A BIOLOGICAL SURVEY OF TILLEY SWAMP SOUTH AUSTRALIA

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South East Region, Department of Environment, Heritage and Aboriginal Affairs

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Cover Photograph: The Morella Basin fringed by *Melaleuca halmaturorum* low open forest. Permanent inundation of this area is expected to cause a decrease in the extent of this rare plant community as well as the local extinction of several other plant populations existing on the basin. (Photo H. Stewart)

Abstract

A ten day survey of the vegetation and vertebrate fauna of the Tilley Swamp watercourse was undertaken in December 1996. This resulted in the recognition of :

- Ten floristic plant communities containing 227 plant species (41 introduced)
- Nineteen mammal species (eight introduced).
- One hundred and seven bird species (five introduced).
- Seventeen species of reptile and four species of frogs.

Eleven species of plant, two plant communities, three species of mammal and 26 bird species of conservation significance were recorded during the present survey. In addition, a further 53 plant species and 9 bird species have been recorded in the study area previously. Although currently not recognised, the Tilley Swamp watercourse contains several populations of plants, mammals and birds of conservation significance. It is therefore worthy of inclusion in the register of important wetlands of South Australia, and as such can be considered an area of high conservation value.

As part of the Upper South East Dryland Salinity and Flood Management Plan (1993) several drainage scenarios have been proposed for the central catchment in the Upper South East of South Australia. The drainage options range from allowing natural watercourses to receive greater volumes of moderately saline water than present before periodic releases into the Coorong; to plans that would see the watercourse being used as an extensive pondage area, containing much greater volumes of relatively saline water. The latter option would result in permanent ponding of parts of the watercourse up to two metres deep. The exact route of the drain and the nature of the drain (ie. whether it will carry water from a deep groundwater drain or a surface drain) have not been specified. This survey and report has therefore dealt with the full spectrum of drainage options and their potential biological impacts in general terms. The biological impacts of the three options outlined can be found in the "Conclusions and Recommendations" section.

The results from this survey suggest that Option 3 would be the preferred choice on biological grounds.

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People Involved

Unlike previous Biological Surveys in this series, the data contained in this report was collected over a two week period of field work in response to the need by the Department of Environment and Natural Resources, now Department of Environment, Heritage and Aboriginal Affairs (DEHAA), to acquire biological information to enable the Department to better assess the potential conservation impact of proposed drainage works through the Tilley Swamp watercourse, in the South East of South Australia. A small team of biologists were developed and supervised by the survey coordinator, Hafiz Stewart with assistance by Jason van Weenen. All members made a notable contribution to the effectiveness of this survey.

Field work

Vegetation survey

The collection of all plant specimens was undertaken by Tim Croft.

Vertebrate survey

The vertebrate survey entailed obtaining records for all mammals (m), reptiles (r) and birds (b) present at the sites during the survey. These records were obtained by Hafiz Stewart (m), Jason van Weenen (r) and by Graham Carpenter (b) in the first week and Jamie Matthew (b) in the following week.

Both groups were also assisted in a volunteer capacity by Rachel Kelly and Jason Cody.

Specimen Identification

Plants: All plant species were identified by Tim Croft in the field. Collected specimens were also verified by Tim Croft using the Departmental and personal herbariums. Peter Lang also assisted in plant identification.

Mammals: Hafiz Stewart and Cath Kemper from the S.A. Museum.

Reptiles: Jason van Weenen and Adrienne Edwards from S.A. Museum.

Map production : Interpretation and delineation of floristic groups, and their transfer on to Mylar was completed by Tim Croft. Final map production was under taken by members of the Geographical Analysis and Research Branch (GAR) of the Department of Transport, Urban Planning and the Arts (DTUPA) and South East Region, Department of Environment and Natural Resources. MapInfo was used to generate several additional maps.

I would also like to recognise the help given by Brenton Grear, Tony Robinson (and others) for editing and providing useful feedback during the production of this report. Roger Ebsary, Project Manager, USE Integrated Catchment Management Program, provided welcome support and facilitated funding from the USE Dryland Salinity and Flood Management Plan implementation program. Lastly, I would like to thank all the land holders involved, including Jock Robertson, Jeff Pentelow, Tom Brinkworth and Rex Anderson for access to their land. The Biological Survey team is indebted to Roger and Yvonne Roberts for their substantial help during the survey.

Introduction

Since 1971 the South Australian Department of Environment Heritage and Aboriginal Affairs has been conducting systematic biological surveys of the vegetation and vertebrate fauna of large regions of the state as part of the Biological Survey of South Australia. The aim of these surveys is to document the range of biological variation across the state to improve long-term natural resource management.

Previous surveys have been conducted or are currently in progress for the States Offshore Islands (excluding Kangaroo Island) (1971 - 1982), the South-East Coast (1982 - 1983), Cooper Creek (1983, 1991), the Nullarbor Plain (1984), the Gawler Ranges (1985), the Yellabinna area (1987), Kangaroo Island (1989 - 1990), Strzlecki Dunefields (1988 - 1992), Murray Mallee (1990 - 1991), Anangu Pitjantjatjara Lands (1991 -), the South Olary Plains (1991 - 1992), Diamantina River Area (1994), Stony Deserts (1994 - 1997), and the North Olary Plains (1995 -). With the exception of the Offshore Island surveys, the regional boundaries of these surveys have been based on the Environmental Regions and the Environmental Associations described and mapped for South Australia by Laut et al. (1977). In addition to these vegetation and vertebrate surveys, vegetation sampling analysis and mapping only has been completed or is in progress for the following areas:- South Mt Lofty Ranges (1986), Tallaringa Area (1988), Murray Mallee (1990), South-East (1991), Western Murray Flats (1991), Mid-North (1992), Burra Hills (1994), Yorke Peninsula (1994), and South Eyre Peninsula (1995 -).

More recently, a number of more specific surveys have been undertaken in response to the need for detailed biological information for particular areas. These include the Biological Survey of Yumbarra Conservation Park (Owens *et al.* 1995b) which assessed the potential impact of the proposed mineral explorations for the Park, the Box and Buloke Grassy Woodlands Biological Survey (Stokes 1996) which collected biological information required to develop management recommendations for the conservation of remnants, and the Biological Surveys of Messent Conservation Park (Owens *et al.* 1995a) and Deep Swamp (Stewart 1996, 1997) which both assessed the likely biological impacts of a proposed drain through these areas as part of the Upper South East Dryland Salinity and Flood Management Plan (1993).

Similarly, a Biological Survey of Tilley Swamp watercourse was undertaken to identify the range of flora and fauna species present and to assess and compare the potential biological impacts of several drainage options planned to utilise this key wetland, and associated native vegetation (Upper South East Dryland Salinity and Flood Management Plan 1993).

CHARACTERISTICS OF TILLEY SWAMP

The Tilley Swamp watercourse is a fresh water to brackish swamp (4 - 5 ppt, Nichols 1996) situated approximately eight kilometres inland from the coast between Henry Creek Road and Salt Creek, in the Upper South East of South Australia (Fig. 1). Tilley Swamp watercourse is situated in the Tilley Swamp Environmental Association (1.2.7) however, the study area also included part of the Cortina Environmental Association (1.2.6) and has been described as consisting of "an elongated interdunal plain with numerous swamps and small lakes, generally fringed on the east by the low lunettes." (Laut et al. 1977: pp 46). Although the predominant land use in the study area is pastoral, a significant proportion still remains as native vegetation (Nicolson 1993). As well as Martin Washpool Conservation Park (1883 hectares) in the north, and Tilley Swamp Conservation Park (1880 hectares) in the south, several Heritage Agreement areas (on Stoneleigh Park, Banff and Safari Stations) and significant amounts of tea tree remain in Tilley Swamp (Figs 2 and 3). Tilley Swamp is approximately 44 kilometres long, and covers an area of 114 square kilometres (Loan 1993). The study area has a Mediterranean type climate, with long warm summers, and cold wet winters and a mean annual rainfall of 500mm (Laut et al. 1977).

Tilley Swamp, and in particular the northern section of the watercourse historically acted as a terminal wetland periodically receiving overland flow from the West Avenue, Bakers Range and Marcollat Watercourses. Since the construction of Bank H in 1912 which diverted the majority of Bakers Range and Marcollat waters to the Watervalley Wetlands, Tilley Swamp has received significantly less overland flow. Tilley Swamp presently receives water from Avenue Flat, the flat immediately south of Henry Creek Road, and precipitation collected *in situ* (Upper South East Dryland Salinity and Flood Management Plan 1993).

Relative to other swamps in the South East, Tilley Swamp (along with Watervalley Wetlands) fills later and retains water longer, with flows occurring between September and December in wetter years. The overland water flow moves north-westerly along the watercourse through Tilley Swamp Conservation Park, north through Martin Washpool Conservation Park to the Morella Basin where it ponds before evaporation (Fig. 4). Excessive clearance of deep rooted native vegetation and replacement with shallow rooted crops in the South East, has led to increased groundwater recharge and a resultant rise in groundwater levels. In many cases this has led to the problem of dryland salinity which has negatively affected farm production and some native vegetation.







Figure 4. Proposed drainage route for the Tilley Swamp watercourse.

Recent research in the Upper South East has shown that the health of the native vegetation of some terminal wetlands has been degraded because of dryland salinity caused by increasing ground water levels (Webb 1993, Loan 1994, Mensforth 1996). For much of the Tilley Swamp watercourse, groundwater is presently between 0.2 - 0.5 m below the surface and expected to rise 0.75m (or to the ground surface) in the next 25 years (Nicolson 1993, Loan 1994). With this rise in groundwater, a decrease in the health of the swamp vegetation in Tilley Swamp can be expected.

UPPER SOUTH EAST DRYLAND SALINITY AND FLOOD MANAGEMENT PLAN (1993)

The Upper South East Dryland Salinity and Flood Management Plan proposes to alleviate the effects of rising ground water, dryland salinity and floods by construction of a series of strategically placed deep groundwater and surface water drains (Upper South East Dryland Salinity and Flood Management Plan 1993). This scheme categorises the South East into three major catchments, namely the northern, central and southern catchments (Fig. 5).

The Tilley Swamp watercourse is situated in the Central Catchment and forms part of the proposed Coorong Outlet infrastructure. As part of the schemes integrated package, several drainage options have been proposed to utilise the Tilley Swamp watercourse. These include:

Option 1

Utilisation of the Tilley Swamp Watercourse as a ponding basin for the full volume of water from the Central Catchment drainage system. Volumes and water quality would be dependent upon the type of drainage (groundwater or surface) implemented in the catchment. A major groundwater scheme could result in annual volumes of 136 000 ML with salinities up to 10 000mg/l. This option would result in permanent ponding up to 2m deep resulting in the destruction of existing riparian vegetation and the impoverishment of the aquatic system. Periodic releases to the Coorong via Salt Creek would be required (Fig. 4).

