extent of protected suitable habitat for those relevant ("affected") threatened biota in the area;
- the proposed development is **not** likely to "threaten" the "survival or evolutionary development" of any threatened biota;
- the Culburra Golf Course will not affect a significant area of habitat or resources for any
  of the relevant ("affected") species, nor indeed any other potential threatened biota. Whilst
  there will be a small area of habitat and some resources for some threatened species
  removed for the purposes of creating and maintaining the golf course, that loss is miniscule
  compared to the extent of such resources in the vicinity and locality, and will not involve
  the imposition of a "significant effect" upon any threatened species;
- the imposition of several "*key threatening processes*" *per* se will not threaten the survival of any threatened species; and
- the implementation of the impact amelioration and environmental management measures as an integral part of the proposed development (Chapters 12.4 and 12.5), and of the dedicated *Environmental Offsets Strategy* (Chapter 12.6), provide an appropriate and sufficient offset for the limited adverse impacts which will or may be imposed by the

project, and will *inter alia* ensure the long-term protection and management of relevant resources for those threatened species.

## 10.8.3 Endangered Ecological Communities

With respect to "*endangered ecological communities*" (EECs), it is the position of the author of this SIS that there are no EECs present on either the "*subject site*" (*ie* the Culburra Golf Course development area) or on Long Bow Point or its environs. As detailed in Chapters 5.7 and 8.5 of this SIS, none of the EECs which were identified in the DGRs for this SIS are present on the subject land (as reiterated below).

It has been suggested by some (but not actually demonstrated by any) that some of the vegetation on the subject land conforms to one or other of the EECs listed in the DGRs, and/or some other EEC. Areas of vegetation which are claimed by some to be EECs on and/or adjacent to the subject land include:

- the Sea Rush/Twig Rush Herbland around the periphery of Lake Wollumboola which is claimed to constitute an example of the Coastal Saltmarsh community;
- the Swamp Oak Forest vegetation type which is claimed to constitute the Swamp Oak Floodplain Forest EEC; and
- the Swamp Forest communities (see Chapter 5) which are claimed by some to constitute the Swamp Sclerophyll Forest on Coastal Floodplains and/or River-flat Eucalypt Forest on Coastal Floodplains EECs.

As detailed in Chapters 5.7 and 8.5 of this SIS, however, the author of this *Report* maintains that none of these EECs, nor any of the other EECs cited in the DGRs, are present - because:

- there is no relevant "*intertidal zone*" within Lake Wollumboola. Consequently, the Coastal Saltmarsh EEC cannot be present;
- no parts of the subject land or adjoining lands constitute a "*coastal floodplain*" or are "*associated with a coastal floodplain*". Consequently, the SSFCF, REFCF and SOFF communities, which are located "*on coastal floodplains*" and/or on landscapes and soils "*associated with coastal floodplains*", cannot be present; and
- other EECs identified in the DGRs (*eg* Bangalay Sand Forest, Littoral Rainforest, Freshwater Wetlands on Coastal Floodplains and Illawarra Lowlands Grassy Woodland) are not present for the reasons identified in Chapter 8.5 of this SIS (*eg* no relevant substrate, not in correct LGA, no floristic equivalence and/or an artificial feature).

Notwithstanding the absence of those EECs, the mesic and low-lying vegetation on the subject land has substantially been avoided by the refined golf course design, on a 'precautionary' basis.

In any case, even if some patches of vegetation on the subject land did constitute those "*coastal floodplain*" EECs or the Coastal Saltmarsh community, it is not "*likely*" that a "*significant effect*" would be imposed upon any such EEC (see Appendix X), because:

• the overwhelming majority of the Swamp Forest communities are located in the lower parts of Downs and Wattle Creeks, and along the Lake Wollumboola foreshore - where there are to be no impacts from the Culburra Golf Course project (direct or indirect);

- only very small areas of any vegetation with some floristic characteristics of some of the "coastal floodplain" EECs will be affected by the removal of vegetation for or around the periphery of the Golf Course;
- the only notable incursion will be the bridge crossing over Downs Creek which will be confined to a narrow band of disturbance and the subject of intense rehabilitation efforts;
- the Culburra Golf Course project incorporates the implementation of dedicated stormwater management regimes (see Appendix D1) and a detailed *Culburra Golf Course Plan of Management* (GCPoM – Appendix D2) – intended specifically *inter alia* to avoid the imposition of indirect adverse impacts upon adjoining vegetation (such as significant changes to hydrologic regimes and/or the discharge of contaminants and fertilisers); and
- one of those alleged EECs (the Coastal Saltmarsh community) is confined to the Lake Wollumboola foreshore (although it is not accepted by the author of this SIS that the Coastal Saltmarsh community is present in Lake Wollumboola). There is no likelihood that the Culburra Golf Course project would have any impact on that community at all, under any circumstances.

# 10.8.4 Potential Threatened Biota

There are a number of other threatened species, identified in the DGRs, which have been recorded in the locality, but which are not regarded as "*affected*" species for the purposes of this SIS (see Chapters 7 and 8). These include:

- additional highly mobile and wide-ranging species (such as a number of threatened birds and additional threatened microchiropteran bats) - of which individuals could potentially utilise the forest and woodland habitats on the subject site on occasions at least, but which have not been recorded on the "subject site" or on the "subject land";
- several terrestrial or other small mammals (*eg* the White-footed Dunnart, Eastern Pygmy Possum and Southern Brown Bandicoot) which could theoretically be present – but which have not been recorded on the subject land or in the vicinity (Culburra, Callala *etc*) during any field investigations since 1994; and
- threatened plant species (particularly orchids) which also have not been recorded on the subject land despite the plethora of field investigations undertaken to date (also since 1994). The Culburra West land (to the north), which contains similar or identical vegetation to that on the majority of the Golf Course land, has been declared by the OEH to be "unlikely to be habitat for the threatened orchids species".

There is, however, no likelihood of a *"significant effect"* being imposed upon any of these potential threatened biota, pursuant to the considerations of Section 5A of the EP&A Act (Appendix X) - because:

- there is no evidence that there is a "viable local population" of any such species on the subject land;
- it cannot reasonably be asserted that a "*viable local population*", or even individuals of a population, of those potential threatened biota could or would be dependent upon the "*subject site*" (*ie* the Culburra Golf Course footprint) for their survival at this location;

- similarly, it cannot reasonably be asserted that populations of those species would be likely to be confined to those parts of the subject land proposed to be affected by the Golf Course - given the distribution of the affected vegetation types;
- the Culburra Golf Course does not contain unique or restricted habitats or resources upon which even individuals of any such biota would likely be dependent; and
- there are very substantial areas of the same, or very similar, habitats and resources
  present in the immediate vicinity and general locality substantial areas of which are either
  already in conservation reserves or will be dedicated to supplement those conservation
  reserves, in part, as a result impact of the Culburra Golf Course project.

Given those circumstances, it cannot be regarded as *"likely"* that a *"significant effect"* would be imposed upon any of these additional potential threatened species.

## 10.8.5 Other Threatened Biota

There is an array of additional threatened species identified in the DGRs and/or the OEH Wildlife Atlas that are not regarded as of relevance or concern with respect to this SIS (as detailed in Chapter 8). Those species include *inter alia*:

- marine birds (such as the Little Shearwater);
- species which are simply not present in the locality (eg the Koala); and
- species for which Lake Wollumboola constitutes habitat, but Long Bow Point does not (the wetland species which are prevalent on and around the foreshores of Lake Wollumboola, the Osprey and the Little Tern).

The proposed Culburra Golf Course will not have any adverse impact upon any of these species, given:

- the separation of the Golf Course from Lake Wollumboola by a 100m+ vegetated buffer;
- the implementation of stringent water quality controls associated with the Golf Course (see Appendices D1 and D2) – to avoid the discharge of any contaminants or pollutants into Lake Wollumboola from the Culburra Golf Course, and to avoid any significant changes to hydrologic regimes in and around the Lake; and
- the implementation of a comprehensive Culburra Golf Course Plan of Management (GCPoM – D2) and Golf Course Ecological Management Plan (GCEMP) - to ensure that ongoing management activities do not affect the Lake or its habitats.

The proposed Culburra Golf Course will have no adverse impact upon Lake Wollumboola, or the threatened biota and migratory species which utilise it. The Golf Course poses no threat to the values of Lake Wollumboola as an important and iconic wading and wetland bird habitat.

In specific terms, there is not "*likely*" to be a "*significant effect*" (pursuant to Section 5A of the EP&A Act) imposed upon any of those additional threatened species. Indeed, it is the opinion of the author of this SIS, that there will be no adverse impact at all upon any such species as a consequence of the proposed Culburra Golf Course.

