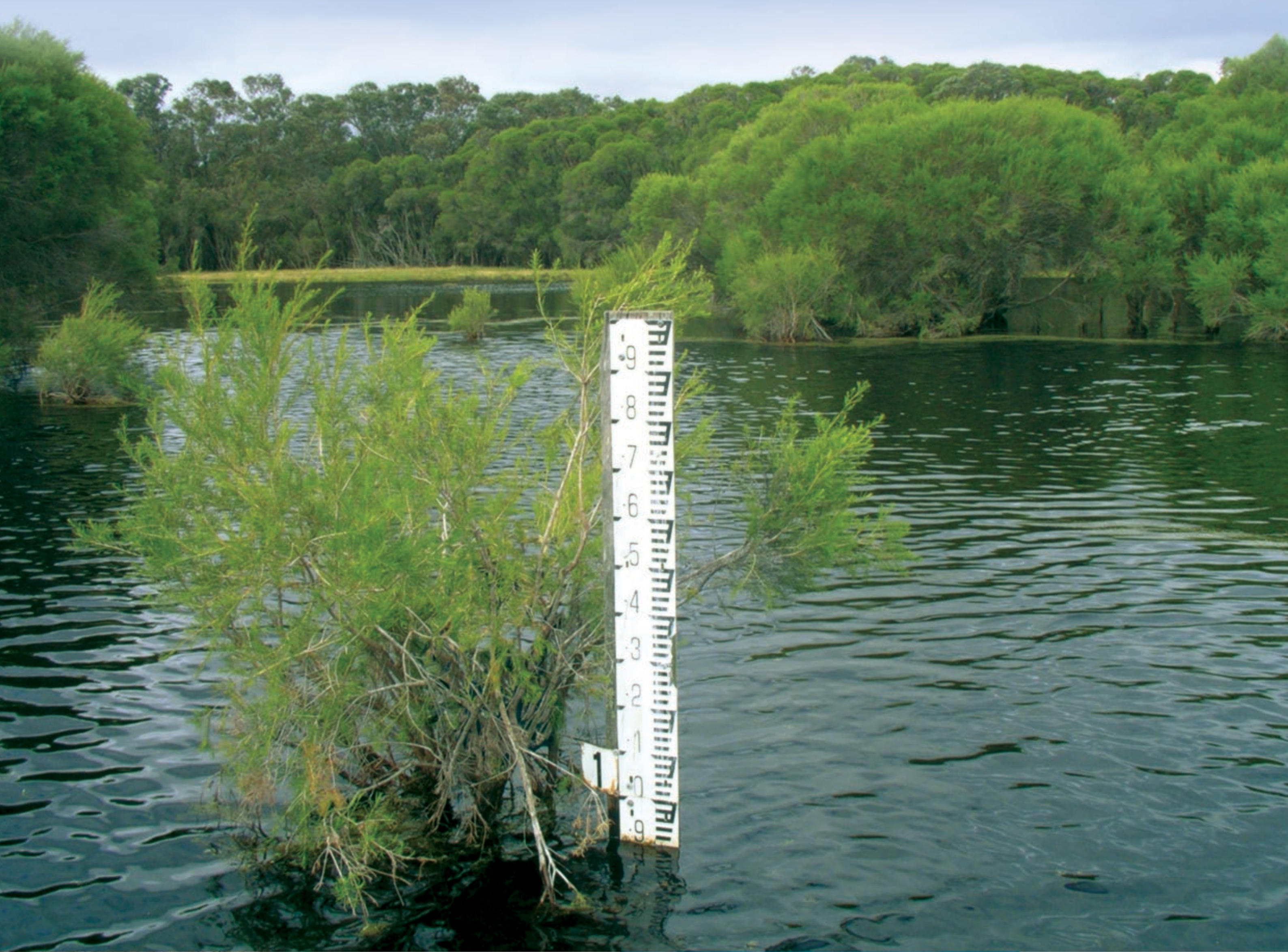
DEPTHS AND SALINITIES OF WETLANDS IN SOUTH-WESTERN AUSTRALIA: 1977 - 2000



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GOVERNMENT OF WESTERN AUSTRALIA