Option 2

Construction of a surface water carrier drain that would receive drainage flow volumes dependent upon the drainage scheme implemented in the Central Catchment. Implementation of the major surface water scheme could result in annual volumes of 37 000ML with salinity levels of 4000 mg/l. Drainage work in the watercourse would aim to retain the current level of flooding and may possibly reduce periods of inundation. Surface waters would be ponded at Morella Basin with pondage levels in the basin expected to increase in height and period. Regular releases to the Coorong via Salt Creek would be required. (Fig. 4) Utilisation of the natural watercourse flow path to manage the area as a high quality wetland. Inundation may increase in area and period but the intermittent brackish nature of the watercourse would be retained. Increased flows would result from surface water not able to be stored in the Watervalley Wetlands and could result in annual volumes up to 37 000 ML. Minimal construction work may be required to reduce constrictions along the flowpath and reduce unacceptable upstream flooding. This option would rely on drainage discharge salinities to be in the vicinity of 3,000 - 6,000 mg/l and would require periodic releases to the Coorong at Salt Creek (Fig. 4).

The choice of drainage option will depend on several factors including drain design and function, cost, feasibility and potential impact on the natural and agronomic environment.

THE BIOLOGICAL IMPORTANCE OF THE SOUTH EAST

The South East of South Australia is ecologically important because it represents the boundary between the 'Bassian' and 'Eyrean' zoogeographic provinces (Twidale and Tyler 1983). As a result, many of South Australia's vertebrates and plants reach the boundary of their distributions in the South East. The South East also contains the highest diversity of Bassian species in South Australia, approximately 74 % of the State's bird species, and 80% of it's non-breeding migrants (Twidale and Tyler 1983, Parker and Reid 1983). Furthermore, 43% of all plant species known in South Australia have been recorded from the South East, and it is the fourth most species rich botanical province after the Eyre Peninsula, Southern Mt Lofty Ranges, and the Murray Mallee (Jessop 1993 in Croft and Carpenter 1996).

However, since European settlement the distribution abundance and existence of much of the native flora and fauna of the South East has been affected by the excessive clearing of native vegetation and drainage of many wetlands. To date only 8.3 % of the original vegetation and less than 7% of the original swamps in the South East remain (Croft and Carpenter 1996, Upper South East Dryland Salinity and Flood Management Plan 1993). Much of what is left exists as small isolated remnants, supporting populations of endemic flora and fauna. Consequently, the South East contains populations of many species of vertebrates and plants of conservation significance. Collection of biological information is therefore of paramount importance if the remaining populations of vertebrates and plants are to be protected in the course of undertaking the Upper South East Dryland Salinity and Flood Management Plan (1993).

Although the present survey used a more intensive sampling program than the previously conducted regional surveys, it utilised the standard sampling, and presentation techniques developed as part of the overall Biological Survey of South Australia. All data was therefore collected in a systematic way which is

Option 3

completely compatible with existing biological survey information.

The present Biological Survey was carried out between December 2 - 11, 1996. The location of all sixteen flora and fauna sampling sites are depicted in Figures 2 and 3 (map at end of report).

Prior to the present survey, some research on the biology of Tilley Swamp had been carried out, including work undertaken by the Native Vegetation Conservation Section (NVCS) of the Natural Resources Group, of the Department of Environment, Heritage and Aboriginal Affairs (DEHAA) during assessment of Heritage Agreement areas, the regional mapping of the South East undertaken by the Geographical Analysis Group (GAR) of the Department of Transport, Urban Planning and Arts (DTUPA), and several post-graduate and other research projects on the health of vegetation in the South East (Webb 1993, Loan 1993, Mensforth 1996, Mensforth and Walker 1996). However, this survey represents the first systematic study of both the flora and fauna of the area, and as such will contribute to the greater understanding of the flora and fauna communities of the South East of South Australia.



Figure 5. Delineation of catchments in the Upper South East according to the USE Dryland Salinity and Flood Management plan (1993).

Methods

The rationale behind these regional Biological Surveys has been explained in detail by Copley and Kemper (1992). The Tilley Swamp Biological Survey was conducted in patches of remnant vegetation in the agricultural district of South Australia, where much of the natural vegetation and its associated vertebrate fauna has been fragmented by clearance and undergone substantial habitat modification for agriculture. For this reason a number of alterations to the methods adopted in the extensive areas of natural vegetation covered by previous regional surveys were required. More recently, a number of specific Biological Surveys (Owens et al. 1995 a,b, Stewart 1996, 1997 and Stokes 1996) have been undertaken which provided a methodology which ensured that the data collected in this survey were comparable to that collected in previous broad-scale surveys.

The Biological Survey of Tilley Swamp was designed with the following aims:

1) To collate any previously existing information on the biota of Tilley Swamp.

2) To undertake a Biological Survey of Tilley Swamp to determine the presence of all flora and fauna, in a standard and comparable format. This entailed providing both the S.A. Museum and State Herbarium with voucher specimens collected during the survey, and entering all the collected data onto the South Australian Survey Database.

3) To establish permanent sampling sites to collect baseline data, and monitor the potential effects of the proposed drain on the flora and fauna of Tilley Swamp.

4) To prepare an accurate vegetation map of Tilley Swamp and surrounding areas at a scale of 1:150,000.

5) To obtain information to assist in the decision as to which drainage option should be implemented in the central catchment and Coorong outlet sections of the Upper South East.

Site Selection and Nomenclature

The fundamental concept behind all the regional surveys conducted as part of the Biological Survey of South Australia to date has been that they are based on intensive sampling at a series of *sites* selected to represent the biological and geographical diversity of the study area. As the Tilley Swamp survey was designed to assess the potential impacts of a proposed drain through a particular area, some changes were

made to the site selection process. Due to the smaller size, and more intensive nature of the survey, this survey considered the whole of the Tilley Swamp watercourse to be a single site designated with the code TS. Given the time available, the number of vegetation types and the relatively small size of the area, a maximum of sixteen principle vegetation and vertebrate sampling quadrats were established (Table 1, and Figs 2 and 3). At least one sampling quadrat was placed in each of the major vegetation types. Some vegetation types were sampled more than once in relation to their abundance and relative importance (in terms of potentially being most affected by the drainage measures). Site selection was also based on their proximity to the proposed drainage works, and on their attributes as a monitoring site.

Where practical, sampling quadrats were only placed in areas of greater than four hectares (200 m X 200 m) to minimise any 'edge' effects associated with neighbouring vegetation types, and were placed in the centre of the vegetation patch.

Data Collection

Each vegetation sampling site consisted of a 30 X 30 m quadrat, within which all vascular plants present were recorded and representative voucher specimens collected for later verification at the State Herbarium. All data on the species recorded, including life stage, cover/abundance, vegetation association description were recorded on standard data sheets. Details on the overstorey height, canopy depth and diameter, and canopy cover were also recorded, as well as a description of the location and physical environment of each quadrat.

All sixteen quadrats sampled for vegetation were also sampled for the presence of vertebrates. At each, a 50 m long line of six fenced pitfall traps were established. Each pitfall trap consisted of a 455 mm x 380 mm sheet of white, high impact polystyrene sheet joined into a cylinder using a slotted H section plastic strip (HM12). The resultant pitfall traps had a diameter of 125 mm and a depth of 380 mm.

A separate line of 15 Elliott traps were set in association with each pitfall line sampling the same

habitat within the quadrat, and two possum/cat size traps were placed at each end. A line of 6 micropitfalls consisting of plastic vials measuring 80 X 20 mm and filled with 70% alcohol were set adjacent to the main pitfall line. All traplines were run for four nights. Reptiles and mammals were also sampled by searching each of the sixteen quadrats at least once during the sampling period.

Birds were recorded for each quadrat. An observer spent from one to several hours during the best bird observation times of early morning and evening recording all birds within or flying over the quadrat during the search period. An attempt was made to put the same amount of search effort into each quadrat during the best observation times.

A permanent photographic monitoring point was established at each of the sixteen vertebrate sampling quadrats using two 1.4 m long steel posts set 10m apart (Figs 6 - 21).

Observations of some plants and vertebrates encountered outside quadrats were recorded on special "opportunistic" data sheets. A single harp trap was set up at a number of sites to capture bats. At least the first specimen of each small mammal and reptile species recorded for the survey area was preserved as a museum specimen. Larger species (ie. *Varanus rosenbergi*) which had been collected from the general region in the past and did not present any identification problems were not collected.

A small amount of vehicle spotlight searching was carried out both on the quadrats and opportunistically but the demands of quadrat sampling and specimen processing did not allow this to be carried out systematically.

Samples of liver tissue were taken from all specimens collected and stored in liquid nitrogen. Tissue samples from all mammals and reptiles are permanently stored at the South Australian Museum (SAM).

Invertebrates were collected from the micro-pitfall and larger vertebrate pitfall traps or opportunistically around each quadrat. These samples were also lodged with SAM.

A summary of the sampling effort over the whole survey is given in Table 2. The number of individual observations during the survey is shown in Table 3.

Table 1.Flora and fauna sampling quadrats established in the Tilley Swamp study area, December 1996.

Survey Site	Vegetation Association
Code	
TS0101	Samphire low shrubland
TS0201	Banksia ornata open heath
TS0301	Eucalyptus diversifolia open scrub
TS0401	Melaleuca brevifolia open heath
TS0501	<i>E.arenacea</i> low open woodland
TS0601	<i>E.fasciculosa</i> open woodland
TS0701	Allocasuarina verticillata low open woodland
TS0801	M.halmaturorum low open forest
TS0901	E.diversifolia open scrub
TS1001	M.halmaturorum shrubland
TS1101	M.halmaturorum open scrub
TS1201	<i>E.arenacea</i> low open woodland
TS1301	M.brevifolia low open heath
TS1401	M.halmaturorum open scrub
TS1501	A.verticillata low open woodland
TS1601	E.leucoxylon var. stephaniae woodland

Site	Pit Trap	Elliott Trap	Vehicle Spotlight	Harp Trap Nights
	Nights	Nights	Hours	
TS0101	24	60		
TS0201	24	60		
TS0301	24	60		
TS0401	24	60		
TS0501	24	60		
TS0601	24	60		
TS0701	24	60		
TS0801	24	60		
TS0901	24	60		
TS1001	24	60		
TS1101	24	60		
TS1201	24	60		
TS1301	24	60		
TS1401	24	60		
TS1501	24	60		
TS1601	24	60		
OPPORTUNISTIC			3	6
TOTALS	384	960	3	6

Table 2				
Trapping and spotlighting effort during the	e Tilley Swamp	Biological Survey	, December	1996

Table 3

Numbers of individual observations of plants and vertebrates during the Tilley Swamp Biological Survey, December 1996.

	Quadrats	i	Opportunistic	Total	
Plants	533	(16 sites)	18	551	
Mammals	72	(16 sites)	38	110	
Birds	538	(16 sites)	116	654	
Reptiles	70	(16 sites)	8	78	
Amphibians	14	(16 sites)	0	14	

Data Management

All collected specimens were lodged with the appropriate institutions for verification and were added to their collections if required. Whereas the State Herbarium received all collected plant specimens, the vertebrate specimens were lodged with SAM. Any corrections to specimen identification were transferred to the original data sheets and the data was entered on the Opportunistic and Survey databases administered by the Biological Survey and Research section of DEHAA.