## 10.8.6 Section 5A Conclusions

Detailed consideration of the likelihood or otherwise of a "significant effect" pursuant to Section 5A of the EP&A Act being imposed upon any threatened biota as a result of the construction and operation of the Culburra Golf Course, has been provided above. Dedicated Section 5A Assessments of Significance have been provided for the relevant ("affected") species (Appendix X of this SIS), and the relevant factors of Section 5A have also been considered with respect to other potential threatened biota (see above).

It is the conclusion of all considerations of Section 5A of the EP&A Act with respect to all threatened biota (relevant or otherwise) by the author of this SIS that it is **not** "*likely*" that a "*significant effect*" will be imposed upon any such biota as a result of the Culburra Golf Course project.

The Golf Course has been specifically designed *inter alia* to avoid the imposition of a "*significant effect*" upon threatened biota, and will be managed in accordance with a dedicated and detailed *Culburra Golf Course Plan of Management* (GCPoM) and *Golf Course Ecological Management Plan* (GCEMP) *inter alia* in order to prevent any "*significant effect*" being imposed upon any threatened biota.

Given those considerations, there is no requirement for the preparation of a *Species Impact Statement* (SIS) for the Culburra Golf Course on Long Bow Point.

That conclusion had been reached previously by the author of this SIS on the basis of the original golf course design (Environmental InSites 2011; SLR Consulting 2012). The further refinement of the Culburra Golf Course design (by a professional golf course designer – Mr James Wilcher and by the project ecologist and author of this SIS – Mr F Dominic Fanning) has further reduced any potential for a *"significant effect"* to be imposed upon any threatened biota.

It is noted that the refinement of the Culburra Golf Course project, as documented in this SIS, fulfils the approach which was adopted by the author of the SIS in the original 2011 *Ecological & Riparian Issues & Assessment Report* (ERIAR).

# 10.8.7 Summary of Section 5A Conclusions

It is **not** *"likely"* that a *"significant effect"* would be imposed upon any threatened biota as a consequence of the Culburra Golf Course project.

As a consequence, there is no requirement for the preparation of a *Species Impact Statement* (SIS) for the proposed Culburra Golf Course on Long Bow Point.

Further, there is no statutory requirement for the Shoalhaven City Council (the consent authority) to obtain or require the 'concurrence' of the Office of Environment & Heritage (OEH) to a *Development Consent* for the Culburra Golf Course.

## 11 FEASIBLE ALTERNATIVES to the PROPOSAL

## 11.1 Introduction and Scope

Sections 110(2)(h) and 110(3)(e) of the TSC Act require that an SIS includes the following information:

"a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development".

Items 5.6 and 6.5 of the DGRs note that in consideration of "*feasible alternatives*", reference may be made to relevant sections of development documents (such as a *Statement of Environmental Effects, Environmental Impact Statement* or *Review of Environmental Factors*), if those documents deal with the matters identified in Section 110(2)(h) and Section 110(3)(e) of the TSC Act.

In addition, those items of the DGRs note that the SIS "must include details of the condition and use of other parts of the subject area and why these can or cannot be considered as feasible alternatives".

In considering "*feasible alternatives*" to the current Culburra Golf Course proposal, it is also particularly relevant to consider whether there is any need or requirement to amend or modify the proposal. In other words, is there any valid justification to consider, or require, any such "*alternative*" – in respect of real or potential impacts on any threatened biota.

## 11.2 Feasible Alternatives

## **11.2.1** Alternative Options for the Golf Course

There are, theoretically at least, several "*alternatives*" to the current 18-hole golf course design on Long Bow Point at Culburra, of which three options are provided below.

These "*alternatives*", however, are either:

- not regarded as "feasible" by the proponent; or
- not considered necessary because the Golf Course as currently designed will not impose a "significant effect" on any threatened biota; or
- not considered 'desirable' given the local community support for the Golf Course and the nature of the land.

Potentially "*feasible alternatives*" to the current refined 18-hole golf course design on Long Bow Point could, conceivably at least, include:

- an alternative slightly modified layout for the 18 holes (or some of those holes) within the Long Bow Point project area;
- a substantially different layout for an 18-hole golf course on Long Bow Point; or
- total relocation of the 18-hole golf course to another site at Culburra.

## 11.2.2 Alternative No. 1

With respect to Alternative No. 1 (minor alterations in the layout of the Culburra Golf Course) - it is the opinion of the author of this SIS that no significant improvement in environmental outcomes would likely result from any such further 'tinkering' with the current Golf Course design.

The current Golf Course layout has been designed through a comprehensive and exhaustive iterative process, involving both the project ecologist (the author of this SIS) and the golf course designer. This process was undertaken to ensure that:

- vegetation clearing for the Culburra Golf Course is minimised or limited;
- no additional or unnecessary vegetation clearing would be required for the project;
- the overwhelming majority of relevant habitat features and resources (*eg* hollow-bearing trees) will be retained; and
- a high quality championship standard golf course will be created at Long Bow Point.

In addition, most of the golf holes and fairways have been walked by the project ecologist and golf course designer – in order *inter alia* to avoid or minimise the need to remove hollow-bearing trees. The result of that exercise is that extremely few tree-hollows (involving less than 5 mapped significant hollow-bearing trees) will be removed for the creation of the whole Culburra Golf Course. The fairways, tees and greens have been adjusted and modified to maximise the retention of hollow-bearing trees.

In addition, the detention basins (or wetlands) have been located so as to avoid any need to remove hollow-bearing trees for their construction and operation, and to assist in protecting the water quality of Lake Wollumboola. Further, those features of the Golf Course will provide supplementary habitat and resources for an array of native (including threatened) biota.

It is the opinion of the author of this SIS that minor modifications to the proposed Culburra Golf Course layout are not likely to produce any significant increase or benefit in environmental outcomes, including with respect to the potential for impacts to be imposed on threatened biota or their habitats.

Critically, in this regard, it cannot be considered likely that any such minor modification of the proposal would reduce any *"likely"* effect (including only *"significant effect"*) on any threatened biota. Nor would it be likely that any such approach would reduce any impacts on Lake Wollumboola or its ecosystems (noting the lack of such impacts with the current design and the proposed management regime for the Golf Course).

This "feasible alternative" therefore is not considered of any particular value.

## 11.2.3 Alternative No. 2

With respect to Alternative No. 2 - a major re-design of the Golf Course on Long Bow Point could, conceptually at least, utilise more of the currently cleared land in the centre of the site.

However, as is clear from the historical aerial photographs contained in Appendix L, much of Long Bow Point had previously been cleared for agricultural purposes. Much of the open forest and woodland, therefore, is regrowth vegetation. Furthermore, the Golf Course design has been refined specifically *inter alia* to retain features and resources of high conservation value (such as hollow-bearing trees).

In addition, such an approach would not significantly reduce the total extent of native vegetation which needs to be removed for the provision of an 18-hole golf course on Long Bow Point, particularly relative to the very substantial areas of native forest and woodland in the vicinity, locality and region.

The total area of forest and woodland to be removed for the Culburra Golf Course (~27ha) represents:

- less than 1% of the Lake Wollumboola catchment the overwhelming majority of which is forested;
- a minute proportion of the private forested land, State Forests and conservation reserves in the 'locality' (Figures 7A and 18); and
- approximately 0.01% (or one thousandth) of the conservation reserves in the LGA (a total of 229,000 hectares).

Some further reduction in the area of open forest and woodland to be removed (even by half) would be inconsequential in the circumstances, amounting to just a few hectares.

In addition, it would also utilise land which could potentially be used in the future for other associated purposes (such as tennis courts, a putt-putt golf course *etc*).

Such a modification is not likely to result in any significant (or indeed any) reduction in impacts on threatened biota or their habitats. Again, this approach would not significantly reduce any likely "effect" on any threatened biota – noting that the current proposal is not "likely" to impose a "significant effect" on any such biota. Further, any such modification would not significantly reduce (or reduce at all) any potential impacts on Lake Wollumboola or its ecosystems.

There is, therefore, no justification for this "feasible alternative".

## 11.2.4 Alternative No. 3

With respect to the third alternative (the total relocation of the Golf Course project to another site in the locality), it is the position of the proponent that there is no other site as well suited to the purposes of an 18-hole golf course at Culburra.

In this regard:

- the land currently has a zoning which permits the construction and operation of a golf course;
- Long Bow Point is located immediately to the southwest of the town of Culburra Beach and is thus appropriately and conveniently located; and
- the topography on Long Bow Point is particularly suitable for the construction of a golf course.

Furthermore, and most relevantly, with respect to those threatened biota that are" *likely*" to be or which may be "affected" by the proposed Culburra Golf Course, and other potential such threatened biota, there is no likelihood that the Culburra Golf Course project would impose a "significant effect" upon any such species – as documented in detail in Chapter 10 and Appendix X of this SIS.

Given that circumstance, and given the substantial impact amelioration, environmental management and biodiversity conservation offset measures which are incorporated into the Culburra Golf Course project (as currently designed), there is no rationale for the implementation of Alternative No. 3 (*ie* the relocation of the Culburra Golf Course to another site).