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

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Cover

Main picture
Chandala Swamp in Nov 2004. Photo - Grant Pearson

Insets (L-R)
Don Munro sampling Poorginup Swamp in 1981. Photo - Cliff Young
Allan Gregory surveying a gauge at Wheatfield Lake in April 2003. Photo - Alan Clarke
Grant Pearson and Paul Nas surveying Dumbleyung Lake in June 1998. Photo - Jim Lane
Alan Clarke sampling Mortijinup Lake in Nov 2003. Photo - Yvonne Winchcombe

Cover Design
Wendy Paine (Planet Graphics, Busselton)

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SUMMARY

This report presents 1977-2000 water depth and salinity data from the South-West Wetland Monitoring Program (SWWMP) conducted by the Western Australian Department of Conservation and Land Management (CALM).

Summaries of September and November depth and salinity data from 151 SWWMP wetlands across south-western Australia are presented, together with long-term trends in these parameters at 41 wetlands monitored for 20 or more years. Most of these wetlands are within conservation reserves vested in the Conservation Commission of Western Australia and managed by CALM. Several are on private property.

SWWMP began in 1977 with a decision in the former Department of Fisheries and Wildlife to commence a program of September and November water level monitoring on a large sample of south-west wetlands in order to provide an objective basis for determining annual waterfowl hunting season specifications. Salinity was also to be monitored because of its potential impact on waterfowl and their habitats.

Eighty-two wetlands were monitored between 1977 and 1980. In 1981 the program was expanded to coincide with a four-year assessment of waterbird use of south-west Wetland Nature Reserves by the Royal Australasian Ornithologists Union. The total number of wetlands monitored under SWWMP during this period was 119 and monitoring was conducted at two month intervals. At the end of this assessment, SWWMP monitoring reverted to September and November each year and the number of wetlands being monitored was reduced to 85.

Recreational waterfowl hunting in Western Australia was banned by State Government in 1992. SWWMP was continued due to its value for management and investigation, however the number of wetlands was reduced and the focus shifted, with more emphasis on near-coastal freshwater wetlands and less on inland saline wetlands. By 1996 only 60 wetlands were being monitored. Funding was declining and the program seemed likely to be discontinued.

In November 1996, the Salinity Action Plan was released. One of its strategic aims was to protect and restore high value wetlands and maintain biological diversity within agricultural areas of Western Australia. Monitoring was recognised as necessary to determine the effectiveness of the plan, which stated “CALM will monitor a sample of wetlands, and their associated flora and fauna, throughout the south-west to determine long term trends in natural diversity and provide a sound basis for corrective action”. Since 1996, SWWMP monitoring has been resumed at many wetlands. The total number now (2000 onwards) being monitored under SWWMP is 100. The aquatic fauna, flora, water chemistry and groundwater levels at 25 of these wetlands are also being monitored by CALM. Permanent benchmarks, of known height relative to former depth gauges, have been established at another 51 wetlands that have been monitored under SWWMP in the past, in order to facilitate resumption of monitoring at any time in the future, should this be needed.

Since 2000, all September and November SWWMP depth and salinity data have been checked, corrected where necessary and analysed to identify general patterns and significant trends. In summary, these patterns and trends are as follows.

Most of the 151 SWWMP wetlands had median September depths of 1<2m and median November depths <1m, including some that were dry. Few had median depths ≥3m. The deepest SWWMP wetland was Lake Jasper (Sep. median 9.68m; Sep. maximum 9.79m). Wetlands close to the coast were generally deeper than those inland, however some inland wetlands did fill to ≥3m in some years, e.g. Dumbleyung Lake was 4.45m in November 1983. Wetlands with least depth variability were generally those closest to the coast.

Most inland SWWMP wetlands were typically saline (10<50 parts per thousand) or hypersaline (≥50 ppt) in September and November. Fresh (1<3 ppt) and very fresh (<1 ppt) wetlands in September and November were found both inland and close to the coast. Wetlands on the eastern south coast were typically more saline than elsewhere on the south-west coast. The freshest wetland was usually Dobaderry Swamp (Sep. & Nov. medians 0.04 ppt & 0.07 ppt respectively). Minimum September and

November salinities of inland wetlands ranged widely, from very fresh to hypersaline. Wetlands with fresh or very fresh maxima were mostly found near the coast. Wetlands with medium to high salinity variability were generally inland or near the eastern south coast. Wetlands with low salinity variability were generally closer to the coast.