Vegetation Mapping

Due to the relatively small number of vegetation quadrats sampled in the current survey, PATN analysis

could not be used to define floristic groups (which has been the case in most previous Biological Surveys).

Instead, a 1:150,000 floristic vegetation map of the Tilley Swamp vegetation was created from interpretation of current aerial photographs at a scale of 1:40,000 from data collected during the present survey and from previous information generated by the Regional Flora Survey undertaken by the Department of Transport, Urban Planning and Arts (DTUPA) in 1991. The vegetation boundaries were then traced from the 1:40,000 aerial photograph onto transparent overlays or 'mylars' at that scale. The mylars were corrected for topological inaccuracy, and the vegetation boundaries were then digitised by members of the Geographical Analysis and Research Group (GAR) of DTUPA. The final map (Fig. 3) was produced using ESRI's ARC/INFO GIS software.

Results

VEGETATION

Some pre-existing information on the vegetation of Tilley Swamp water course was available prior to undertaking this survey from Heritage Agreement assessments carried out by the Native Vegetation Conservation Section (DEHAA) and sampling sites conducted during the South East Floristic Survey undertaken by the Department of Transport, Urban Planning and Arts (DTUPA) in September 1991.

Floristic Vegetation Mapping

Ten floristic plant communities were recognised in this study, including four communities associated with calcareous ridges (*Eucalyptus fasciculosa* woodland, *E.leucoxylon* ssp. *stephaniae* woodland, *E.diversifolia* closed mallee and *Allocasuarina verticillata* low woodland), one community associated with sandy rises (*Banksia ornata* shrubland with emergent *Eucalyptus arenacea*) and five intergrading communities associated with areas subject to seasonal waterlogging or inundation (*Melaleuca brevifolia* shrubland, *M.halmaturorum* tall shrubland and low woodland, *Selleria radicans* herbland, and Samphire low shrubland). (Table 4 and Fig. 3). The description and naming of floristic groups followed those defined in DTUPA's floristic survey of the South East.

This survey recorded 228 species of plants (41 introduced) including 11 species of high conservation significance and two plant communities considered to be rare in the South East (Lang and Kraehenbuehl 1997). (Appendix I). Including data from prior studies, the ten plant communities in the study area contain 280 species of plant (47 introduced) and 18 species of conservation significance.

Sampling was undertaken in early December, when most ephemeral species such as orchids Droseraceae and Liliaceae species had died off. Therefore, the list of species recorded is not expected to represent all plant species in the study area. Similarly, the following description of species may not represent all of the threatened plant species extant in the Tilley Swamp watercourse.

Species of Particular Interest

This survey recorded seven species of state significance and 11 species of regional significance. Although no plants of national significance were recorded during the survey, the nationally **endangered** Metallic Sun-orchid (*Thelymitra epipactoides*) has been previously recorded within the study area during the South East Flora Survey, (1991). Collectively, 19 plant species of high conservation significance have been recorded from the Tilley Swamp watercourse (Lang and Kraehenbuehl 1997). Below are brief descriptions of all species of high conservation significance so far recorded for the watercourse. As some species have different ratings at a state and regional level, both listings will be given as well as their rating under the *National Parks & Wildlife Act*, *1972* where appropriate.

Species of State and Regional Significance

Austral bugle (Ajuga australis form A)

A small perennial or annual herb with erect branches to 30 cm high, flowering from September to December. Due to taxonomic difficulties, its Australian distribution is unknown. However, in South Australia it has a wide distribution where it occurs in the Flinders Ranges, Eyre and Yorke Peninsulas, Southern Lofty, Northern Lofty, Kangaroo Island and the South East botanical regions.

In the South East, it is most often recorded from *Eucalyptus fasciculosa* or *E. leucoxylon* woodlands on consolidated dune ridges with red loam and outcropping limestone. This species was recorded at site TS1501 (*Allocasuarina verticillata* low woodland on a limestone ridge with red loam soil). Lang and Kraehenbuehl (1997) consider this species to be **uncommon** in the South East. Only three populations of *A.australis* were known to be conserved in Padthaway, Mount Scott and Aberdour Conservation Parks. This record represents the first record of the species in Tilley Swamp Conservation Park.

As the site where the plant was recorded is located on a ridge above the watercourse, diversion of water along the watercourse is expected to have minimal or no impact on this species.

Wedge-leaf Daisy (Brachycome cuneifolia)

Perennial herb to 60 cm high with underground rhizomes, erect flowering stem and mostly basal leaves. Flowers August to October. Endemic to South Australia, it has been recorded from the Eyre Peninsula, Murray Mallee, Yorke Peninsula, Southern Lofty, Kangaroo Island and South East botanical regions. Lang and Kraehenbuehl (1997) consider this species to be **uncommon** in South Australia and **endangered** in the South East. This species remains poorly conserved in the Reserve system, and until this survey had not previously been recorded for any Conservation Parks or Heritage Agreements within the South East botanical region. A good, but sparse population was recorded at site TS1501 (*Allocasuarina verticillata* low woodland).

As this floristic community was recorded on a ridge above the watercourse, diversion of water along the watercourse is expected to have minimal or no impact on this species.

Slender daisy (Brachycome exilis)

Small, delicate, annual herb with branched stems to 18 cm high. Flowers August to November. The Slender Daisy has been recorded from New South Wales, Victoria and Western Australia. In South Australia this species has been recorded from Gairdner-Torrens, Flinders Ranges, Eyre Peninsula, Murray Mallee, Yorke Peninsula, Southern Lofty, Kangaroo Island and South East botanical regions.

Lang and Kraehenbuehl (1997) consider this species to be **rare** in the South East. Also poorly conserved, until this survey, populations of this species had not been recorded from any Conservation Parks or Heritage Agreements within the South East botanical region. During the survey, it was recorded as having good, widespread, populations throughout the low lying areas of *Melaleuca halmaturorum*, *Melaleuca brevifolia* and samphire plant communities (TS0101 and TS1401).

As the species was recorded in the watercourse and all over the Morella Basin, this species will be most affected by the altered water regime. Changes to the local flow regime (salinity increases, duration and timing of flooding) are expected to negatively affect this species.

Small hairy daisy (Brachycome leptocarpa)

Annual herb with branched stems from the base to 25cm high. Flowers September to November. Elsewhere in Australia it is recorded within the Northern Territory, New South Wales, and Victoria, while in South Australia it is recorded in most agricultural regions except Kangaroo Island.

Lang and Kraehenbuehl (1997) consider this species to be **uncommon** in South Australia with an **indeterminate** rating in the South East. Although not recorded during the present survey, this species was recorded during the DTUPA's South East Floristic Survey (1991) within *Allocasuarina verticillata* low open woodland.

As the species occurs on the terrestrial limestone ridge, it is not expected to be adversely affected by diversion of water along the watercourse.

Hard-head daisy (Brachycome lineariloba)

Annual herb, branching at ground level to 15cm high. It flowers June to October. This species has been recorded from the Northern Territory, Western Australia, New South Wales and Victoria, and South Australia. In South Australia it has recorded from most botanical regions except Kangaroo Island and the North West botanical region.

B.lineariloba is listed as **uncommon** in the South East by Lang and Kraehenbuehl (1997). Although not recorded during the present survey, this species was recorded during the South East Floristic Survey (1991) within *Allocasuarina verticillata* low open woodland.

As this species occurs on the terrestrial limestone ridge, it is therefore not expected to be adversely affected by diversion of water along the watercourse.

Veined spider-orchid (Caladenia reticulata)

A slender orchid 10-30cm high, flowering September to November. Elsewhere in Australia it is known from Queensland, New South Wales, Victoria, and Tasmania, and in South Australia from the Southern Lofty, Northern Lofty, Kangaroo Island and South East botanical regions.

C.reticulata is considered **uncommon** in South Australia and **indeterminate** in the South East (Lang and Kraehenbuehl 1997). Not recorded in this survey, it has been collected from Drooping Sheoak low open woodland within Martin Washpool CP during the 1991 South East Floristic Survey.

As the species occurs on the terrestrial limestone ridge, it is not expected to be adversely affected by diversion of water along the watercourse.

Pink purslane (Calandrinia calyptrata)

Low lying annual with stems to 20cm, flowering August to October. Elsewhere in Australia it is known from Western Australia, New South Wales, Victoria and Tasmania, and within South Australia from all agricultural botanical regions except Yorke Peninsula.

It is listed as **uncommon** for the South East in Lang and Kraehenbuehl (1997). It was not recorded in this survey, but was collected from *Eucalyptus fasciculosa* woodland within Martin Washpool CP during the 1991 South East Floristic Survey.

As the site where the plant was recorded is located on a ridge above the watercourse, diversion of water along the watercourse is expected to have minimal or no impact on this species.

Small milkwort (Comesperma polygaloides)

A small erect perennial subshrub with a woody root stock growing 10 to 20 cm tall. Flowers October to March (Jessop *et al* 1986). This species has been recorded from Western Australia, Victoria and in the Murray Mallee and Southern Lofty botanical regions of South Australia. Small milkwort is considered **rare** in South Australia and in the south east (Lang and Kraehenbuehl 1997, National Parks & Wildlife Act, 1972).

As this species was observed at sites TS0401 and TS1301 which support *Melaleuca brevifolia* shrubland, and occurs on the watercourse (Fig. 2), any changes to flow regime (salinity increases, duration and timing of flooding) would be expected to negatively affect this species.

Long-hair plume grass (Dichelachne crinita)

Tall, tufted perennial grass to 1.2m high. Flowers October to December. Although the distribution of *D.crinita* within Australia is unclear, in South Australia it has been recorded from the Flinders Ranges, Eyre Peninsula, Northern and Southern Lofty Ranges, Murray Mallee, Yorke Peninsula, Kangaroo Island and South East botanical regions. In the South East, several populations of this species are protected in a number of Parks including Piccaninnie Ponds, Penola, Bangham, Messent and Mary Seymour Conservation Parks. This species is considered to be uncommon in the South East botanical region (Lang and Kraehenbuehl 1997).

As this species was recorded from TS0301 and TS1301 in *M.brevifolia* shrubland, changes to the flow regime may be expected to negatively affect this species.

Sword mat-rush (Lomandra sororia)

A small perennial herb with leaves to 40 cm high and clusters of yellow flowers on a number of branched spikes. This species has been recorded from Victoria and South Australia where it has been recorded from the Northern and Southern Lofty Ranges, and Murray Mallee botanical regions. This species is considered to be **uncommon** at the state level and **rare** in the South East (Lang and Kraehenbuehl 1997).

As this species was recorded at TS0901 situated on a sandy rise some distance from the proposed drain route, the drain should not affect this species.