The detailed documentation contained in this SIS demonstrates that it is **NOT** "*likely*" that a "*significant effect*" will be imposed upon any threatened biota, or their habitats, as a result of the Culburra Golf Course project as currently designed.

As a consequence, the relevant considerations in this SIS do not provide a justification or rationale for the Culburra Golf Course on Long Bow Point not to proceed, or for the Golf Course to be located elsewhere.

# 11.2.5 Final Considerations

In the event that the Culburra Golf Course was determined likely to impose a "*significant effect*" on threatened biota or their habitats, it would be reasonable to pursue alternatives to the current proposal.

However, as documented through this SIS, the Culburra Golf Course project is not considered likely to impose a "*significant effect*" on any threatened biota or their habitats. There is, therefore, no rationale for the pursuit of alternatives to the current proposal. The Culburra Golf Course has been designed and is to be managed so as to limit adverse impacts on the natural environment in general, and on threatened biota and their habitats in particular.

No alternatives are necessary.

Finally, it needs to be noted that the construction of an 18-hole golf course on Long Bow Point at Culburra is not only the desire of the proponent – it is also the strong desire of the majority of the local community at Culburra.

A public forum to discuss the proposed Culburra Golf Course – on the 29<sup>th</sup> of August 2011 (convened by Shoalhaven City Council) – demonstrated overwhelming local support for the concept of a golf course on Long Bow Point.

It is also important to take into account the social and economic benefits that will arise from the construction activities and ongoing management and maintenance of the Golf Course, and the provision of a recreational and social facility at this location. These are relevant matters – as documented in the approval by SCC for the extra 3 holes on the Shoalhaven Heads Golf Course, and the then DECCW concurrence for that project.

## 11.3 Ecologically Sustainable Development

The principles of *Ecologically Sustainable Development* (ESD), as defined in the *Protection of the Environment Administration Act* 1995 (PoEA Act), are:

- the "precautionary principle" which states that "if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation";
- "inter-generational equity" namely that "the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations";
- the "conservation of biological diversity and ecological integrity"; and
- *"improved valuation, pricing and incentive mechanisms"* to ensure that environmental factors are *"included in the valuation of assets and services"*.

In the opinion of the author of this SIS, the proposed Culburra Golf Course project satisfies "*the principles of ecologically sustainable development*" (ESD) – in terms of the natural environment in general, and in terms of threatened biota and their habitats in particular.

In particular, the proposed Culburra Golf Course, including its associated impact amelioration and environmental management measures (see Chapter 12 of this SIS), achieves an appropriate and reasonable balance between the provision of a much desired public recreation facility and biodiversity conservation outcomes.

The Culburra Golf Course project has been designed specifically in a highly sensitive and environmentally responsible manner - to limit the imposition of adverse impacts upon the natural environment in general (and upon threatened biota and their resources in particular), as well as to provide new and complementary habitats and resources for native species (including threatened biota) in the landscape. The quantum of vegetation loss within the Golf Course layout has been minimised by careful design, and specific and important elements of the landscape for threatened biota (*eg* hollow-bearing trees and stands of preferred feed trees) have been preferentially retained.

# The Precautionary Principle

Importantly, with respect to the consideration of the *Precautionary Principle*, it is clearly the case that the Culburra Golf Course project does not involve "*threats of serious or irreversible environmental damage*" - notwithstanding the removal of some native open forest and woodland vegetation.

In the first instance, that loss of vegetation, on the basis of the documentation contained in this SIS and the iterative design process for the Culburra Golf Course, has sought specifically to avoid the imposition of any "*serious*" damage to the environment of threatened biota, and also of native biota which are not threatened. The area of vegetation removal is small - particularly given the extent of suitable habitat and resources available, and protected, in the vicinity, locality and region

In the opinion of the author of this SIS, the Culburra Golf Course project has avoided the imposition of any "*serious* ... *environmental damage*".

Furthermore, the "*environmental damage*" to be imposed by the Culburra Golf Course (minimal though it is) is not actually "*irreversible*". It would, theoretically at least, be possible to return all or most of the Golf Course site to native vegetation - if some future generation, person or authority determined that to be an appropriate course of action.

In addition, the Culburra Golf Course proposal has not, in any way, postponed any "*measures to prevent environmental degradation*". To the contrary, the Culburra Golf Course project has embraced, developed and designed a significant array of such "*measures*" – as discussed in detail in Chapters 10 and 12 of this SIS.

As a consequence, the requirements of the *Precautionary Principle* have been thoroughly satisfied with respect to the Culburra Golf Course project:

- there are no "threats or serious or irreversible environmental damage"; and, in any case
- an array of relevant "*measures to prevent environmental degradation*" are to be implemented as part of the Culburra Golf Course project.

Of particular relevance in achieving the goals of ESD are the following "measures to prevent environmental degradation".

- The design and implementation of the stormwater management and runoff regime for the Culburra Golf Course – as detailed by Martens 2015 in the *Integrated Water Management Plan* (Appendix D1). This approach is specifically designed inter alia to avoid the potential for any adverse impacts on Lake Wollumboola, its associated watercourses, and the ecosystems and biota which depend upon it.
- A commitment to implementing the GCPoM (Appendix D2) prepared by Golf by Design.
- Implementation of a *Construction Environmental Management Plan* (CEMP) –to protect the netural environment around the Golf Course during construction activities.
- Implementation of a dedicated *Golf Course Ecological Management Plan* (GCEMP) to be prepared to protect, enhance and manage native biota and habitats on and around the Golf Course in the long term.
- The guarantee of a 'no nett loss' policy for tree-hollows across the whole of the subject land, and particularly around the Golf Course.
- The implementation and funding of a long-term *Plan of Management* for the proposed 113ha private Conservation Reserve on Long Bow Point'.
- The dedication of additional lands to Council for biodiversity conservation purposes.

## The Conservation of Biological Diversity and Ecological Integrity

In addition to the implementation of those measures described above, the proposed Culburra Golf Course project facilitates (in part) the achievement of a substantial *Environmental Offsets Strategy* to provide biodiversity conservation outcomes - which is being proposed by the landowner. That *Environmental Offsets Strategy* (as detailed in Chapter 12.5 of this SIS) will ensure the dedication of private forested land, both within the Golf Course land on Long Bow Point and elsewhere in the vicinity, for biodiversity conservation purposes.

In addition, the proposed Environmental Offsets Strategy involves the following measures.

- Management of the Golf Course itself for biodiversity conservation purposes (*eg* maintenance of ponds, basins and swales as fauna habitat; ongoing monitoring and replacement of hollow-bearing trees as they fall *etc*).
- Dedication of and maintenance of 113 hectares of native vegetation on Long Bow Point as a private Conservation Reserve (see Chapter 12);
- The rehabilitation of the Lake Wollumboola foreshore *Conservation Area* around the Golf Course with the removal of substantial areas of weeds (Bitou Bush and Lantana) and the implementation of an ongoing management and maintenance regime.
- The implementation of a comprehensive weed and feral pest/predator eradication and control program to facilitate the conservation of biodiversity on Long Bow Point.

#### Inter-generational Equity

With respect to "*inter-generational equity*", the Culburra Golf Course project will achieve both an excellent environmental outcome and a nett social and economic benefit:

- by virtue of the implementation of the *Environmental Offsets Strategy* which is a part of the proposal; and
- the provision of a valuable social and economic amenity with the Golf Course providing a valuable recreational resource as well as opportunities for employment in the long-term.

Further, the dedication of various lands for long-term biodiversity conservation purposes and the longterm management of the Long Bow Point Conservation Reserve, as well as retained native vegetation around the Golf Course, will jointly contribute in a positive manner to long-term biodiversity conservation outcomes. Those benefits outweigh the loss of vegetation required for construction of the Golf Course.

There will be no relevant diminution in the natural environment or in natural resources or the natural environment as a result of the Culburra Golf Course. The project will provide social and economic benefits for future generations, as well as implementing an array of measures to protect and/or enhance the natural environment.

## Improved Valuation, Pricing and Incentive Mechanisms

The approach has been adopted for the design and long-term management of the Culburra Golf Course land, in addition to the 113 hectares of the Long Bow Point Conservation Reserve, appropriately address the principle of *"improved valuation, pricing any incentive mechanisms"*.

The Culburra Golf Course project, including its *Environmental Offsets Strategy* and environmental management measures, takes into account environmental costs, as well as social and economic benefits. The dedication of lands for conservation purposes, and the management of the Long Bow Point Conservation Reserve, will be provided at no cost to the public purse.

## 11.4 Justification of the Action

The proposed Culburra Golf Course project on Long Bow Point Culburra, which is the subject of this SIS, is justified for the following reasons.