The 41 wetlands monitored for 20 or more years show the following general patterns of depth variation: sudden large increases that were subsequently maintained; occasional large increases not subsequently maintained; long term decline; occasional dramatic declines; pronounced, recurring, long-term patterns of increase and decline; dramatic year-to-year variation; little year-to-year variation, and combinations of these patterns. All of these wetlands, except Lake Powell whose depths are manipulated, show a general pattern of November depths being less than September depths, reflecting the Mediterranean climate (cool wet winter grading to hot dry summer) of south-western Australia.

The same 41 wetlands show the following general patterns of salinity variation: long term increase; sudden, occasional large increases not subsequently maintained; long term decline; sudden large decreases subsequently maintained; pronounced, recurring, long-term patterns of increase and decline; substantial year-to-year variation; little year-to-year variation, and salinities very fresh for the entire period of monitoring. Most of these wetlands show a general pattern of November salinities being greater than September salinities, due to concentration of salts as depths decline due to evaporation.

Two general and closely related patterns are apparent from comparison of depths and salinities. Most monitored wetlands show an inverse relationship between depth and salinity and many wetlands exhibit a dramatic increase in salinity as depth approaches zero, that is, when they are close to dry. These patterns have implications for future analysis of data.

September and November data from the 41 wetlands monitored for 20 or more years have also been analysed to detect long-term trends and their levels of significance. Eighteen showed no significant trends in depth or salinity; nine increased in depth but not salinity; three increased in salinity but not depth; three (Lake Bryde, Crackers and Yarnup Swamps) increased in both depth and salinity, suggesting a substantial increase in their salt loads.

Probable causes of some statistically significant, long-term increases or decreases in depths and/or salinities are suggested. These include secondary salinisation (Bryde, Toolibin, Yarnup), groundwater discharge (Warden), surface water diversion (Crackers, Towerrinning), trends in local rainfall (Dulbinning, Eganu, Muir), a multitude of human interventions (Thomsons) and cause unclear (Bambun, Chandala, Nine Mile, Poorginup, Unicup, Warrinup, Yealering). Several of these wetlands and their catchments are the subject of detailed hydrological and related investigations by CALM and others. Some, particularly Crackers and Nine Mile, are recommended for future investigation.

Some general issues arise from the analysis of 1977-2000 results of SWWMP.

Monitoring at 30 of the 41 wetlands selected for trends analysis in this report began during a period (1976-1979) of severe drought. In contrast, the late 1990s to 2000 was a period of more-normal rainfall. This has probably resulted in more wetlands showing trends of increasing depth and decreasing salinity than would have been the case if these start and end periods had similar rainfall.

Many south-west wetlands have highly variable salinities. This high variance might have prevented some instances of increasing salinisation from being detected by the routine statistical procedures applied in this report. Visual examination of depth and salinity data from some SWWMP wetlands (Eganu, Unicup, Warden, Yealering) suggests that, whereas routine analysis did not reveal statistically significant trends in salinity, analysis of 'same-depth' salinity data might do so. This type of analysis is therefore proposed for a future report. Additional statistical analyses are also proposed to assist in determining whether depth trends are due to changes in rainfall or other factors of possible concern.

It is important that potentially threatening depth and salinity changes are detected and responded to as soon as possible, however unwarranted responses should be avoided. It is therefore desirable that a protocol be developed for detection and appropriate response to potentially adverse changes as revealed by SWWMP, with particular attention being focussed on wetlands with high conservation values potentially at risk. This is proposed.

Some SWWMP wetlands have undergone dramatic, short-term, apparently natural changes in depth and/or salinity that have not occurred at any other time throughout the entire period (20 or more years) of monitoring. Shorter or different periods of monitoring would have missed these infrequent, but highly significant, hydrological events. It is also possible that some highly significant, natural, hydrological events might happen even less frequently than once every 20 or more years. These observations suggest that longer periods of monitoring may be required before the 'normal' regimes of south-western Australian wetlands can be fully described.