Creeping boobialla (Myoporum parvifolium)

A prostrate, mat-forming shrub less than 0.1 m high. It flowers mainly in October to March. Elsewhere in Australia it occurs in Victoria, but within South Australia, it is also recorded from Eyre Peninsula, Murray Mallee, Yorke Peninsula, Southern Lofty, Kangaroo Island botanical regions.

It is listed as **rare** for South Australia and the South East in Lang and Kraehenbuehl (1997). The plant was recorded opportunistically during the survey from the edges of the flats within Martin Washpool CP. Diverting water along the watercourse is therefore expected to negatively affect this species.

Austral adder's-tongue (Ophioglossum lusitanicum)

Small herb about 5cm high, occurring in all Australian states, New Zealand and all botanical regions of South Australia. Not recorded in this survey, the plant was collected from *Allocasuarina verticillata* low woodland during the South East Flora Survey, 1991. Lang and Kraehenbuehl (1997) list the species as **uncommon** for the South East.

As the species occurs on the terrestrial limestone ridge, it is not expected to be adversely affected by diversion of water along the watercourse.

Grey copper-wire daisy (Podolepis canescens)

Annual, erect herb 6 to 80 cm high. Flowers May to November. This species is widely distributed, being recorded from all mainland states including the Northern Territory. In South Australia *P.canescens* has been collected from all botanical regions except Kangaroo Island, and in the South East it has been recorded from Messent and Gum Lagoon Conservation Parks. In Tilley Swamp, several small populations were recorded from open grassy areas on the low lying flats.

This species is considered to be **rare** in the South East (Lang and Kraehenbuehl 1997). During the survey, this species was recorded opportunistically on herbaceous flats in between the *M.halmaturorum* plant communities in the Morella Basin and western edges of Martin Washpool CP. Consequently, changes to the local hydrology can be expected to adversely affect this species.

Feather bush-pea (Pultenaea vestita)

A small shrub up to 1m high. Flowers from November to January and has been recorded from Victoria, Western Australia, and from the Yorke Peninsula, Kangaroo Island and South East botanical regions of South Australia.

P.vestita remains poorly conserved in the reserve system. Populations of this species have only been recorded from Gum Lagoon and Messent Conservation Parks and from one Heritage Agreement within the South East botanical region. The small population recorded opportunistically during this survey within the *Melaleuca brevifolia* shrubland in Tilley Swamp Conservation Park, represents a new record for the Park. This species is considered to be **uncommon** at the state level and **rare** in the South East (Lang and Kraehenbuehl 1997).

As this species exists in the Tilley Swamp watercourse, changes to flow regime (salinity increases, duration and timing of flooding) would negatively affect this species. In addition, any widening of the existing drain (as proposed in the Drainage Strategy) would result in the destruction of some of this population.

Squarrose fireweed (Senecio squarrosus)

An erect, perennial herb, 30-40 cm high that flowers between December and March. This species has been

recorded from New South Wales, Victoria, Tasmania and South Australia. In South Australia, *S.squarrosus* has been recorded from the Southern Lofty and South East botanical regions. This species remains relatively well conserved, with populations being recorded from several Conservation Parks and Heritage Agreements within the South East. During the present survey, *S.squarrosus* was only recorded as occurring sparsely through the low lying *Melaleuca halmaturorum* and *Melaleuca brevifolia* plant communities (TS0401, and opportunistically) occurring along the watercourse. This species is considered to be **uncommon** at the state level and in the South East (Lang and Kraehenbuehl 1997).

As the species was recorded in the watercourse, changes to flow regime (salinity increases, duration and timing of flooding) are expected to negatively affect this species.

Silky wilsonia (Wilsonia humilis var. humilis)

A prostrate, slender, much-branched perennial shrub which flowers from September to December. Silky wilsonia has a wide distribution across Australia including Western Australia, South Australia, Victoria and Tasmania. In South Australia this species has been recorded from the Lake Eyre, Nullarbor, Eyre and Yorke Peninsulas, Southern Lofty, Kangaroo Island and South East botanical regions.

In the South East it is typically recorded on the watercourses of the Upper South East, and has been collected from Messent and Gum Lagoon Conservation Parks. This species is considered to be **uncommon** at the state level and in the South East (Lang and Kraehenbuehl 1997).

During the survey, the species was recorded from TS0101, TS1001, and TS1101. As this species was recorded from the watercourse and the Morella Basin (Figs 2 and 4) changes to flow regime (salinity increases, duration and timing of flooding) are expected to negatively affect this species.

Rare Plant Communities

Of the ten vegetation communities defined in this report, two are of conservation significance. Croft and Carpenter (1996) recognise *Melaleuca halmaturorum* low open forest (Table 1) as **rare** in the South East, and *Allocasuarina verticillata* low woodland as **vulnerable**. Of these, only the former community is expected to be negatively affected by the drainage. This plant community occurs on the south western corner of Martin Washpool Conservation Park. Currently predicted volumes of water planned to be ponded in the Morella basin, and the amount of time it is expected to remain may drown the *M.halmaturorum* low open forest. *M.halmaturorum* requires a drying period every three years, and does not survive well when its roots are permanently under water (Mensforth and Walker 1996).

Potential presence of Other Threatened Species

Metallic Sun-orchid (Thelymitra epipactoides)

Although not recorded during the present survey, this nationally **endangered** species has been recorded from several Conservation Parks adjacent to Tilley Swamp including Messent, and Gum Lagoon (Owens *et al* 1995a, Davies unpublished data 1995) and was recorded during the South East Floristic Survey 1991 from *Eucalyptus fasciculosa* woodland within Tilley Swamp CP.

T.epipactoides is a robust orchid to 50cm high, which flowers between August and November. In South Australia, this species has been recorded from Eyre Peninsula, Murray Mallee and Southern Lofty botanical regions, and also in Victoria.

As the site where this species was recorded from was located on a ridge above the watercourse, diversion of water along the watercourse is expected to have minimal or no impact on this species.

Table 4Floristic plant communities recorded in the Tilley Swamp study area, December 1996.

Plant communities associated with calcareous ridges.

1. *Eucalyptus leucoxylon var. stephaniae* woodland OVER sparse *Acacia longifolia* var *sophorae* OVER mid dense to sparse *Xanthorrhoea caespitosa*, *Vittadinia gracilis* (on better developed sandy loams on calcrete).

2. *Eucalyptus fasciculosa* open woodland OVER very sparse *Lepidosperma congestum* (on better developed sandy loams on calcrete).

3. *Allocasuarina verticillata* low open woodland OVER very sparse *Acacia longifolia* var *sophorae* (with and without, *Bursaria spinosa*, *Pteridium esculentum*) (on sandy loams on calcrete).

4. Eucalyptus diversifolia open scrub OVER very sparse Calytrix tetragona, Thomasia petalocalyx,

Hibbertia riparia (at the base of calcareous ridges adjoining swamp vegetation)

Plant community associated with sandy rises

5. Banksia ornata shrubland with emergent Eucalyptus arenacea OVER a mid-dense heath understorey of Leptospermum myrsinoides, Allocasurina mackliniana, Xanthorrhoea caespitosa, Phyllota pleurandroides, and Calytrix alpestris on deep sand.

Intergrading plant communities subject to seasonal waterlogging or inundation

6. Melaleuca brevifolia shrubland with emergent Banksia marginata and Ghania filum OVER a low shrub layer of Darwinia micropetala, Lasiopetalum baueri, and Pimelea glauca (less saline areas subject to less frequent and prolonged flooding).

7. *Melaleuca halmaturorum* tall shrubland OVER a sparse low shrub layer of *Halosarcia pergranulata* ssp *pergranulata* and *Sarcocornia quinqueflora* over a herbaceous species (areas of the watercourse).

8. *Melaleuca halmaturorum* low open forest OVER a very sparse mid-shrub layer of *Rhagodia candolleana* ssp *candolleana*, and *Leucopogon parviflorus* (areas of the watercourse).

9. Selleria radicans herbland

10. **Samphire low shrubland** (areas of shallow standing water)



Figure 6. TS0101. Samphire low shrubland. Photo. H.Stewart



Figure 7. TS0201 *Banksia ornata* open heath. Photo. H.Stewart



Figure 8. TS0301. *Eucalyptus diversifolia* open scrub. Photo. H.Stewart



Figure 9. TS0401 *Melaleuca brevifolia* open heath. Photo. H.Stewart



Figure 10. TS0501. *Eucalyptus arenacea* low open woodland. Photo. H.Stewart



Figure 11. TS0601 *Eucalyptus fasciculosa* open woodland. Photo. H.Stewart



Figure 12. TS0701. *Allocasuarina verticillata* low open woodland. Photo. H.Stewart



Figure 13. TS0801 *Melaleuca halmaturorum* low open forest. Photo. H.Stewart



Figure 14. TS0901. *Eucalyptus diversifolia* open scrub. Photo. H.Stewart



Figure 15. TS1001 *Melaleuca halmaturorum* shrubland. Photo. H.Stewart



Figure 16. TS1101 *Melaleuca halmaturorum* open scrub. Photo. H.Stewart



Figure 17. TS1201 *Eucalyptus arenacea* low open woodland. Photo. H.Stewart



Figure 18. TS1301 *Melaleuca brevifolia* low open heath. Photo. H.Stewart



Figure 19 TS1401 *Melaleuca halmaturorum* open scrub. Photo. H.Stewart



Figure 20. TS1501 *Allocasuarina verticillata* low open woodland. Photo. H.Stewart



Figure 21. TS1601 *Eucalyptus leucoxylon var. stephaniae* woodland. Photo. H.Stewart

MAMMALS

Most of the previous biological research undertaken in Tilley Swamp, has concentrated on vegetation or avifauna. This survey represents the first systematic mammal trapping in the study area.

A total of nineteen species (eight introduced) of mammal were recorded during the survey, of which only one species was considered **vulnerable** and one species considered **rare** (*NPW Act, 1972*, Kemper and Queale 1990, Croft and Carpenter 1996) (Appendix III). Although few in number, this is to be expected considering that few endangered South East mammal species (eg. Brush-tailed Phascogale, Feather-tail Glider, Sugar Glider, and Yellow Bellied Glider) occur this far north (Croft and Carpenter 1996).

Species of Particular Interest

Vulnerable Species

Common Wombat (Vombatus ursinus)

The Common Wombat is a nocturnal burrowing herbivore distributed from the northern border of New South Wales, south along the temperate coast to Salt Creek in South Australia. The population in Martin Washpool Conservation Park exists on the most north western part of their distribution. Although, this species has been undergoing a reduction in distribution since the Pleistocene, European settlement has exacerbated this decrease (Mc Ilroy 1995). Presently, in the south east of South Australia the Common Wombat exists in isolated populations on the eastern sides of dunes where sufficient cover, and perennial native grasses exist (Croft and Carpenter 1996, Owens et al. 1995a). Although the Common Wombat is considered to be **common** at the national level, it is listed as vulnerable in the National Parks and Wildlife Act (1972) in South Australia and in the South East (Kemper and Queale 1990, Croft and Carpenter 1996).