- The project will involve the removal of only approximately 27.84 hectares of native open forest and woodland vegetation from a portion of land which occupies approximately 201 hectares (*ie* 13.5% of the subject land).
- The area of open forest and woodland to be removed constitutes less than 1% of the catchment of Lake Wollumboola, and constitutes only a miniscule proportion of those resources in the Shoalhaven LGA.
- The Golf Course has been specifically designed to avoid areas of higher ecological sensitivity and value such as most areas of moist forest and swamp forest>
- The Golf Course has been specifically and carefully designed, through a comprehensive iterative process involving the project ecologist and a professional golf course designer, to ensure the retention of virtually all of the hollow-bearing trees on the land, as well as areas of dense foraging habitat for the Glossy Black Cockatoo.
- The Golf Course project is to be undertaken on the basis of a policy of no nett loss of treehollows – by implementation of the *Hollow-bearing Tree Protocol* (see Chapter 12).
- The project incorporates a stormwater management and treatment regime which will ensure that increased levels of nutrients are not discharged into Lake Wollumboola, and which is also designed to provide supplementary habitat for some native biota (particularly the Green & Golden Bell Frog).
- The Golf Course is designed to be an element of the natural environment retaining hollow-bearing trees and native bushland between fairways and around the course, as well as providing supplementary habitat (*eg* native grasslands and wetlands).
- The proposal avoids the imposition of a "*significant effect*" upon any threatened biota by virtue of the project design and the long-term management of the Golf Course.
- The project facilitates the achievement of an *Environmental Offsets Strategy* which will provide biodiversity conservation benefits in the immediate vicinity and general locality (see Chapter 12).

On the basis of all of those considerations, the Culburra Golf Course project represents an appropriate and environmentally sound, high value community facility with minimal impacts upon the natural environment in general, and on threatened biota in particular.

The project will not involve the imposition of a "significant effect" upon any "threatened species, populations or ecological communities, or their habitats" (Chapter 10; Appendix X).

Further, the Culburra Golf Course project facilitates the opportunity to achieve an excellent biodiversity conservation outcome by virtue of implementation of the *Environmental Offsets Strategy* (see Chapter 12). The project will thus achieve both community and social (and economic) benefits, whilst both avoiding "*environmental degradation*" and providing some environmental benefits.

## 12 IMPACT AMELIORATION and ENVIRONMENTAL MANAGEMENT

#### 12.1 Introduction and Scope

#### 12.1.1 Matters to be Addressed

In respect of *"threatened species"* and *"endangered populations"*, Section 110(2)(i) of the TSC Act requires a *Species Impact Statement* (SIS) to provide:

"a full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations, including a compilation (in a single section of the statement) of those measures".

In respect of "*endangered ecological communities*", Section 110(3)(f) of the TSC Act requires a *Species Impact Statement* (SIS) to provide:

"a full description and justification of the measures proposed to mitigate any adverse effect of the action on the ecological community including a compilation (in a single section of the statement) of those measures".

The DGRs for this SIS (Items 6.1.1 to 6.1.4 - Appendix A) request further details of the "*ameliorative measures*" to be implemented as part of the proposal (as addressed below), particularly regarding:

- "long term management strategies" (Item 6.1.1);
- "compensatory strategies" (Item 6.1.2);
- "ongoing monitoring" programs (Item 6.1.3); and
- *"translocation"* of threatened biota (Item 6.1.4).

The potential for adverse impacts to be imposed upon threatened biota by the proposed Culburra Golf Course development on Long Bow Point has been considered in detail in Chapters 10 and 11 of this SIS. The proposed development has been designed *inter alia* to limit adverse impacts upon the natural environment in general, and on threatened biota of relevance, and their habitats and resources.

Nevertheless, there is a requirement for the clearing of some native vegetation for the proposal, and some adverse impacts on the subject site (minimal although they are) are thus inevitable. In addition, there is (or would be absent appropriate design and management approaches) a theoretical possibility for discharges of nutrients or untreated stormwater into adjacent bushland, watercourses and/or Lake Wollumboola.

As documented previously in this SIS, and in this Chapter, these further potential impacts have been considered in detail, and will be avoided by virtue of:

- implementation of the stormwater treatment and management measures detailed in the *Integrated Water Management Report* of Martens (Appendix D1); and
- implementation of the measures outlined in the *Culburra Golf Course Plan of Management* (GCPoM Appendix D2) prepared by Golf by Design.

## 12.1.2 Structure of Chapter 12

This Chapter of the SIS deals with Sections 110(2)(i) and 110(3)(f) of the TSC Act, and Items 6.1.1 to 6.1.4 of the DGRs:

- Chapter 12.2 briefly summarises the proposed Culburra Golf Course development, and the impacts which will or may be imposed on the subject site
- Chapter 12.3 briefly identifies the relevant biota, and the relevance to those biota of the vegetation protection and rehabilitation measures proposed
- Chapter 12.4 documents the impact amelioration and environmental management measures to be implemented as part of the proposed development
- Chapter 12.5 considers offsets and compensatory measures
- Chapter 12.6 addresses the long-term management strategies to be incorporated into the project
- Chapter 12.7 addresses on-going monitoring of the Culburra Golf Course project and of the rehabilitation measures to be implemented
- Chapter 12.8 addresses the issue of translocation

## 12.2 The Proposed Development

The proposed development on Long Bow Point at Culburra is for an 18-hole championship standard golf course with associated ancillary features – including an access road, carpark, maintenance shed, driving range and (at a future date) a clubhouse.

It is noted that the clubhouse is not part of the current *Development Application* (DA), but is shown conceptually in the Golf Course design drawings (Appendix C1). As a clubhouse is likely to be a future part of the ultimate Culburra Golf Course development, it has been considered in this SIS with respect to the potential imposition of impacts on threatened biota (as required by the DGRs).

The proposed Culburra Golf Course will require the removal of approximately 27.84 hectares of native open forest and woodland vegetation, as well as development within areas of existing cleared grazed land and regrowth Tick Bush shrubland. That loss of vegetation, however, represents only a minute fraction of the open forest and woodland vegetation present in contiguous bands in the immediate vicinity and general locality (Figure 1), including very substantial areas in existing conservation reserves in the locality and region (Figures 7A and 7B).

Further, the Culburra Golf Course has been specifically designed to retain the overwhelming majority of hollow-bearing trees, as well as areas of high density she-oaks as foraging resources for the Glossy Black Cockatoo, and an existing nest tree for the Square-tailed Kite (Figure 17).

Other elements of the Culburra Golf Course project which are relevant when considering the potential and/or likely impacts of the project include:

- the provision of supplementary open native grassland habitat in rehabilitation earthworks areas (see Appendices C and D2) – particularly as foraging habitat for macropods, bandicoots and a number of diurnal birds;
- the retention and supplementary planting of native groundcover species in 'roughs' around golf course fairways providing habitat and resources for many species;
- the provision of freshwater aquatic habitat in detention basins and other elements of the stormwater management train (Appendix W) – designed specifically to provide potential habitat and resources for native biota (including the Green & Golden Bell Frog);
- the implementation of a Golf Course Ecological Management Plan (GCEMP) and Culburra Golf Course Plan of Management (GCPoM – Appendix D2) – as integral parts of the Environmental Offsets Strategy for the Golf Course project;
- the rehabilitation and long-term management of the lands zoned for *Environmental Protection* around Lake Wollumboola as part of the project, and maintenance of the Golf Course lands (between fairways and around the periphery);
- the dedication of a private Conservation Reserve (see Chapter 12.5) on the balance of Long Bow Point (Figure 19) - subject to a dedicated *Conservation Reserve Plan of Management* – CRPoM; and
- the implementation of a comprehensive habitat management program throughout Long Bow Point – including major weed removal and habitat supplementation (logs, treehollows, nest boxes *etc*), a feral pest eradication program, and habitat rehabilitation, where necessary.

One integral element of the Culburra Golf Course project is the implementation, in part, of a detailed *Environmental Offsets Strategy* (as detailed in Chapter 12.5), which will involve *inter alia*:

- the dedication of private native forest for biodiversity conservation purposes the private 'Conservation Reserve' proposed on Long Bow Point;
- the dedication to Shoalhaven City Council of 3.4ha land along the Lake Wollumboola foreshore at East Crescent, Culburra (Appendix Y), which contains the "*endangered ecological community*" Bangalay Sand Forest – for expansion of its reserve system and for biodiversity conservation purposes, and to protect the northern shore of Lake Wollumboola;
- the dedication to the OEH of 6.1ha of land at Worrowing Heights (near Vincentia Appendix Y) – for biodiversity conservation purposes; and
- implementation of the dedicated *Management Plans* cited above for retained vegetation around the Golf Course itself and throughout the private 'Conservation Reserve'.

The proposed Culburra Golf Course project will involve the removal of some native vegetation from the subject land. However, that loss represents only a minute fraction of the native open forest and woodland vegetation and habitats available in the immediate vicinity, general locality and region.