Average wet season rainfall in south-western Australia from 1976-2001 was 85-90% of the preceding 50-year average. This reduction has no doubt impacted on water levels and salinities of many wetlands. SWWMP monitoring began in 1977, two years after the 50-year period of higher rainfall. Descriptions of 'normal' hydrological regimes based on SWWMP data are likely to be significantly different from descriptions based on the preceding 50 years or from both periods combined. Understanding of hydrological regimes could be significantly enhanced by comparison of pre-1977 water level and salinity data with the SWWMP dataset. Early data are relatively few in number and widely scattered. Nonetheless their potential value warrants efforts being made to locate them.

By 1969, some 13.77 million hectares (54%) of the south-western Australian agricultural region had been cleared of native vegetation. Clearing resulted in rising saline groundwaters and extensive waterlogging within catchments of many SWWMP wetlands. Consequently many wetlands were showing the effects of secondary salinisation and increased inundation long before SWWMP monitoring began. While some of the wetlands showing 'no significant trend' in water depth or salinity during the period of SWWMP monitoring are still in pristine or near-pristine condition, others had already undergone massive change.

Data from SWWMP have been used by CALM personnel and made available to other organisations and individuals over the past 26 years for many purposes. These are listed. Most recently, SWWMP has contributed to the Natural Diversity Recovery Catchment program and the 1997–2000 Biological Survey of the Wheatbelt, two substantial Salinity Strategy[1] programs undertaken by CALM.

A primary objective of this report has been to provide an overview of the data that have been collected since SWWMP commenced in the expectation that this will assist current and future users. A report on results of pH (acidity/alkalinity) monitoring of all 151 SWWMP wetlands from 1981 to 2000 is currently being prepared. This will be followed in 2005 by reports on monitoring to 2004 of the depth, salinity and pH of the 100 SWWMP wetlands that continue to be monitored under the Salinity Strategy. SWWMP data will also continue to be made available to other organisations and individuals upon request. CALM is also endeavouring to make wetland data available via its website from 2006 onwards.

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[1] Since its release in November 1996, the Salinity Action Plan has been superseded by the State Salinity Strategy (2000) as updated by the Government of Western Australia's (2002) response to Frost *et al.* (2001).

1. INTRODUCTION

This report presents results of analyses of 1977-2000 data from SWWMP, a south-west region wetland monitoring program conducted by the Western Australian Department of Conservation and Land Management under the Western Australian Salinity Action Plan (Government of Western Australia 1996a) and State Salinity Strategy (State Salinity Council 2000a) as updated by the Government's response (Government of Western Australia 2002) to the Salinity Taskforce report (Frost *et al.* 2001).

Water depth and salinity data from 151 wetlands are presented, together with long-term trends in these parameters and rainfall at 41 wetlands monitored for 20 or more years.

Most of the monitored wetlands are within conservation reserves (Nature Reserves or National Parks) vested in the Conservation Commission of Western Australia. The Department of Conservation and Land Management is responsible for their management. Several are on private property.

The Department of Conservation and Land Management continues to monitor 100 wetlands under the Salinity Strategy. Permanent benchmarks have been established at the remaining 51 wetlands so that monitoring can readily be resumed at any time in the future should this be required.

2. BACKGROUND

SWWMP began, though not originally by that name, in 1977 with a decision in the former Western Australian Department of Fisheries and Wildlife (DFW) to commence a program of biannual (September and November) water level monitoring on a large sample of south-western Australian wetlands, in order to provide an objective basis for deciding annual waterfowl hunting season specifications (Lane & Munro 1981; Young 1981, Lane 1985). Salinity was also monitored because of its potential impact on wetland habitats and their suitability for waterfowl breeding. While most monitoring was undertaken by Departmental staff, members of the Western Australian Field and Game Association provided valuable assistance during early years.

From 1981 to 1985 the frequency of water depth and salinity monitoring was increased from two to six times per year to coincide with a four-year assessment of waterbird use of south-west Wetland Nature Reserves. This assessment was conducted by a large team of volunteer observers coordinated by the Royal Australasian Ornithologists Union (now Birds Australia) under an agreement with the Department of Fisheries and Wildlife, with funding from duck hunters' annual licence fees (Lane 1981). From 1981 onwards[1], water pH (acidity/alkalinity) was also measured and, from July 1984 to May 1985, total phosphorous concentration. During this four-year period, the number of monitored wetlands was increased from 82 (in 1980) to 119 (in 1983), thus ensuring coverage of more than half of the 186 (July 1981) to 208 (June 1985) Wetland Nature Reserves existing[2] in south-western Australia at that time.