The Common Wombat remains moderately conserved within the Reserve system being recorded from seven Conservation Parks, two National Parks, five PISA Forestry Reserves and at least one Heritage Agreement area in the South East in the last ten years (Results taken from the South Coast Biological Survey 1982-86, and the South East Biological Survey 1997). The Tilly Swamp population is also thought to be on the western edge of the species distribution.

Evidence of Wombats were observed at nine of the sixteen fauna sampling sites, being recorded in Martin Washpool and Tilley Swamp Conservation Parks, 'Safari' Heritage Agreement and on Pitlochary station (Appendix III, and Fig. 2). Construction of a surface water drain may impact on this species if the drain causes the destruction of the Wombats burrows, or by flooding of their food supply (eg flats containing perennial grasses).

Common Wombats have been known to investigate and turnover disturbed soil. Drain design and maintenance will need to take into consideration the potential for the Common Wombat to dig/burrow any disturbed soil associated with drain construction.

Red-necked Wallaby (Macropus rufogresius)

The Red-necked Wallaby has a wide distribution from southern Queensland through the temperate east coast of Australia to the south east of South Australia and Tasmania. At a national level this species is considered to be **common** with a distribution that has remained largely unchanged since European settlement (Calaby 1983). However, this is not the case in the South East, as the distribution of this species has markedly declined since European settlement and now only exists in the larger remnants of native scrub left uncleared for agriculture (Aitken 1983, Best and Croft 1995). At a state level, and in the South East M.rufogresius is considered to be rare (NPW Act 1972, Kemper and Queale 1990, Croft and Carpenter 1996). Populations of the Red-necked Wallaby have been recorded from Fairview, Bangham and Big Heath Conservation Parks, at Kingston, in the "Deepwater" property, and at Deep Swamp (Owens et al 1995a, Stewart 1996).

In the present survey, the Red-necked Wallaby was only recorded at TS0301 in Martin Washpool Conservation Park. However, this species is probably more abundant in the study area than the results of this survey show. This population is also at the most western limit of the species distribution.

The Red-necked Wallaby may be negatively impacted if the drain presents a barrier to the free movement of individuals within the population, particularly where drain construction is required in Martin Washpool Conservation Park. A deep and wide drain may separate the population, thereby further limiting the size of the reproductive population, and ultimately their long term viability.

Uncommon Species

Little Pygmy-possum (Cercartetus lepidus) (Fig. 22)

The Little Pygmy-possum is a small nocturnal inhabitant of open heath, open scrub and low woodland with a dense understorey. This species has a wide but disjunct distribution including Tasmania, Kangaroo Island and in a small area in the south east of South Australia. *C.lepidus* has been recorded from a number of Conservation Parks in the South East, including Messent (Owens *et al.* 1995a), Fairview, Big Heath and Mt Scott (from the South Australian Biodiversity Database) (Fig. 1). Although this species is considered to be nationally **common**, the Little Pygmy-possum is considered to be **uncommon** (Watts 1990) or **rare** in the South East (Croft and Carpenter 1996).

C.lepidus was only recorded from three sites (TS0201, TS0301, and TS0501) during the survey, all of which were in Martin Washpool Conservation Park (Appendix II). All of these sites were elevated, and therefore drain construction should not affect the local distribution of this species.

Silky Mouse (Pseudomys apodemoides)

The Silky-mouse is an inhabitant of the dry mallee heathlands of north western Victoria, and eastern South Australia (Cockburn 1981). The presence of this species is usually conspicuous because of the large spoil heaps created during burrow construction. This species has been recorded from a number of Conservation Parks including Ngarkat, Mt Scott and Fairview. A solitary pregnant *P.apodemoides* was captured at TS0501 (*E.arenacea* low open woodland). As this site is a considerable distance from the proposed drain, and occurs on a sand dune, the drain should not affect this species.

Other Species Captured During the Survey

Several other native mammal species were captured or observed during the survey. These included the Shortbeaked Echidna (*Tachyglossus aculeatus*) (Fig. 23), Western Grey Kangaroo (*Macropus fuliginosus*), Western Pygmy-possum (*Cercartetus concinnus*), Chocolate-wattled Bat (*Chalinolobus morio*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*), King River Eptesicus (*Vespadelus regulus*) and the Little Forest Eptesicus (*Vespadelus vulturnus*). All of these species are classified as **common** in *the NPWS Act*, 1972, as well as at the state level and in the South East except for the King River Eptesicus which is considered to be **rare** in the South East (Kemper and Queale 1990, Croft and Carpenter 1996).

In addition to the above, eight species of introduced mammals were recorded during this survey. These include the Red Fox (*Vulpes vulpes*), Feral Cat (*Felis catus*), Fallow Deer (*Cervus dama*), Goat (*Capra hircus*), Cattle (*Bos taurus*), Rabbit (*Oryctolagus cuninculus*), Hare (*Lepus capensis*) and House Mouse (*Mus domesticus*).

Construction of a drain through the study area may also negatively impact on the native small mammal fauna as it will provide improved access for introduced predators to hunt them (May and Norton 1996).


Figure 22. Little Pygmy Possum (*Cercartetus lepidus*). Recorded from three sites in Martin Washpool CP, this uncommon species is unlikely to be affected by the proposed drains. Photo. PD Canty.



Figure 23. Echidna (*Tachyglossus aculateus*). This species was recorded from several sites during the survey, but is not thought to be affected by the proposed drains. Photo. Dept. Environment and Heritage

Tilley Swamp Biological Survey

BIRDS

The avifauna of Tilley Swamp has received attention since the early 1930's when Salt Creek formed the focus of ornithological surveys into the "Freshwater Lakes" of Alf Flat (in the Messent area), and the study area (Hanks 1930, Sutton 1930, 1933). Further information on the avifauna of Tilley swamp has been collected by several authors including the Royal Australasian Ornithological Union from 1977 to 1981, Jaensch & Auricht (1989) who surveyed waterbirds in Tilley Swamp and G.Carpenter who recorded bird species as part of the native vegetation assessments of Heritage Agreements on "Safari Park" and Tilley Swamp Conservation Park (Figs 2 and 4) on 22-23/5/86 and 21/7/87 respectively, and of Tilley Swamp (about 1 km south of Site TS1101) on 23 December 1981 (Appendix IIIa). The latter report provided valuable information on the importance of the study area to waterbirds during flood years. Of particular interest was the breeding of the Painted Snipe, a rarely reported species, and the count of almost 3000 waterbirds of 21 species.

The present survey recorded 107 species, including 84 from the survey sites and five introduced species (Appendix III). Of these, twenty six species of conservation significance were recorded (Table 5). These include one nationally **vulnerable** species, six species considered to be **vulnerable** in South Australia and in the South East, five species considered to be of **rare** or **unknown** conservation status in South Australia and the South East, thirteen species considered to be either **uncommon** or **vulnerable** in South Australia and the South East, and one species considered to be **endangered** in the South East. These conservation ratings follow Carpenter and Reid (1988) and the National Parks and Wildlife Act 1972.

Species of Particular Interest

Vulnerable

Malleefowl (Lepoia ocellata) (Fig. 24)

The Malleefowl is sparsely but widely distributed in mallee and adjacent low woodlands across southern Australia. Its distribution has declined extensively due to introduced predators, land clearance for agriculture and introduced grazing animals (Blakers *et al.* 1984).

Malleefowl occur in small numbers within the study area, being observed in *E. fasciculosa* low woodland at TS0601 and in nearby mallee habitats in and adjacent to Martin's Washpool Conservation Park. Malleefowl are no longer known to occur in the nearby Messent Conservation Park (Owens *et al.* 1995), but occur to the east and west in the Coorong National Park and Gum Lagoon Conservation Park. Close (1981) found at least five mounds in Martin's Washpool Conservation Park in April 1981.

As Malleefowl are known to forage over a range of habitats, including lower-lying areas of *Melaleuca halmaturorum* shrubland in the South-East (Possingham 1983, Stewart 1996), they may be affected by the clearance associated with the construction of a drain and any subsequent indirect effects on native vegetation.

Blue-winged Parrot (Neophema chrysostoma)

The Blue-winged Parrot is a mobile and poorly known species which breeds in a limited area of south-eastern Australia and disperses widely into the inland during autumn-winter (Blakers *et al.* 1984). In South Australia it breeds in stringybark forests in the South East north to about Naracoorte. In winter it disperses widely as far as the north-east of the State, with concentrations in the saltmarshes and dunes along the South East and Coorong coast.

The species probably does not breed in the study area, occurring only as a post-breeding visitor in small numbers. During the survey birds were seen flying over only, thus no information on habitats used in the study area were obtained.

Latham's Snipe (Gallinago hardwickii)

Latham's Snipe is a non-breeding summer (October -February) visitor to Australia mostly from Japan. This species frequents ephemeral and permanent freshwater swamps with dense sedges and adjacent shelter, especially red gum and teatree swamps in the South East, River Murray and Murray Lakes. Areas of flooded grasses and samphire adjacent the Murray Lakes occasionally support large numbers. In South Australia numbers have declined, probably due to clearance and drainage of wetlands (Naardang 1983), and historically because of hunting.

The study area would provide habitat for small numbers in late spring-early summer when the wetlands fill, especially areas of flooded *Melaleuca brevifolia* open heath where dense cover is available.

Latham's Snipe would be adversely affected by the loss of fresher wetland habitats in the study area. Conversely, if the proposed drain retained relatively fresh water into the summer months (with adjacent cover), it may extend the duration of suitable wetland habitat for this species in the study area.

Painted Button-quail (Turnix varia)

A sparsely but widely distributed mobile species which occupies a range of Eucalypt associations across southern Australia, wherever leaf litter is prominent. It has declined generally due to clearance and grazing of woodland habitats (Blakers *et al.* 1984).

Although secretive, this species' presence is revealed by numerous circular clearings of 10-15 cm diameter in the leaf litter, usually exposing bare ground. Although recorded at only one site (*E. diversifolia* open scrub at TS0301) the species is likely at times to be sparsely distributed throughout mallee and woodland associations within the study area. Close (1981) recorded it in pasture with mallee adjacent Martin's Washpool CP in April 1981.

As the species is generally associated with Eucalypt dominated habitats and is capable of dispersing widely, it is unlikely to be affected by the proposed drain.

Rufous Bristlebird (Dasyornis broadbenti) (Fig. 25).

The Rufous Bristlebird is a secretive ground-frequenting inhabitant of coastal scrubs in western and southern Australia. The Western Australian subspecies is probably extinct (Blakers *et al.* 1984) while the eastern population is threatened by its limited distribution, development of coastal habitats, introduced predators and slow reproductive rate.

In South Australia the species is locally **common** in extensive areas of dense coastal scrubs (*Acacia longifolia* var. *sophorae*, *Myoporum insulare*, *Leucopogon parviflorus*, *Lepidosperma gladiatum*), rarely extending inland into sub-coastal Drooping sheoak *Allocasuarina verticillata* low woodlands (especially where *A. longifolia* occurs in the understorey) and Swamp paperbark *Melaleuca halmaturorum* and *M. brevifolia* shrublands (e.g. Martin's Washpool - Tilley Swamp district). The subcoastal populations are threatened by isolation and fire (e.g. the population at Messent Conservation Park has not been reported since an extensive fire in 1979).