The Golf Course is located close to the northeastern periphery of a very extensive band of native vegetation at this general location (Figures 1, 7C and 18), and will not involve the removal of a significant area of known habitat for any threatened biota. Nor will it involve the removal of critical, restricted or unique habitats or resources at this general location.

Notwithstanding that loss of vegetation, the Culburra Golf Course project will provide a set of significant environmental benefits and positive outcomes, including *inter alia*:

- the dedication of substantial areas of native vegetation for biodiversity conservation purposes, as part of the *Environmental Offsets Strategy* for the project;
- active management of the retained vegetation on the subject land, including areas of vegetation between golf course elements for biodiversity conservation purposes;
- the removal of substantial infestations of Bitou Bush, Lantana and other weeds;
- the implementation of an ongoing feral pest eradication program; and
- the creation of additional habitat and resources (grasslands for macropods and bandicoots, and artificial wetlands for amphibians and wading birds) throughout the Golf Course itself.

In addition, the Culburra Golf Course project has been designed specifically inter alia:

- to ensure that there is no nett loss of tree-hollows for native biota by virtue of the Hollowbearing Tree Protocol;
- to ensure that there is no reduction in water quality discharges and no material change in hydrologic regimes with respect to Downs Creek, Wattle Creek or Lake Wollumboola; and
- to incorporate management regimes which will ensure the improvement and long-term maintenance of the biodiversity attributes of the subject land.

## 12.3 Relevant Threatened Biota

Chapters 5 to 9 of this SIS have considered the threatened biota present on the subject land or which are likely to occur, and have determined which of those biota are *"likely to be affected"* by the proposal.

No threatened terrestrial fauna species have been recorded on the subject land at Long Bow Point, despite appropriate surveys over a long period (since 1994), by an array of ecological experts. Similarly, no threatened terrestrial or small mammal species have been recorded on the Culburra UEA lands to the north (including during any of the dedicated surveys over the past 4 years).

No relevant threatened plant species have been recorded on the subject land, or on the Culburra UEA lands to the north. The only threatened plant recorded at Culburra is the Round-leafed Wilsonia *Wilsonia rotundifolia* – which occurs only in a narrow band around the edges of Lake Wollumboola. No impacts will be imposed upon this species.

Further, as discussed in detail in Chapter 8 of this SIS, there are no "*endangered ecological communities*" (EECs) present on or adjacent to Long Bow Point. In any case, those vegetation types with floristic similarities to various EECs are to be retained and protected (predominantly), and are to be managed for biodiversity conservation purposes in the long-term.

The relevant (*ie* the "*affected*") threatened species for this SIS for the Culburra Golf Course are:

- threatened birds the Powerful Owl, Glossy Black Cockatoo and Square-tailed Kite;
- a threatened arboreal mammal the Yellow-bellied Glider; and
- an array of threatened microchiropteran bat species.

Whilst there are a number of other highly mobile and wide-ranging threatened fauna species known in the locality (including a few additional threatened microchiropteran bats and a few additional threatened birds), none of these species have been recorded on the subject land itself. Although not regarded as relevant ("*affected*") species for the purposes of this SIS, these species have been considered in relevant parts of the SIS (including in Chapter 10 with respect to Section 5A Assessments of Significance).

Furthermore, any impacts which would theoretically be imposed upon any of those additional threatened fauna species would be the same as or similar to those which would be imposed upon the threatened species which are regarded as of relevance in this SIS. Consequently, the potential for a *"significant effect"* to be imposed on those species has been taken into account, and the impact amelioration and environmental management measures which mitigate or avoid the imposition of adverse impacts upon the relevant *"affected"* threatened species would also be of relevance for any such additional species.

As discussed elsewhere in this SIS, the impact amelioration and environmental measures which have been incorporated into the Culburra Golf Course project for the benefit of those threatened biota which are considered of particular relevance (*ie* those species were likely to be "*affected*" by the proposal) would also operate to the benefit of those additional 'potential' threatened species that might possibly occur on the Golf Course site.

#### 12.4 Impact Amelioration

#### 12.4.1 General Impact Amelioration Measures

The potential impacts of the proposed Culburra Golf Course on native biota and on the natural landscape in general, and on threatened biota and their habitats in particular, are the subject of a number of specific impact amelioration measures. As discussed throughout this SIS, the Culburra Golf Course project has been refined through an exhaustive iterative process, to avoid or minimise the imposition of adverse impacts wherever possible (in the first instance).

The amelioration of potential impacts which could potentially have arisen as a result of the Culburra Golf Course project has been achieved by:

- locating the Golf Course essentially wholely outside of the 7(a) Environmental Protection (Wetlands) Zone (except for the single bridged crossing of Downs Creek) – thus maintaining a setback from Lake Wollumboola of at least 100 metres;
- avoiding the significant and/or sensitive wetlands and mesic communities present on and around Long Bow Point – with the minor exceptions of a single bridged crossing of Downs Creek (for golfing activities and for service or maintenance vehicles), and a few minor incursions near Downs and Wattle Creeks;
- designing a stormwater and run-off management system to maintain very high water quality outcomes and to protect the water quality of Lake Wollumboola (Appendix D1); and
- incorporating various design elements into the Golf Course, including:
  - the preferential and targeted retention of hollow-bearing trees throughout the Golf Course – as determined on site by the project ecologist and golf course designer;
  - the preferential retention of stands of she-oaks for Glossy Black Cockatoos;
  - implementation of a *Hollow-bearing Tree Protocol* (see below) which will facilitate the salvage and re-use of tree-hollows which require removal and/or the use of nest boxes to ensure that there is no nett loss of tree-hollows; and
  - the specific design of water quality features and ponds to provide supplementary habitat and resources for a range of native biota.

All of these elements of the proposed Culburra Golf Course act to ameliorate the impacts which could otherwise be imposed by a less sensitive or less environmentally sound approach to the Golf Course.

In addition, the Culburra Golf Course project will facilitate a substantial regime of weed removal (particularly of Bitou Bush and Lantana) and a supplementary planting program (where deemed necessary) of native indigenous plant species. This approach is to be adopted throughout the Golf Course land and in the 'Conservation Reserve' around Lake Wollumboola (see Figure 19) – to enhance retained habitat and vegetation communities on the subject land, as part of the *Environmental Offsets Strategy* and the ongoing management of Long Bow Point.

The Culburra Golf Course project will also include an ongoing program of feral pest eradication and control throughout the private 'Conservation Reserve' on Long Bow Point and in the Golf Course land. This program will target species such as the Fox, Feral Cat, Rabbits and introduced rodents, on a

permanent basis, and will reduce (or ideally eliminate) the impacts of those pests on native fauna on Long Bow Point.

This approach is **more intensive, more certain and more regular** than any pest control program likely to be implemented under any other tenure (*eg* OEH or Shoalhaven Council).

It is noted that the majority of the Culburra Golf Course is to be located in the more common and widely distributed xeric vegetation types and communities on the subject land (see Figure 14). Further, all elements of the Golf Course are located at least 100 metres from Lake Wollumboola, separated by fully vegetated land.

That approach, in addition to the rigorous treatment of stormwater discharges (see Appendix D1) and ongoing management of the Golf Course itself (see Appendix D2), is intended *inter alia* to ensure that no adverse impacts are imposed upon Lake Wollumboola and its ecosystems, including its dependent native biota.

As discussed in Chapter 2.3 of this SIS, the Culburra Golf Course project has adopted a philosophy of 'abundant caution' in its design approach. Environmental issues and sensitivities have been preeminent in the project's inception, design and development.

## 12.4.2 The Hollow-bearing Tree Protocol

The project will also involve the implementation of a *Hollow-bearing Tree Protocol*, designed to ensure that there is **no nett loss** of tree-hollows as a consequence of the Culburra Golf Course project.

The Hollow-bearing Tree Protocol includes:

- the segmental 'dismantling' (by professional tree experts) of any hollow-bearing trees to be removed in order to salvage tree-hollows, wherever possible;
- the placement of salvaged tree-hollows in existing large trees or on dedicated posts in retained vegetation around the Golf Course and/or in the Conservation Reserve;
- alternatively, the placement of salvaged tree-hollows on the ground as hollow log habitat, where placement in existing trees is not practical; and
- the use of artificial nest boxes to replace any tree-hollow which cannot be salvaged, and to supplement that resource on the subject land.

It is noted that there has been some resistance to the *Hollow-bearing Tree Protocol* by the Office of Environment & Heritage (OEH). For example, in its submission on the Culburra West project, the OEH stated that *"this approach is not supported by underpinning scientific research at this time to be considered a viable mitigation measure"*.

However, it is the opinion of the author of this SIS that such resistance to the concept of the *Hollow-bearing Tree Protocol* is neither rational nor reasonable. The OEH, amongst a number of government agencies, regularly recommends the installation of artificial nest boxes as a measure to offset the loss of tree-hollows on an array of projects throughout the state. Those artificial nest boxes are generally constructed of plywood, and are well known to have a 'life span' of only approximately 10 years.