The 'Waterbird Use of Wetland Nature Reserves' survey (Jaensch *et al.* 1988) ended in May 1985. The number of wetlands monitored each year was reduced to 85 and the timing to September and November, as before. The revised list of 85 included five 'new' wetlands, two of which (Clifton[3], Jasper) were within National Parks. This reflected the creation in 1985 of the Department of Conservation and Land Management (CALM), an amalgamation of the Wildlife components of DFW with the former National Parks Authority and the Forests Department.

In 1991, five wetlands (Boat Harbour, Davies, Maringup, Owingup, Wilson) in conservation reserves of the south-west coast were added following surveys of the biota and water chemistry of these and other permanent coastal wetlands from Cape Naturaliste to Albany (Jaensch 1992a,b,c; Robinson 1992; Edward *et al.* 1994).

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[1] Except Byenup, Poorginup and Tordit-Gurrup, where pH monitoring began in 1977 in response to a peat mining proposal.

[2] Based on a card index maintained by JAK Lane until 1985.

[3] For the sake of brevity, all wetland names in this report are in reduced form. For example, Lake Clifton is referred to simply as 'Clifton' and Byenup Lagoon as 'Byenup'.

Recreational waterfowl hunting in Western Australia was banned by a decision of State Government in June 1992. The wetland monitoring program continued, albeit on a smaller scale, due to its recognised value for management and investigation. However, the number of wetlands being monitored was further reduced, from 84 (in 1991) to 55 (in 1992). The focus of the program also shifted. Monitoring of many saline wetlands of the inland agricultural area was discontinued, while the number of freshwater sites closer to the coast was maintained.

Funding for the wetland monitoring program declined during the 1990s and was insufficient for the depth gauge network, i.e. the gauges themselves, to be maintained. By 1996 it seemed unlikely that the program of biannual sampling would continue.

In November 1996, the Salinity Action Plan (SAP) for Western Australia was released (Government of Western Australia 1996a). One of the Plan's four strategic aims was to: 'Protect and restore high value wetlands, and to maintain natural (biological and physical) diversity within agricultural areas of Western Australia'. Monitoring was recognised as being necessary to determine the effectiveness of the Plan. In particular, it would determine 'progress towards achieving agricultural, water resource and natural diversity objectives' and 'natural bio-physical trends and the likely impact of land management change on trends over time'. Concerning monitoring of natural diversity, the Plan stated that "CALM will monitor a sample of wetlands, and their associated flora and fauna, throughout the south-west to determine long term trends in natural diversity and provide a sound basis for corrective action". This was to be across all three identified rainfall zones of the south-west and additional funds were to be allocated for this purpose.

As a consequence of the 1996 SAP recommendations, the south-west wetland monitoring program was revitalised. The number of wetlands being monitored for water depth and salinity was progressively increased from 60 in 1996 to 100 in 2000, with most additions being in the inland agricultural area. Initially, some wetlands where monitoring had previously been discontinued were re-included, with preference given to those with relatively low salinity ranges which were also reasonably accessible and would provide a wide geographic spread. In 1999 and 2000, wetlands not previously monitored, but shown by the 1997-2000 SAP biological survey (Keighery *et al.* 2004; Halse *et al.* 2004; Pinder *et al.* 2004) to have significant conservation values, were added. This brought the total to 100. Most of the 40 'new' wetlands were inland rather than coastal. Permanent benchmarks were established at all monitored wetlands and all depth gauges were surveyed to these, thus ensuring the 'security' of water level readings. Many (29+ by November 2000) of these benchmarks have subsequently been surveyed to Australian Height Datum (mean sea level) thus enabling the elevations (vertical positions) of water levels and lake beds to be precisely determined within natural drainage lines and surrounding landscapes. Depth gauges have been repaired, replaced and installed. A modern database, also referred to as SWWMP[1], has been developed and all 1977-2000 depth, salinity and pH records have been checked, re-checked and corrected where necessary. For additional detail concerning this and other work undertaken, readers are referred to Wallace (2001).