Rufous Bristlebirds were recorded at four sites (TS0501, TS0701, TS1301 and TS1501) during the survey; in the understorey of *Allocasuarina verticillata* low woodland, (where *Acacia longifolia* var. *sophorae* and *Isolepis nodosa* were prominent), and nearby in areas of *Melaleuca brevifolia* open heath (usually with taller areas of dense *M. halmaturorum* and *Gahnia filum*). The latter is a new habitat confirmed for the species in South Australia, and is very different to its normal dune habitat along the Coorong and South East coasts.

This species is likely to be adversely affected by the proposed drain through clearance of habitat. It is not known whether the drain would physically impede the species' dispersal, and may need further monitoring in the drain proceeds.

Yellow-tailed Black-Cockatoo (Calyptorhynchus funereus)

This large distinctive cockatoo occurs as a non-breeding mostly winter visitor to the study area, where it feeds

primarily on the flowers (and seeds) of *Banksia ornata* and possibly *B. marginata*, as well as the seeds of *Pinus* spp. in adjacent agricultural land. The species is threatened in many areas due to the lack of suitable breeding habitat, large, hollow bearing Eucalypts with feeding areas nearby.

A small flock was recorded in *Eucalyptus arenacea* low open woodland at site TS0501. The species is unlikely to be affected by the proposed drain.

Indeterminate Species

Elegant Parrot (Neophema elegans)

Like the Blue-winged Parrot, the Elegant Parrot is a poorly known mobile species which is distributed in southern and western Australia. In South Australia it occurs mostly in woodlands and low open forests, dispersing into coastal and inland habitats during winter. In the field it is easily confused with the Blue-winged Parrot, especially when not seen clearly (e.g. flying overhead).

During the survey it was recorded opportunistically flying overhead at Tilley Swamp Conservation Park. It is unlikely that the survey area would provide an important habitat for the species, although Sutton (1930) reported a nest with young in a Eucalypt hollow near Salt Creek which may have been of this species.

Rare Species

Beautiful Firetail (Emblema bellum)

This finch inhabits coastal and subcoastal scrubs and low open forests throughout south-eastern Australia and has declined due to clearance and introduced predators. It feeds mostly on the seeds of a variety of native sedges (Read 1994).

During the survey the Beautiful Firetail was recorded from three sites (TS0401, TS0901 and TS1601) in a range of habitats, with largest numbers associated with larger areas of *Melaleuca brevifolia* open heaths and adjacent *M. halmaturorum* shrublands. Clearance of these habitats caused by the construction of the proposed drain would adversely affect this species.

Australasian (Blue-winged) Shoveler (*Anas rhynchotis*)

This duck occurs throughout wetlands in south-eastern Australia and has declined generally with the drainage of swamps and lack of suitable flooding events to trigger breeding. Relatively large numbers may occur in the study area during floods, with areas of temporarily flooded *Melaleuca brevifolia* open heath providing suitable breeding habitat.

During the survey five birds were recorded opportunistically in a shallow ephemeral wetland immediately north of Tilley Swamp Conservation Park. Further deterioration of wetland habitats in the study area would adversely affect this species.

Shining Bronze Cuckoo (Chrysococcyx lucidus)

An elusive species generally confined to the canopy of open forests. Adults were observed in *Allocasuarina verticillata* low woodland at sites TS0701 and TS1001 during the survey, possibly on migration from its normal breeding habitat; stringybark, sugar gum and *E. viminalis* woodlands and open forests in the wetter parts of the Mount Lofty Ranges and South East.

Although the species has been recorded breeding near Salt Creek (Sutton 1933), the survey area would not be considered to provide an important breeding habitat for the species, but may be important during migration. It is unlikely that the proposed drain would adversely affect this species.

Southern Emu-wren (Stipiturus malachurus) (Fig. 26).

A small secretive species which has declined in many areas due to drainage and clearance of habitat and introduced predators. It is widely distributed in wet heaths throughout southern Australia. In the study area it occurs in undisturbed areas of both sandy heath (*Banksia ornata* - Xanthorrhoea caespitosa - Leptospermum myrsinoides) and wet heath (*Melaleuca brevifolia - Darwinia* micropetala - Gahnia filum).

During the survey the Southern Emu-wren was recorded from sites TS0501 and TS1301, in the dense understorey of *E. arenacea* low open woodland and *Melaleuca*. *brevifolia* open heath respectively.

Due to the emu-wren's apparent limited dispersive ability (Schodde 1982, T.Littley & J.Cutten pers. comm.), drain construction and dieback of *M. brevifolia* open heaths would adversely affect this species.

Species of high conservation significance previously recorded in the study area

Painted Snipe (Rostratula benghalensis)

The Painted Snipe is a rarely reported mobile species which is considered **vulnerable** in South Australia. During December 1981 this species was found nesting by R.Jaensch and others in flooded *Melaleuca halmaturorum* open shrubland about 1 km south of site TS1101.

Blue-billed Duck (Oxyura australis)

The Blue-billed Duck is a **rare** and poorly known species which in South Australia occurs mainly in the South East. It breeds in deeper waters with dense cover, especially tea-tree and *Gahnia* swamps (Parker *et al.* 1985). Jaensch & Auricht (1989) found two nests attributed to this species about 1 km south of site TS1101 in December 1981.

Rose Robin (Petroica rosea)

Rose Robins breed in the wetter forests of south-eastern Australia and disperse into drier woodland and open forest habitats during winter. In South Australia it occurs as a rare non-breeding visitor, mostly to the southern Mount Lofty Ranges. One individual was recorded at Martin's Washpool Conservation Park in July 1981 (May 1981), possibly on migration.

Slender-billed Thornbill (Acanthiza iredalei hedleyi)

The subspecies *A.i.hedleyi* "Dark Thornbill" is sparsely distributed in low heath habitats in the southern Murray Mallee and has recently been recorded in the South East as far south as Naracoorte (Possingham 1983, Parker 1985), where it occurs in low *Melaleuca brevifolia* and *Darwinia micropetala* open heaths. Parker (1985) suggested that the low heaths they inhabit may have been colonised following extensive drainage of more permanent wetlands in the region.

It is likely to occur in the study area because it is known to occur in similar habitats nearby in Messent Conservation Park (Owens *et al.* 1995), Gum Lagoon Conservation Park (Possingham 1983) and Deep Swamp (Stewart *et al.* 1997).

This species is likely to be affected by the clearance associated with the drain, and further assessment is required to determine whether indirect impacts of the drainage works would adversely affect its conservation status in the region (Matthew 1994).

Grey-crowned Babbler (Pomatostomus temporalis)

Sutton (1930, 1933) recorded this species during visits to Salt Creek in October of 1929 and 1932, including two nests on the latter visit. Now virtually extinct in South Australia, the Greycrowned Babbler once inhabited the Sheoak woodlands in the district (Parker & Reid 1983).

Blue Bonnet (*Northiella haematogaster*)

May (1981) also reported a pair of Blue Bonnets 1 km east of Salt Creek in July 1981, a **rare** species in the South East region (Carpenter & Reid 1988).

Southern Whiteface (Aphelocephala leucopsis)

Sutton (1933) reported seven birds near Salt Creek in October 1932. This species is now **endangered** in the South East (Parker & Reid 1983, Carpenter & Reid 1988).

White-winged Chough (Corcorax melanorhamphos)

Sutton (1933) recorded a flock of White-winged Choughs near a lake inland from Salt Creek, and Condon in Sutton (1936) reported a group of Whitewinged Choughs "near Tilley's Swamp" on 22 September 1935. This species no longer occurs in the district and is considered **vulnerable** in South Australia (Carpenter & Reid 1988).

Striped Honeyeater (Plectorhyncha lanceolata)

Sutton (1930) included this species in a list of birds seen at Salt Creek and district in October 1929. This

vulnerable species is unlikely to still occur in the study area.

Other species of interest

Purple-gaped Honeyeater (Lichenostomus cratitius)

The Purple-gaped Honeyeater is an **uncommon** species in South Australia occurring in a variety of mallee-heath habitats. The study area is close to its southern limit of distribution in South Australia, and the species is regarded as **rare** in the South East (Carpenter & Reid 1984).

In the study area it was reported in small numbers from site TS0301 in *E. diversifolia* open scrub.

Peaceful Dove (Geopelia placida)

The Peaceful Dove is a widely distributed woodland species whose range has declined in the wetter parts of South Australia, especially the South East and Mount Lofty Ranges. In the South East it is now considered **endangered** through loss of habitat (Parker & Reid 1983, Carpenter & Reid 1988).

During the survey small numbers of Peaceful Doves were recorded in *Allocasuarina verticillata* low woodland at TS0701, and opportunistically around "Morella" homestead. The drain is not expected to affect this species.

Yellow Thornbill (Acanthiza nana)

The Yellow Thornbill is a small arboreal species which occurs in wetter woodlands, especially those not dominated by Eucalypts (e.g. *Allocasuarina* spp., *Callitris* sp., *Melaleuca halmaturorum*). It is considered **uncommon** in South Australia and **rare** in the South East, mainly due to the scarcity of suitable habitats (Carpenter & Reid 1988).

During the survey Yellow Thornbills were recorded at sites TS0701 and TS1501 in *Allocasuarina verticillata* low woodland. It is unlikely that the drain will affect these habitats, and therefore, the Yellow Thornbill should not be affected.

Brown and Inland Thornbills (*Acanthiza pusilla* and *apicalis*)

Although not considered of conservation significance, these two closely related taxa are of scientific interest because they overlap and probably interbreed in the study area, rendering accurate identification difficult (Boles 1983). A morphological and genetic study of specimens from the area is required.

Table 5. Birds of conservation significance recorded during the Tilley Swamp Biological Survey, December 1996.