Conversely, real tree-hollows last for decades, and potentially for centuries. The careful salvaging of tree-hollows as segments of trees, and the subsequent bolting or wiring of those hollows into large existing trees, is likely to be far more efficient and effective (efficacious) than the use of artificial nest boxes (which will deteriorate within a decade or so). Furthermore, when those salvaged and re-deployed tree-hollows fall, they will likely continue to constitute suitable habitat (as hollow logs) – whereas the artificial nest boxes simply become rubbish.

The suggestion that the *Hollow-bearing Tree Protocol* should be rejected because of a lack of *"underpinning scientific research"* into its efficacy is neither logical nor reasonable. Nor is it consistent with the *Precautionary Principle* – which states that a *"lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation"*.

## 12.5 Environmental Management Measures

In addition to the impact amelioration measures discussed above, an array of specific environmental management measures are to be implemented both during construction of the Culburra Golf Course and its associated features, and during the ongoing management of the Golf Course.

## **12.5.1** Construction Activities

It is expected and required that all works associated with the Culburra Golf Course will be undertaken in an environmentally sensitive manner, involving the use of current 'best practice' (at a minimum) techniques - to contain and manage sediment and stormwater discharges, wastes and contaminants.

Standard elements of the construction works to be undertaken on the site would include inter alia:

- protection fencing for all retained vegetation and retained trees;
- the use of temporary sediment basins and sediment fences, wherever required;
- · the use of cleared areas for any stockpiles and equipment or vehicle parking;
- implementation of a dedicated Waste Management Strategy; and
- the implementation of a comprehensive monitoring strategy, with an *Incident Response Protocol*, during all works on Long Bow Point.

Prior to the removal of any native vegetation, several measures are to be implemented – in accordance with a detailed *Golf Course Ecological Management Plan* (GCEMP):

- the collection of seeds and other propagules by a bush regenerator to provide plants and material for regeneration and rehabilitation areas;
- the inspection of all bushland and hollow-bearing trees prior to their removal by a project ecologist; and
- the identification of hollow-bearing trees that need to be dismantled segmentally, and other special features to be salvaged for re-use (*eg* large tree boles and stumps *etc*).

Other environmental management measures, which are to be implemented during the construction phase of the Culburra Golf Course and its associated facilities, will include:

- the collection of native plant material where any clearing of vegetation is required and its re-use in areas to be rehabilitated within and around the Golf Course and/or in the private 'Conservation Reserve' on Long Bow Point (as discussed above);
- implementation of the Hollow-bearing Tree Protocol (see below); and
- the preparation and implementation of a Golf Course Ecological Management Plan (GCEMP), which will include inter alia the Hollow-bearing Tree Protocol and a Tree & Vegetation Protection Protocol – to ensure that vegetation which is to be retained is protected during construction works and during operation of the Golf Course.

All of these measures will be incorporated into a *Construction Environmental Management Plan* (CEMP) and/or the *Golf Course Ecological Management Plan* (GCEMP) – to be prepared for the

Culburra Golf Course project, and approved by Council, prior to the commencement of any clearing or construction activities.

It is to be noted that in constructing the Culburra Golf Course, a clearing and construction regime is to be implemented which minimises and/or avoids impacts on vegetation to be retained. A detailed *Tree & Vegetation Protection Protocol* will be prepared and implemented (as noted above) to ensure that:

- all felling of trees and vegetation is contained within the Golf Course footprint (*ie* trees are to be felled into areas of golf course features, and not into adjoining retained vegetation);
- all earthworks are undertaken within the development footprint avoiding any adjoining vegetation which is to be retained;
- the full extent of permissible disturbance will be identified by orange safety mesh fencing to be installed under the supervision of a project ecologist and project environmental manager, prior to any works occurring;
- all construction yards, maintenance areas and stockpiles are located within the cleared land in the centre of the subject land and/or on cleared areas during the construction program (*eg* on golf course fairways *etc*);
- no hollow-bearing trees are removed without prior inspection by the project ecologist, and without salvaging tree-hollows for re-deployment either as tree-hollows (see the *Hollow-bearing Tree Protocol* below) or as logs; and
- native vegetation removed from the Golf Course footprint and considered suitable for rehabilitation purposes is retained for re-deployment and use within conservation areas between fairways and/or in the private Conservation Reserve on Long Bow Point including for the provision of additional habitat features (such as logs and woody debris).

# 12.5.2 Stormwater Management

One of the key environmental management measures for the Culburra Golf Course project is the stormwater regime. Notwithstanding that the project is for a golf course, and does not therefore involve substantial areas of impervious surfaces, there is still the potential (theoretically at least, and absent the environmental management and impact amelioration measures documented in this SIS) for adverse impacts to be imposed upon the adjoining natural environment - both during the construction phase of the Culburra Golf Course (see above) and during its subsequent use.

Given the acknowledged sensitivity of Lake Wollumboola and of ecosystems around Long Bow Point, the integrated water management regime for the proposed Golf Course (Martens 2015; Appendix D1) and the GCPoM (Appendix D2) have been designed *inter alia*:

- to strictly control and manage sediment and erosion during all construction activities associated with the Golf Course;
- to capture run-off (particularly from greens and tees, and other areas where fertilisers may be used), and to ensure its treatment prior to any discharge of such waters;
- to capture and re-use stormwater run-off for irrigation purposes to avoid any requirement for the use of potable water for irrigation, gardens and toilets on the Golf Course;
- to capture, treat and re-use roof run-off and run-off from the carpark; and

• to ensure that all discharges into Downs and Wattle Creeks and/or into Lake Wollumboola are of the same quality (or better) as current stormwater discharges.

Details of the stormwater management regime are contained in the *Integrated Water Management Report* of Martens 2015 (see Appendix D1), and dedicated design features for fauna habitat are provided in Appendix W. In addition, a GCPoM is to be implemented (see draft in Appendix D2) – which will *inter alia* ensure the protection of vegetation and of water quality during both the construction phase of the Golf Course and its subsequent ongoing operational phase.

# 12.5.3 Other Environmental Management Measures

Environmental management measures are proposed in order to ensure the maintenance of native vegetation on the subject site, to enhance wildlife conservation, and to protect water quality throughout the life of the Golf Course. The natural environment is regarded as a major asset for the Culburra Golf Course, and the project will celebrate that asset *inter alia* by the provision of educational signage around the Golf Course (see below).

Relevant features in this regard include:

- preparation of a detailed *Golf Course Ecological Management Plan* (GCEMP) which is to be implemented throughout the areas of retained vegetation around the Golf Course (*ie* in the 'Golf Course Land' – see Figure 19);
- incorporation into the GCEMP of specific measures to control and manage the maintenance requirements for any APZs located within any native vegetation – which will ensure that such areas remain as native vegetation;
- the ongoing monitoring and management of all stormwater detention and quality control basins, ponds and bioretention swales - to ensure the highest standards of stormwater discharges from the Golf Course (see Appendices D1 and D2), and to provide supplementary habitat for native biota;
- implementation of a GCPoM (see draft version in Appendix D2) prior to use of the Golf Course - to ensure that fertilisers, pesticides and other chemicals are not applied in such quantities anywhere on the Golf Course so as to result in contaminated runoff (see the Martens 2015 *Report* in Appendix D1 and the draft GCPoM in Appendix D2);
- the creation of a private Conservation Reserve on Long Bow Point occupying a total of 113ha (Figure 19);
- the preparation and implementation of a Conservation Reserve Plan of Management (CRPoM) – to co-ordinate all management activities within the Long Bow Point Conservation Reserve;
- the implementation of a comprehensive weed and feral pest eradication program throughout the subject land; and
- the creation and implementation of an *Incident Response Protocol* as part of the GCPoM to enable rapid resolution of any incidents (*eg* contaminant spills) that might occur.

## 12.6 Offsets & Compensatory Strategies

An integral element of the proposed Culburra Golf Course project is the implementation of an *Environmental Offsets Strategy* – which is intended *inter alia:* 

- to offset (or compensate for) the removal of vegetation and habitats from the Culburra Golf Course development footprint; and
- to contribute to the provision of a positive long-term biodiversity outcome on the subject land and in the general locality.