An accompanying program of biological monitoring of 25 of these wetlands has also been initiated (Halse *et al.* 2002; Cale *et al.* 2004). This latter program involves periodic monitoring of waterbird and aquatic invertebrate communities, fringing plant communities, ground water levels and detailed water chemistry (Ogden & Froend 1998; Gurner *et al.* 1999, 2000; Franke *et al.* 2001; Halse *et al.* 2002; Kabay 2002; Cale *et al.* 2004).

The State Salinity Strategy (State Salinity Council 2000a) of March 2000 endorsed the Salinity Action Plan's strategic aim of protecting and restoring high value wetlands and maintaining natural diversity within the south-west region of Western Australia by adopting this as one of its own goals. This Strategy also recognised the importance of monitoring for providing information on 'progress towards agreed goals for agricultural systems, water resources, natural diversity, infra-structure and capacity-building' and 'longer-term bio-physical trends and the likely impact of changes in land use management'. To this end, the State Salinity Council supported the continuation of funding of CALM's wetland monitoring program (State Salinity Council 2000b).

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[1] For several years SWWMP (the south-west wetland monitoring program) was referred to as SWALMP (south-west athalassic lakes monitoring program). The name and acronym have recently been changed to more accurately reflect the broader geographic scope of the program (athalassic = inland) and the diversity of wetlands included.

This report presents results of analyses of SWWMP data from its inception in 1977 to the year 2000. Similar reports are planned for the future. By the end of 2004, 60 wetlands in this program will have been monitored for 20 or more years, including 37 monitored for 25 or more years (maximum 26 years). A report presenting the results of pH monitoring from 1981 to 2000 is at an advanced stage of preparation.

This report presents only depth and salinity data collected under SWWMP. It is recognised that additional depth and salinity data have been collected from some SWWMP wetlands by other government agencies, institutions, individuals and community groups. These additional data have mostly been collected over relatively short periods, from single visits to a few years. A few SWWMP wetlands, most notably in the Perth metropolitan area, have been monitored for tens of years by organisations such as the Water Authority and Water & Rivers Commission (now Department of Environment) and by tertiary institutes. Comparison with data from these sources has been considered beyond the scope of this report on SWWMP.

3. THE WETLANDS

The locations of all wetlands monitored under SWWMP during the period 1977-2000 are shown in Figure 1. Wetlands are shown as ‘Current’ (wetlands that continue to be monitored under the Salinity Strategy) or ‘Historical’ (wetlands monitored at some time in the past, but not currently). Each is uniquely identified by a four-letter code, usually the first four letters of the wetland’s name. A complete list of names[1] and codes is provided in Appendix 1. The inland boundary of the south-west agricultural area and the 400mm and 600mm average annual rainfall isohyets are shown as these are significant in terms of areas of application and emphasis of the Salinity Strategy[2].

There are 100 ‘current’ wetlands. These have been selected for continued monitoring under the Salinity Strategy primarily on the basis of their nature conservation significance and monitoring history, with preference being given to high nature conservation value wetlands with long and unbroken histories of previous systematic monitoring under SWWMP. They are broadly distributed across coastal and inland agricultural areas of south-western Australia. Few are within tall forest (Jarrah *Eucalyptus marginata* and Karri *E. diversicolor*) areas of the south-west, both for historical reasons and because most of these areas are thought to be at relatively low risk of secondary salinisation. Because of the origins of the program, many of the monitored wetlands are important for waterbirds. Nonetheless most are also (some alternatively) important for other biota. A substantial number have significant recreational values, both passive (nature walks) and active (e.g. boating activities).

The 100 Salinity Strategy wetlands comprise 58 ‘continuing’ (most of those that were monitored up to and including 1996), 24 ‘resumed’ (those that were monitored for a period in the past, but were no longer being monitored in 1996) and 18 ‘new’ (those where monitoring began between 1997 and 2000). The ‘new’ wetlands that were added to the monitoring program were a selection of previously un-monitored wetlands that the Biological Survey of the Wheatbelt, conducted from 1997 to 2000, showed to be of particular interest from a biodiversity perspective (Pinder *et al.* 2004).