COMMON NAME	SCIENTIFIC NAME	FAMILY	^{+}A	*SA	#SA	*SE
Malleefowl	Leipoa ocellata	MEGAPODIDAE	V	V	Е	V
Blue-winged Parrot	Neophema chrysostoma	PSITTACIDAE		V	V	V
Latham's Snipe	Gallinago hardwickii	SCOLOPACIDAE		V	V	V
Painted Button-quail	Turnix varia	TURNICIDAE		V	V	V
Rufous Bristlebird	Dasyornis broadbenti	DASYORNITHIDAE		V	V	V
Slender-billed Thornbill	Acanthiza iredalei	ACANTHIZIDAE		V	V	V
Yellow-tailed Black-cockatoo	Calyptorhynchus funereus	PSITTACIDAE		V	V	V
Elegant Parrot	Neophema elegans	PSITTACIDAE		Κ	Κ	Κ
Beautiful Firetail	Emblema bellum	PASSERIDAE		R	V	R
Shining Bronze-cuckoo	Chrysococcyx lucidus	CUCULIDAE		R	R	R
Southern Emu-wren	Stipiturus malachurus	MALURIDAE		R	V	R
Australasian Shoveler	Anas rhynchotis	ANATIDAE		R	R	R
Blue-billed Duck	Oxyura australis	ANATIDAE		R	R	R
Purple-gaped Honeyeater	Lichenostomus cratitius	MELIPHAGIDAE		U		R
Australian Hobby	Falco longipennis	FALCONIDAE		U		U
Brush Bronzewing	Phaps elegans	COLUMBIDAE		U		U
Chestnut Teal	Anas castanea	ANATIDAE		U		U
Eastern Yellow Robin	Eopsaltria australis	EOPSALTRIIDAE		U		U
Grey Currawong	Strepera versicolor	CORVIDAE		U		U
Hardhead	Aythya australasica	ANATIDAE		U		U
Mallee Ringneck	Barnardius barnardi	PSITTACIDAE		U		U
Musk Duck	Biziura lobata	ANATIDAE		U	V	U
Shy Heathwren	Sericornis cautus	ACANTHIZIDAE		U	V	U
Southern Scrub-robin	Drymodes brunneopygia	EOPSALTRIIDAE		U		U
Tawny-crowned Honeyeater	Phylidonyris melanops	MELIPHAGIDAE		U		U
Yellow-rumped Pardalote	Pardalotus xanthopygus	PARDALOTIDAE		U	V	U
Peaceful Dove	Geopelia placida	COLUMBIDAE		С		Е

⁺ Conservation significance according to the Schedules of the Commonwealth Endangered Species Act 1992.
* Conservation significance after Carpenter & Reid (1988)
Conservation significance according to the Schedules of the SA National Parks & Wildlife Act 1972.



Figure 24. Malleefowl (*Leipoa ocellata*). This nationally vulnerable species was recorded from TS0601 (*Eucalyptus fasciculosa* open woodland) and opportunistically in *E.diversifolia* open scrub in Martin Washpool CP and Stoneleigh Park Heritage Agreement. Photo. Lynn Pedler

Figure 25. Rufous Bristlebird (*Dasyornis broadbenti*). This vulnerable species was recorded at TS0501, TS0701, TS1301 and TS1501. Photo. Lynn Pedler



Figure 26. Southern Emu-wren (*Stipiturus malachurus*). Recorded from sites TS0501, and TS1301, in the dense understorey of *Eucalyptus arenacea* low open woodland, and *Melaleuca brevifolia* open heath. This rare bird will potentially be affected by the drainage scheme. Photo. Deb Hopton

Tilley Swamp Biological Survey

REPTILES AND AMPHIBIANS

Prior to this survey, little was known about the herpetofauna of Tilley Swamp. Only a single specimen from the watercourse had been lodged with the South Australian Museum, and no species lists had been made for either Martin Washpool or Tilley Swamp Conservation Parks. Currently there are 17 species of reptile and amphibian known to inhabit the area (Appendix IV), consisting of eight skinks, two dragons, two elapid snakes, one legless lizard, and four species of frog. None of these species have been assigned any conservation significance (Edwards and Tyler 1990, Cogger *et al.* 1993).

A range of commonly occurring reptiles found in the Tilley Swamp study area are shown in Figures 27 - 30.

The most abundant species captured included the small skinks, particularly *Lerista bougainvilli, Morethia obscura* and *Lampropholis delicata*. Relatively cool weather conditions during the second week of trapping is likely to have influenced the trap success for reptiles and the relatively dry conditions at this time of the year may have also been less favourable for trapping. Light rain did prove beneficial in the capture of three species of frog.

All of the reptile and amphibian species captured during this survey are considered relatively **common**, and robust in their response to disturbance. No species are expected to become locally extinct or affected by any proposed drainage.

Other Species Potentially Occurring Within the Tilley Swamp Watercourse.

Although 17 species have been found in the Tilley Swamp watercourse, it is unlikely that all species were detected during the relatively short trapping period. Several other species have been collected from both Messent (Owens *et al.* 1995a) and Gum Lagoon (Unpublished data - Gum Lagoon Biological Survey) Conservation Parks (Figs 1 and 3). These include -*Tympanocryptis lineata, Suta spectabilis, Drysdalia mastersi, Varanus rosenbergi, Pygopus lepidopodus, Litoria ewingii, Limnodynastes tasmaniensis, Pseudophryne bibroni,* and *Chelodina longicollis.*



Figure 27. Spotted Skink (*Ctenotus orientalis* [prev. *uber*]). Photo. NPWSA anon.



Figure 28. Common Bluetongue (*Tiliqua scincoides*) Photo. PD Canty



Figure 29. Common Bearded Dragon (*Pogona vitticeps*) Photo. Tony Robinson NPWSA



Figure 30. Mallee Tree-dragon (Amphibolurus norrisi) Photo. Hafiz Stewart NPWSA

Conclusions and Recommendations

The Tilley Swamp watercourse and surrounding vegetation provides habitat for many populations of flora and fauna of conservation significance. In addition to the 40 taxa (26 species of bird, 11 species of plant and 3 species of mammal) of national and regional conservation significance, and the regionally rare plant community recorded during this survey, a further 14 species of conservation significance have been previously recorded in the study area. These include the nationally endangered Malleefowl, Southern Emu-wren, Bluewinged Parrot, Latham's Snipe, Rufous Bristlebird, as well as habitat for the Metallic sun orchid, the Wedgeleaf daisy, Creeping boobialla and the Slender daisy. The study area also coincides with the north-western limits of distribution of the Red-necked Wallaby and the Common Wombat.

The ornithological survey of areas in Tilley Swamp by Jaensch and Auricht (1981) highlights the "ephemeral" biological importance of Tilley Swamp as a breeding area for migratory wetland birds during times of flood. These patterns are difficult to pick up during a short term biological survey. Relative to the rest of the South East, Tilley Swamp still contains a large area of remnant native vegetation. This adds to the long-term viability of resident populations of fauna and flora, and also provides an important link for the movement of birds between the wetter forested habitats of the South East and the Mount Lofty Ranges.

Clearly, Tilley Swamp is of high conservation significance and worthy of consideration as a wetland of importance in South Australia. Any construction of a drain through this area should be carried out with caution, and minimal biological disturbance.

Drainage Options and their Potential Affect on the Flora and Fauna of the Tilley Swamp watercourse

The construction of a drain through native vegetation negatively affects local flora and fauna in several ways. These include destruction of habitat through clearance and potentially through flooding, modification of habitat through changes to local hydrology and the introduction of weeds and feral pests. In addition, the drain may act as a physical barrier impeding the dispersal of some flora and fauna. Therefore, the flora and fauna of Tilley Swamp potentially most threatened by the proposed drainage options are those species

- existing on or utilising the Tilley Swamp watercourse and/or the Morella Basin
- species associated with the habitat on the edge of the watercourse or Morella Basin
- species with poor dispersive powers
- fauna prone to predation by exotic species (eg. small ground dwelling mammals and birds)
- flora cleared for drain construction and prone to competition with introduced weeds

The degree to which each species is affected will depend on drain design and the ensuing water flow regime.

Several alternative drainage options have been proposed for the Tilley Swamp watercourse as explained in the "Introduction". All proposals utilise the watercourse to transfer water north to the Morella Basin where it will be ponded before release to the Coorong. Each proposal differs in the degree of construction required, the volume and salinity of water to be transported in the watercourse and in the planned duration of ponding in the "Morella Basin".

Table 6 illustrates the potential affects of each drainage option on the biota of Tilley Swamp. The potential affects on each species that may be affected by the drain are delineated by a - sign for negative affects and a + for positive affects and a ? where the affects are not known. Blank spaces in the table imply that the associated species should not be affected by any of the drainage options.

Table 6

Potential affects of the three drainage options proposed for the Tilley Swamp watercourse

Plants				
Common Name	Scientific Name	Option 1	Option 2	Option 3
Slender daisy	Brachycome exilis	-	-	-
Small milkwort	Comesperma polygaloides	-		
Long-hair plume	Dichelachne crinita	-		
grass				
Grey copper-wire	Podalepis canescens	-	-	-
daisy				
Feather bush-pea	Pultenaea vestita	-	?	?
Squarrose fireweed	Senecio squarrosus	-		
Creeping boobialla	Myoporum parvifolium	-	?	
Silky wilsonia	Wilsonia humilis var. humilis	-	-	-

wiammais				
Common Name	Scientific Name	Option 1	Option 2	Option 3
Common Wombat	Vombatus ursinus	-	?	
Red-necked Wallaby	Macropus rufogresius	-	?	

Birds

Mammale

Common Name	Scientific Name	Option 1	Option 2	Option 3
Malleefowl	Leipoa ocellata	-	?	?
Latham's Snipe	Gallinago hardwickii	-		-
Rufous Bristlebird	Dasyornis broadbenti	-	?	
Beautiful Firetail	Emblema bellum	-	?	
Southern Emu-wren	Stipiturus malachurus	-	?	

OPTION 1

This drainage option would see all of the Tilley Swamp watercourse and the Morella Basin under water for substantial periods of time to depths of up to possibly two metres.

This would result in local extinction of the Slender daisy, Grey copper-wire daisy and the Silky wilsonia and may negatively affect populations of Small milkwort, Longhair plume grass, Feather bush-pea, Squarrose fireweed and Creeping boobialla as well as flooding of the regionally rare floristic plant community *Melaleuca halmaturorum* low open-forest on the north western edge of Martin Washpool C P. All of the above plant species are of high conservation significance (Refer to the Results section).

Option 1 would also negatively affect several mammal and bird species through destruction and or modification of wetland habitats (eg. *Melaleuca halmaturorum* and *M.brevifolia* plant communities occurring on the watercourse) and the creation of a physical barrier to the free movement and dispersal of both small and large native mammals, and some small secretive birds.

Although Malleefowl (*Leipoa ocellata*) are known to forage in *M.halmaturorum* low open forest, and much of this plant community is threatened by this option, Malleefowl were only recorded during the survey, in and around Martin Washpool CP which supports little of this habitat. However, there is the potential for individuals not recorded during this survey but using this habitat elsewhere in the watercourse to be negatively affected by the flooding of this habitat. The population of Rufous Bristlebirds recorded at TS1301 in *M.brevifolia* open heath in Tilley Swamp CP was the first time this species was recorded for the Park and in that habitat type. Flooding of this habitat, and the proposed clearance of vegetation in Tilley Swamp CP (Upper South East Dryland Salinity and Flood Management Plan 1993) would negatively affect this species. Given the isolated nature of the population, and the uncertainty as to whether the drain would impede its dispersal ability, monitoring of the populations' abundance would be desirable.

The Southern Emu-wren (*Stipiturus malachurus*) was also recorded in the *M.brevifolia* open heath in Tilley Swamp CP at TS1301. Clearance and flooding of this habitat in Tilley Swamp CP as proposed in the USE Dryland Salinity and Flood Management Plan (1993) would negatively affect the abundance and therefore long term viability of this small and isolated population. This is due to the poor dispersive powers of the Southern Emu-wren and the lack of other suitable habitat for them to colonise. Clearance and flooding of this habitat may lead to the local extinction of this population. Long term monitoring of this population should therefore be undertaken.