The Environmental Offsets Strategy for the Culburra Golf Course project (Table 12.1) includes:

- the planting and management of constructed bioretention swales, detention basins and wetlands throughout the Golf Course to provide supplementary habitat and resources for aquatic and amphibian species (Appendix W) – particularly for wetland birds, the Largefooted Myotis and for the Green & Golden Bell Frog;
- the maintenance of native vegetation and resources (*eg* hollow-bearing trees) between and around the golf course holes;
- the rehabilitation and long-term management of the private Conservation Reserve on Long Bow Point, including the *Environmental Protection* zone around the Lake Wollumboola foreshore (Figure 19) – subject to a dedicated *Conservation Reserve Plan of Management* (CRPoM) to be prepared on approval the Golf Course and prior to its construction;
- the maintenance and funding of the Long Bow Point Conservation Reserve in the interim at least by the established 'Halloran Trust';
- the establishment of a *Threatened Species Recovery and Re-introduction Program*, in consultation with the OEH to reintroduce threatened species to Long Bow Point (*eg* the Green & Golden Bell Frog, the Koala, the Southern Brown Bandicoot); and
- the dedication of private lands vegetated with open forest and woodland communities on Long Bow Point (Figure 19) and in the general locality for biodiversity conservation purposes, including:
  - the private Conservation Reserve on Long Bow Point (Figure 19);
  - a site at East Crescent, Culburra (3.4ha) which contains approximately 2ha of the EEC known as Bangalay Sand Forest (Appendix Y); and
  - a second site at Worrowing Heights (near Vincentia) which contains approximately 6.1ha of shrubland and woodland (Appendix Y).

	Item	Characteristics
1	Private Conservation Reserve on Long Bow Point	<ul> <li>Retention of 113ha of native vegetation on Long Bow Point</li> <li>Long-term maintenance – pursuant to a dedicated <i>Conservation Reserve Plan of Management</i></li> <li>Implementation of a program of intensive weed removal</li> <li>Implementation of an ongoing intensive feral pest and predator elimination program</li> <li>Long-term funding by the Halloran Trust</li> </ul>
2	Special habitat creation	<ul> <li>Specific design of detention basins and the irrigation lake – to provide supplementary habitat (<i>eg</i> for the Green &amp; Golden Bell Frog and Large-footed Myotis)</li> <li>Native grasslands in 'roughs' – as habitat for birds, macropods and bandicoots</li> <li>Long-term maintenance and management – by the Culburra Golf Club subject to a dedicated <i>Golf Course Ecological</i> <i>Management Plan</i> (GCEMP)</li> </ul>
3	Lot 1 in DP 614607 East Crescent, Culburra - to Shoalhaven City Council	<ul> <li>Approximately 3.4ha in area</li> <li>Approximately 2ha of the Bangalay Sand Forest EEC</li> <li>Protection of Lake Wollumboola foreshore</li> <li>Relinquishment of 14 approved residential lots</li> </ul>
4	Lots 1 and 2 in DP 109714 Worrowing heights – to the OEH	<ul> <li>Approximately 6.1ha in area</li> <li>Woodland and native shrubland</li> <li>Habitat for the endangered Eastern Bristlebird</li> </ul>
5	Re-introduction of threatened species	<ul> <li>Koala, Green &amp; Golden Bell Frog, Southern Brown Bandicoot</li> <li>In consultation with OEH</li> </ul>

# Table 12.1 Elements of the Environmental Offsets Package for the Long Bow Point project

## 12.7 Long-term Management

The long-term management of various elements of the Culburra Golf Course project (including lands to be dedicated for biodiversity conservation purposes) will vary depending on the long-term ownership of those various elements. The three different elements of the Culburra Golf Course project include:

- the Golf Course lands (Figure 19) which include the central parts of Long Bow Point, as well as the access road, Downs Creek bridge and land south of Downs Creek (on which Holes 13 and 14 are located);
- the Long Bow Point Conservation Reserve (Figure 19) which surrounds the Golf Course land and includes all of the *7(a) Environment Protection* zoned land;
- Lot 1 at East Crescent, Culburra as well as Lots 1 and 2 at Worrowing Heights (Appendix Y) – which are to be donated to Shoalhaven City Council and the OEH respectively.

## 12.7.1 Culburra Golf Course Lands

The land on Long Bow Point identified as the 'Culburra Golf Course land' (Figure 19) includes the central part of Long Bow Point (on which the bulk of the Culburra Golf Course is located) and land on the southern side of Downs Creek (on which Holes 13 and 14 are located). In addition, the Culburra Golf Course land includes the access road from Culburra Road, as well as the bridge crossing of Downs Creek.

In addition to all of the elements of the Culburra Golf Course itself, the Golf Course land includes:

- strips of native vegetation between and around the golf holes and fairways;
- the substantial areas of cleared land in the centre of Long Bow Point;
- the stormwater detention basins, bioretention swales and wetlands which are to be constructed *inter alia* to provide habitat for native (including threatened) species; and
- other areas of native vegetation (which are not to be affected for the Golf Course).

The Culburra Golf Course land will be retained in the ownership of the Halloran Trust, in the interim at least. Management of the Culburra Golf Course land will be the responsibility of the Halloran Trust, which will be responsible for implementation of:

- the Integrated Water Management Plan of Martens 2015 (Appendix D1);
- a Construction Environment Management Plan;
- the Culburra Golf Course Plan of Management (GCPoM see Apendix D2); and
- a detailed *Golf Course Ecological Management Plan* (GCEMP) which is to be prepared specifically for retained vegetation in and around the Golf Course itself.

Funding for the implementation of the GCPoM and GCEMP, after completion of the Golf Course and the conduct of initial vegetation management works by the proponent, will be the responsibility of the Culburra Golf Club.

# 12.7.2 Long Bow Point Conservation Reserve

The Long Bow Point Conservation Reserve, occupying approximately 113 hectares of forested land on and adjoining Long Bow Point (Figure 19) will be retained, for the time being, in the ownership of the Halloran Trust.

That Reserve is to be maintained in accordance with a dedicated *Conservation Reserve Plan of Management* (to be prepared and placed on the title of the land) by the Halloran Trust.

# 12.7.3 Dedicated Offset Lands

The *Environmental Offsets Strategy* which has been prepared as part of the Culburra Golf Course project includes the dedication (Appendix Y) of:

- Lot 1 East Crescent, Culburra to Shoalhaven City Council (SCC) to conserve the Bangalay Sand Forest (BSF) EEC on the land and for the protection of the foreshore of Lake Wollumboola; and
- Lots 1 and 2 in DP 109714 at Worrowing Heights near Vincentia to OEH for biodiversity conservation purposes (woodland and shrubland, including habitat for the endangered Eastern Bristlebird).

The long-term management of those lands will be the responsibility of the OEH or Shoalhaven City Council, as relevant.

## 12.8 Ongoing Monitoring

The substantial area of vegetation which is to be retained on the subject land, within the private Conservation Reserve on Long Bow Point (including the *Environmental Protection* zoned lands around Lake Wollumboola) and other vegetated land around the Golf Course elements, is to be monitored on a long-term basis.

That monitoring will be undertaken pursuant to:

- the *Golf Course Ecological Management Plan* (GCEMP) to be prepared for the Golf Course itself; and
- a *Conservation Reserve Plan of Management* (CRPoM) to be prepared for the balance of the private Conservation Reserve on Long Bow Point.

There will be ongoing monitoring and management of:

- weed infestations on and around the Golf Course itself;
- weed infestations within all areas of retained vegetation;
- pests and vermin (*eg* feral cats, foxes, rats and mice) with the implementation of control mechanisms to remove or destroy infestations of such species;
- regular monitoring of native biota (including threatened species) utilising the Golf Course and surrounding bushland – to provide for modifications to management activities (if required) to benefit threatened biota; and
- regular monitoring of water quality, water discharges, fertiliser use and pesticide/herbicide use on and around the Golf Course to ensure there is no discharge of contaminants into the groundwater or Lake Wollumboola.

All of these measures will be documented in the detailed *Golf Course Ecological Management Plan* (GCEMP) and the final GCPoM (see draft in Appendix D2) – which will be prepared pursuant to the receipt of a consent for the Culburra Golf Course, prior to the release of any *Construction Certificate*.

It is anticipated that *Annual Reports* addressing all of these matters would be prepared by an independent expert, and forwarded to:

- Shoalhaven City Council as the consent authority; and
- the OEH as a neighbour (Lake Wollumboola is part of the Jervis Bay National Park) and as the authority responsible for threatened biota.

It is to be noted that the management and monitoring regime proposed for the Culburra Golf Course and the Long Bow Point Conservation Reserve, including the weed and feral pest management regimes, is considerably more comprehensive and intensive than any such scheme currently operating, or ever likely to be implemented, on any other lands in the locality (including within the National Parks in the vicinity).

#### 12.9 Translocation

No "translocation" of any threatened biota is proposed as part of the Culburra Golf Course project.

However, as noted above, a number of 'salvage and re-use' and/or 'relocation' measures are proposed as part of the Culburra Golf Course project - including *inter alia*:

- the salvage, mulching and re-use of native plant material (shrubs, understorey and tree canopies) for use around the Golf Course project area and within the private Conservation Reserve for rehabilitation activities (*eg* where there are currently stands of Lantana or Bitou Bush and in the regeneration areas within the Golf Course);
- the salvage and re-use of all tree-hollows which need to be removed (small though that number is) with implementation of the *Hollow-bearing Tree Protocol* (as detailed in Chapter 12.4.2 of this SIS);
- the deployment of large tree bases and/or any current fallen logs from within the Golf Course footprint into immediately adjoining retained vegetation - to enhance the resources available for native (including threatened) species; and
- pre-clearing inspections of all areas of vegetation and all hollow-bearing trees to minimise the potential for hazards to be imposed on individual native biota.