The 100 Salinity Strategy wetlands represent a broad range of depth and salinity regimes, from shallow to deep (for south-western Australia), fresh to hypersaline, ephemeral to permanent, and high to low variability in these parameters. The depth and salinity regimes of many have changed since European settlement, as a consequence of land clearing and hydrological disturbances within their catchments. Some are in the process of changing (as will be seen later in this report) or considered likely to change in the near future. Some within large conservation reserves are unlikely to change for some decades at least, except perhaps as a consequence of climate change[3]. Not all will change for the worse; some are being rehabilitated through the efforts of government agencies and local communities.

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[1] Wetlands without official names are referred to by Local Authority and Reserve Number, e.g. Albany 26385.

[2] Three zones for salinity management were recognised under SAP; these were the high (>600mm/yr), medium (400-600mm/yr) and low (<400mm/yr) rainfall regions. Average annual rainfall in some parts of the south-west exceeds 1200mm.

[3] South-western Australia is within the part of Australia considered most likely to experience climate change due to increasing greenhouse gas emissions (CSIRO 2001).

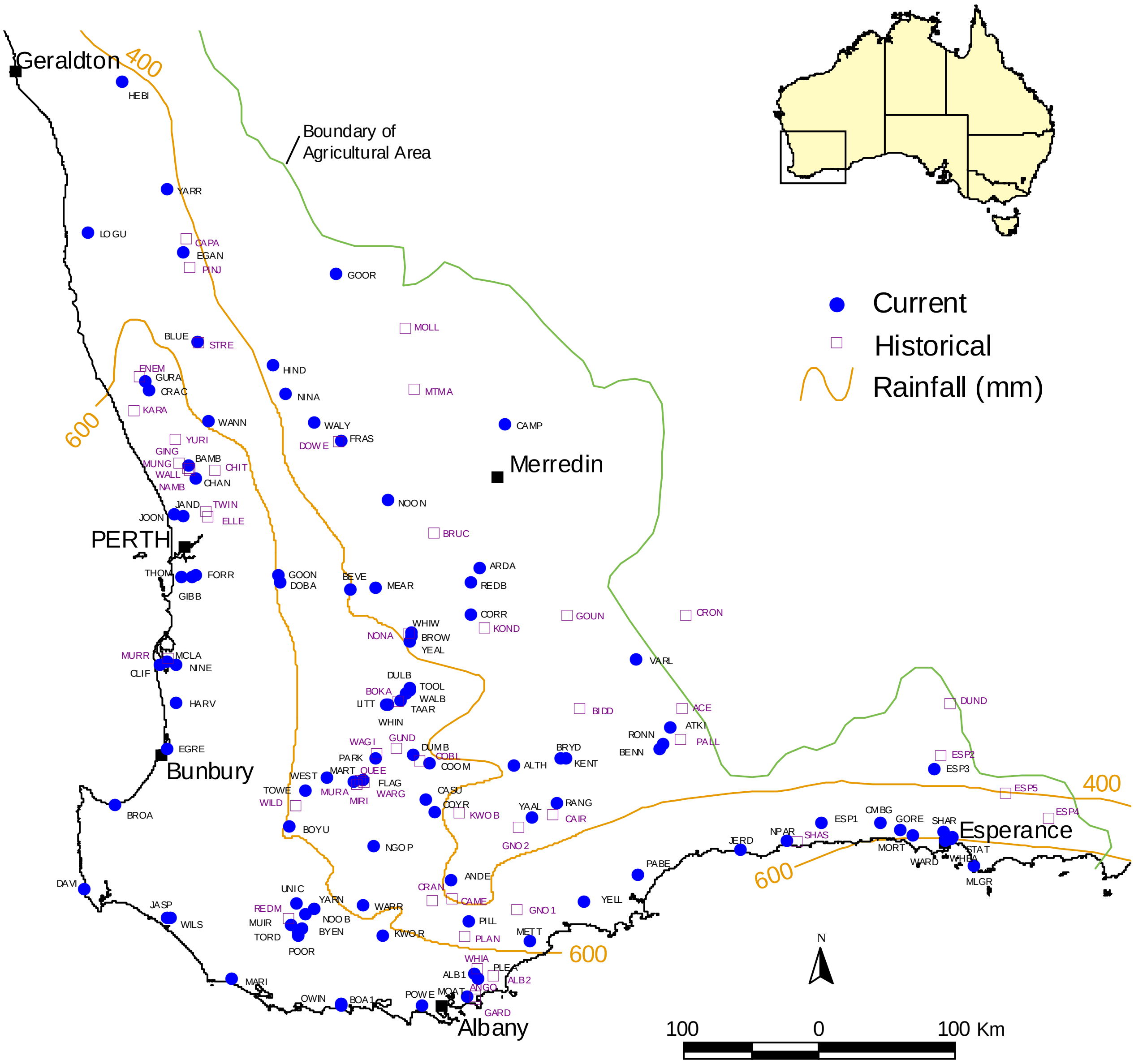

Figure 1: Wetlands currently monitored under the State Salinity Strategy ('Current') and wetlands previously monitored ('Historical').

It is important to note that, for historical reasons, the wetlands being monitored under the Salinity Strategy have not been selected *a priori* as a representative sample of south-western Australian wetlands, nonetheless they do present a wide range of types, values, uses, degrees of threat and likely futures.

This report also presents data from 'historical' wetlands. These are wetlands that have been monitored under SWWMP at some time in the past (i.e. prior to selection of the 100 Salinity Strategy wetlands), but are no longer monitored. Monitoring was discontinued at these wetlands when the south-west waterbirds survey ended in 1985, or when recreational duck hunting was banned in 1992, or when the 100 Salinity Strategy wetlands were selected during 1997-2000.

4. METHODS

4.1 Water levels

Since 1977, water levels have been monitored by visual checking of depth gauges (0.01m graduations) installed to indicate the depth at the deepest point in each wetland (Lane & Munro 1981, 1982, 1983). Deepest points were determined by visual inspection (including use of aerial photographs) and survey by 'dumpy level' (on dry or near-dry wetlands) or depth measurement from a dinghy (on deeper wetlands). As a precaution against gauge loss or movement, a Fisheries & Wildlife / CALM 'datum' (small concrete block) was installed on nearby high ground at the