Beautiful Firetails were located during the survey in largest numbers in the *M.brevifolia* heaths and

M.halmaturorum shrublands. Clearance of these habitats and deterioration due to flooding will negatively affect this species due to the loss of cover. However, their food source (primarily exotic grass seeds *sensu* Read 1994) should not be affected, and they have been recorded from several other vegetation types not affected by the drainage. Therefore only some of the population would be affected.

Further, salinisation and higher water levels would negatively impact on the visiting Japanese Snipe population.

Extended periods of high inundation in the Tilley Swamp watercourse would also affect the dispersal of the Common Wombat and the Red-necked Wallaby thereby only allowing for the movement of animals in a northsouth direction but separating individuals on the east and west of the watercourse. The populations of Common Wombats and Red-necked Wallabies in the study area are biologically interesting because they exist on the northern and western edge of their ranges, and because their abundance has generally been declining in South Australia. Monitoring of their abundance should therefore be undertaken in the future.

OPTION 2

This Option is designed to facilitate the movement of water generated from a major surface water scheme in the central catchment to the Morella Basin where it would be ponded before periodic release into the Coorong. Option 2 would have similar adverse impacts on the flora of the Morella Basin, and edges of Martin Washpool CP as Option 1, but would not affect the flora and fauna of the upstream watercourse to such a degree. Salinity levels (approx 4000 mg/l) and flooding regimes would be maintained similar to present levels differing only in there being greater volumes of water flowing along the watercourse. Depending on ponding scenarios at Morella Basin, implementation of Option 2 could reduce the periods of inundation along the watercourse due to increased efficiency of drainage. This would result in further drying of the wetland and a successional shift in wetland vegetation. This may result in further domination of M.brevifolia and M.halmaturorum plant communities along the watercourse. The ecological effects of this are unclear at present, and would require long term monitoring to define.

OPTION 3

This Option would utilise the Tilley Swamp watercourse as a high quality wetland, with increases in the area and period of inundation, but maintaining the brackish nature of the water. Option 3 is dependent on the implementation of a surface water scheme in the central catchment and water inflow salinities of 3000 - 6000 mg/l. The increased flows of water would result from excess water not able to be stored in the Watervalley Wetlands. This Option should have minimal impact on the native flora and fauna of the Tilley Swamp watercourse and may enhance the habitat for many water birds including Japanese Snipe. However, similar to the two previous options, increased ponding periods are planned for the Morella Basin which would cause similar impacts to the Basin as explained in Options 1 and 2.

The Preferred Option

Clearly, Option 3 stands out as the preferred option on biological grounds, as it contains no further drain construction in native vegetation and proposes to manage the watercourse to increase the quality of the wetland habitats. Historically, Tilley Swamp would have received greater flows than it presently receives. Changes to the flow regime, so that Tilley Swamp would receive higher volumes of brackish water (and not highly saline water) should enhance the habitat quality of the water course.

Recommendations

Selection of drainage options

- 1. That Option 3 is preferred from a biodiversity conservation perspective.
- 2. If either Option 1 or 2 is selected, that these schemes avoid clearance or flooding of the *Melaleuca brevifolia* open heath at TS1301 in Tilley Swamp CP due to the high number of taxa of conservation significance recorded there during the survey.
- 3. If construction is required, all spoil banks be removed, and precautions taken to minimise the introduction of weeds into patches of remnant vegetation. Any cleared areas would require immediate revegetation with local provenance seed.

Maintenance of wetland habitats and habitat connectivity

- 1. That the water flow regime include provision for the periodic drying of Tilley Swamp watercourse and flushing of the system with fresher water to maintain the *Melaleuca halmaturorum* plant communities. Without this action plant communities may be degraded (Mensforth 1996).
- 2. That a corridor of habitat between Martin Washpool CP and Messent CP be created to facilitate the movement of native flora and fauna between the two areas. This will offset some of the isolation of populations that may occur due to the drainage.

Monitoring of the potential biological impact of the drain

1. In addition to maintaining the collection of data from the biological survey sampling established during this survey for several years post drain construction or modification of water flow to Tilley Swamp, more specific monitoring of populations of flora and fauna of conservation significance should be established and maintained.

- 2. Monitoring should be undertaken to determine the presence and abundance of the Rufous Bristlebird and Southern Emu-wren at site TS1301 in Tilley Swamp CP, as well as the Beautiful Firetail at sites along the watercourse.
- 3. Monitoring for the presence of the wetland plants that exist on Morella Basin is required. These populations are at most risk of becoming locally extinct.
- 4. Monitoring of the levels of heavy metals and contaminants along the length of the watercourse, Morella Basin and Coorong. This may require collection of sediments from the Morella Basin before any works are commenced to establish a baseline against which to determine the rate at which the heavy metals precipitate out of solution.

- 5. Monitoring of water salinity in the watercourse. This will provide better information to improve wetland management.
- The Tilley Swamp watercourse contains a relatively large amount of remnant native vegetation including two Conservation Parks, several Heritage Agreements and substantial amounts of regenerating Melaleuca halmaturorum and M.brevifolia heath on the watercourse. This native vegetation provides habitat for many flora and flora of national and regional conservation significance, and is an important link between areas of native vegetation in the Lower South East and the Mount Lofty Ranges for several bird species. With this in mind the watercourse should be managed as a high quality wetland, with the dual function of being able to transfer saline water to the Coorong, rather than the whole watercourse being used simply as a pondage area for agricultural drainage water.

Resource Material and Bibliography

MAPS

1:250 000 Topographic

Naracoorte	SJ 54-2	1988
1:50 000 Topog	graphic	
Taunta Tilley Swamp Cantara Santo	6825-I 6825-II 6825-III 6825-IV	1982 1983 1984 1983

Floristic Vegetation Map (DTUPA)

AERIAL PHOTOGRAPHS

Naracoorte 1:40 000, Svy 4484 Photos: 0479, 0480, 0481, 0490, 0491, 0554, 0555, 0556, 0557 (11 February 1992).

Naracoorte 1:40 000, Svy 4487 Photos: 0636, 0637, 0638, 0731, 0732, 0733, 0738, 0739, 0740 (16 February 1992).

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Appendices

Appendix I

PLANT SPECIES RECORDED FROM TILLEY SWAMP

Plant taxonomy and nomenclature is in accordance with Jessop (1993). All common names were derived from Jessop and Toelken (1986) and/or the SA Flora database. All species have been listed alphabetically in order of Family. Exotic species have been marked with an asterisk (*). Plants of conservation significance have been labelled. These ratings follow *the National Parks and Wildlife Act (1972)*, and the SA Flora database. Only species of conservation significance were labelled. The following descriptions of conservation significance was taken from Lang and Kraehenbuehl (1997 update).

- X Extinct/Presumed Extinct: not located despite thorough searching of all known and likely habitats; known to have been eliminated by the loss of localised population(s); or not recorded for more than 50 years from an area where substantial habitat modification has occurred.
- **E Endangered**: rare and in danger of becoming extinct in the wild.
- V Vulnerable: rare and at risk from potential threats or long term threats which could cause the species to become endangered in the future.
- T¹ Threatened: likely to be either Endangered or Vulnerable but insufficient data for a more precise assessment.
- R Rare: having a low overall frequency of occurrence: confined to a restricted range or scattered sparsely over a wide area. Not currently exposed to significant threats, but warranting monitoring and protective measures to prevent reduction of population sizes.
- **K Uncertain**: likely to be either Threatened or Rare but insufficient data for a more precise assessment.
- U Uncommon: less common species of interest but

not rare enough to warrant special protective measures.

¹ This category does not appear in the NPWS Act (1972).

Appendix 1

Tilley Swamp Biological Survey

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Appendix II

MAMMAL SPECIES RECORDED FROM TILLEY SWAMP

Mammal taxonomy follows Kemper and Queale (1990).

Introduced species are indicated with an asterisk (*).

The State conservation ratings are shown in bold following the scientific name. These have been taken from Kemper and Queale (1990).

The definition for the status codes are as follows:

E Endangered: taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.

V Vulnerable: taxa believed likely to move into endangered category in the near future if the causal factors continue operating.

R Rare: taxa with small populations in South Australia that are not at present endangered or vulnerable, but are at risk.

In addition two other categories have been used for species not considered at risk (Watts 1990). The definitions for these status codes are as follows:

U Uncommon: taxa occurring in relatively low numbers in South Australia, but not rare.

C Common: the category of greatest abundance; relatively numerous generally, locally and/or seasonally. (Local abundance applies to species with restricted distribution.)

Appendix 2

Tilley Swamp Biological Survey

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Appendix III

BIRD SPECIES RECORDED FROM TILLEY SWAMP

Species are arranged in alphabetical order of Family using the taxonomy and nomenclature of Parker and Horton (1990). The following list includes all birds observed in the sampling quadrats as well as those recorded opportunistically. The presence of each bird species at the sampling sites is indicated by a cross at the site number. Introduced species are preceded with an asterisk (*). Conservation ratings are shown in bold following the scientific name. State conservation ratings follow the *NPWS Act (1972)*, Kemper and Queale (1990) and Carpenter and Reid (1994).

The definition for the status codes are as follows (after Kemper and Queale (1990) :

E Endangered: taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.

V Vulnerable: taxa believed likely to move into endangered category in the near future if the causal factors continue operating.

R Rare: taxa with small populations in South Australia that are not at present endangered or vulnerable, but are at risk.

In addition Watts (1990) also used the category Uncommon for species not considered at risk. The definition for this category follows:

U Uncommon: taxa occurring in relatively low numbers in South Australia, but not rare.

All species considered common, and therefore not at immediate risk have not been labelled.
Appendix 3

Tilley Swamp Biological Survey

Appendices

Appendix IIIA

WATERBIRDS OBSERVED ABOUT 1 KM SOUTH OF SITE TS011 ON 23 DECEMBER 1981 (JAENSCH AND AURICHT 1989)

Species	Number Seen	Number of clutches of nests
White-faced Heron	5	
Glossy Ibis	70	
Straw-necked Ibis	20	
Black Swan	20	+
Australian Shelduck	30	
Grey Teal	500	
Blue-billed Duck		2
Musk Duck		2
Australian Spotted Crake		20
Eurasian Coot	10	
Painted Snipe	1	1
Red-kneed Dotterel	30	+
Black-winged Stilt	50	+
Wood Sandpiper	4	
Common Greenshank	1	
Sharp-tailed Sandpiper	c.800	
Red-necked Stint	c.100	
Curlew Sandpiper	c.100	
Silver Gull	500	
Whiskered Tern	500	
Little Grassbird	c.5	+

Tilley Swamp Biological Survey

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Appendix IV

REPTILE SPECIES RECORDED FROM TILLEY SWAMP

Reptile taxonomy follows Edwards and Tyler (1990), however all common names are those proposed by Hutchinson (in prep.). Species have been listed alphabetically in order of Family.