Further, as noted above, a part of the *Environmental Offsets Strategy* for the Culburra Golf Course project includes a positive contribution to the improvement of biodiversity on Long Bow Point – by the creation of new habitats and resources for threatened biota on and around the Golf Course (*eg* grasslands for foraging, wetlands for the Green & Golden Bell Frog, Large-footed Myotis and wetland birds) and by a dedicated program of introduced species and pest eradication.

In addition to the creation of supplementary habitat, the proponent and landowner (the Halloran Trust) proposes a program of re-introducing threatened species that have been lost from this locality – in consultation with the Office of Environment & Heritage (OEH).

Threatened biota which could readily, and relevantly, be re-introduced onto Long Bow Point include:

- the Koala for which there are suitable foraging trees, and which had historically been present in the Culburra area. It is understood that the local Jarninga Land Council is in favour of the re-introduction of the Koala to the locality;
- the Southern Brown Bandicoot for which there is ample available habitat; and
- the Green & Golden Bell Frog for which the wetlands to be created on and around the Culburra Golf Course will provide suitable habitat.

An array of other threatened biota could be considered for re-introduction to Long Bow Point, by agreement with the OEH.

#### 13 ADDITIONAL INFORMATION

#### 13.1 Approvals Required

The TSC Act requires, pursuant to Sections 110(2)(j) and 110(3)(g), that an SIS includes:

"a list of any approvals that must be obtained under any other Act or Law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the ecological community".

Development consent for the proposed Culburra Golf Course is required from Shoalhaven City Council - pursuant to the EP&A Act. Other approvals pursuant to "*any other Act or Law*" which are (or may be) required "*before the action may be lawfully carried out*" are detailed below.

It is important to note that the Culburra Golf Course project does not require the *concurrence* of the Director-General of the Office of Environment & Heritage (OEH) – despite the preparation of this SIS. As documented in Chapter 10 and in Appendix X of this SIS, the Culburra Golf Course project is **NOT** *"likely"* to result in the imposition of a *"significant effect"* on any *"threatened species, population or ecological community, or its habitat"*.

Consequently:

- there is **NO** requirement for the preparation of this SIS; and
- the OEH has NO concurrence role with respect to the Culburra Golf Course project.

There are two statutory "*approvals that must be obtained*" for the development of the Culburra Golf Course – pursuant to the EP&A Act and the *Water Management Act 2000* (see below).

Legislation	Authority
Environmental Planning & Assessment Act 1979	Shoalhaven City Council
Water Management Act 2000	NSW Office of Water
	<ul> <li>for a Controlled Activity Approval for the crossing of Downs Creek</li> </ul>
	• for a Water Storage Licence

Shoalhaven City Council is the relevant consent authority for the *Development Application* (DA) for the Culburra Golf Course proposal – pursuant to Part 4 of the *Environmental Planning & Assessment Act 1979* (EP&A Act). It is the responsibility of the consent authority to determine the application.

The Water Management Act 2000 will be triggered by the proposal to construct the bridge and crossing of Downs Creek. At that location, Downs Creek constitutes a "river" according to the Water Management Act 2000, and there is relevant "waterfront land" present. A Controlled Activity Approval

(CAA) will be required from the NSW Office of Water (NOW) for that element of the Culburra Golf Course.

Additionally, the creation and use of the detention basins/wetlands on the Culburra Golf Course land will require the provision of a *Water Storage Licence* by NOW.

The author of this SIS has considered the relevant, or potentially relevant, matters contained in the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act). It is noted that the assessment of a proposed development pursuant to the EP&A Act and/or the TSC Act does not invoke a statutory requirement for approval pursuant to the EPBC Act.

It is the position of the author of this SIS that the Culburra Golf Course project will not impose a *"significant impact"* upon any *Matters of National Environmental Significance* (MNES) – including any threatened biota or migratory species listed in the EPBC Act (Appendix K). There is, therefore, no requirement for a formal *Referral* of the Culburra Golf Course project pursuant to the EPBC Act.

Nevertheless, consultation by the proponent with the Commonwealth Department of Environment (DoE) regarding the Culburra Golf Course, amongst other projects in the Jervis Bay Region, is ongoing.

#### 13.2 Licences

The DGRs (Item 9.3 of Appendix A) indicate that "*persons conducting flora and fauna surveys must have appropriate licences or approvals under relevant legislation*", including those required pursuant to the *National Parks & Wildlife Act 1974* (NP&W Act), the TSC Act and the *Animal Research Act 1985*.

All personnel working on this project have and/or relevantly had the requisite licences and approvals to conduct fauna and flora investigations throughout NSW.

## 13.3 Qualifications and Experience

Section 110(4) of the TSC Act requires that:

"an SIS must include details of the qualifications and experience in threatened species conservation of the person preparing the statement and of any other person who has conducted research or investigations relied on in preparing the statement".

The qualifications and experience of Mr F Dominic Fanning (the author of the SIS), and the field biologists involved (Ms Fiona Iolini and Mr Matthew Consterdine – of SLR Ecology), are provided in Appendix Z of this SIS.

Presumably that Section of the Act does not require such details in respect of the many dozens of researchers and ecologists contained in the references contained in the Bibliography – upon which this SIS has, in part, *"relied"*.

# GLOSSARY

Affected Species	The "subject species" (and "endangered populations" and "endangered ecological communities") which are "likely to be affected by the action", pursuant to Section 110(2)(b) of the TSC Act
Biota	<i>"Biota"</i> means the animals and plants, and other organisms, of a geographic region or locality. Although <i>"biota"</i> includes fungi and micro-organisms, for the purposes of this SIS, the term is used to refer to plants, animals and <i>"ecological communities"</i>
Bioregion	A "bioregion defined in a national system of bioregionalisation that is determined (by the Director-General by order published in the Gazette) to be appropriate for those purposes" (TSC Act)
CSM	Coastal Saltmarsh of the NSW North Coast, Sydney Basin and South East Corner Bioregions
DA	Development Application - prepared pursuant to the EP&A Act
DEC	Department of Environment & Conservation
DECC	Department of Environment & Climate Change
DECCW	Department of Environment, Climate Change & Water
DGRs	<i>Director-General's Requirements</i> provided by the OEH pursuant to Section 111(1) of the TSC Act
Director-General	The Director-General of the National Parks & Wildlife Service (now OEH)
DoE	Commonwealth Department of Environment (previously SEWPaC)
EEC	Endangered Ecological Community - "an ecological community specified in <i>Part 3 of Schedule 1</i> " of the TSC Act
Ecological Community	The TSC Act definition is "an assemblage of species occupying a particular place"
Endangered Population	A "population specified in Part 2 of Schedule 1" of the TSC Act
EP&A Act	Environmental Planning & Assessment Act 1979
FWCF	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions
КТР	Key Threatening Process - " <i>a threatening process specified in Schedule 3</i> " of the TSC Act
Locality	The area of contiguous, or near-contiguous, ecosystems and habitats within a radius of up to at least 10 kilometres (depending on individual species) from the " <i>subject site</i> "
NOW	NSW Office of Water
NPWS	NSW National Parks & Wildlife Service
OEH	NSW Office of Environment & Heritage
Proposal	The "development, activity or action proposed" (DGRs)

Recovery Plan	A "plan prepared and approved under Part 4" of the TSC Act
REFCF	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions
Region	The Jervis Bay Regional Area, as identified in the Jervis Bay Regional Environmental Plan - which correlates approximately to the Shoalhaven Local Government Area (LGA)
SEWPaC	The Commonwealth Department of Sustainability, Environment, Water, Population & Communities (now DoE)
SIS	<i>Species Impact Statement</i> - prepared pursuant to Sections 109, 110 and 111 of the TSC Act, and the DGRs
SOFF	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions
SSFCF	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions
Study Area	The "subject site and any additional areas that are likely to be affected by the proposal, either directly or indirectly" (DGRs)
Subject Land	Part Lots 5 and 6 in DP 1065111 - south of the Culburra Road (on which the Golf Course is proposed)
Subject Site	The "area directly affected by the proposal" (DGRs)
Subject Species	Those "threatened and significant species that are known or considered likely to occur in the study area" (DGRs)
Survey Area	The area within which previous ecological investigations have been undertaken within the 'Locality'
Threatening Process	A "process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities" (TSC Act)
Threatened Species	A "species specified in Part 1 or 4 of Schedule 1 or in Schedule 2" of the TSC Act
TSC Act	Threatened Species Conservation Act 1995
UEA	Urban Expansion Area. Relevantly – the Culburra UEA (which includes Long Bow Point, the Culburra West project land, and the intervening parts of Lots 5 and 6)
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