time of gauge installation and each gauge was surveyed to this. Since 1997, more-permanent Department of Land Information (DLI) benchmarks have been installed near the gauge or gauge clusters at all 151 monitored wetlands. Details of these benchmarks are incorporated in the State-wide Geodetic Data Base (GESMAR) maintained by DLI, thus ensuring this information is never likely to be lost. The benchmarks are protected under law and DLI has a well-established mechanism for reporting of any proposed or impending disturbance to them and a program for their maintenance or replacement as necessary (B. McCarthy, DLI, pers. comm.). Additionally, all these benchmarks have been or will be surveyed to Australian Height Datum (AHD) and, where appropriate, the associated National horizontal datum - Map Grid Australia 1994 (MGA94). This will allow precise replacement of wetland gauges, transects and other 'query sites' in the highly unlikely event of all local site references being destroyed.

Gauge readings are entered manually onto field recording sheets and later entered on computer. All readings are double-checked at the time of recording in order to minimise the risk of both reading and recording errors. Readings are also compared at the time of recording with data from the same wetlands in previous years and (in November only) with immediately preceding September records. As will be seen later in this report, at most wetlands there is a reasonably-consistent, small decrease in water level from September to November each year. This assists in record verification, both in the field and in the office. Where *increases* in depth from September to November are recorded, these are checked in the office by reference to rainfall records from the nearest Bureau of Meteorology recording stations. Over two decades of monitoring, the most commonly detected (but nonetheless rare) field recording error has been misidentification of whole gauge plates, resulting in an error of ±1.00m (each gauge plate is 1.00m in length). These errors have been readily detected and corrected.

Rainfall across south-western Australia is highly seasonal, with most occurring during the cooler late autumn and winter months of May to August and least during the hot summer months of December to February. As a consequence, wetland water levels usually decline from September to November each year and, particularly in a low rainfall year, many inland wetlands become dry during this period or earlier. With this in mind, a decision was made in early years of SWWMP that wetlands that were dry or near-dry when visited in September would not be revisited in the following November, provided Bureau of Meteorology rainfall records indicated there had been no significant rainfall in the relevant district in the intervening 7-8 week period. The November water levels of wetlands meeting these conditions were recorded as 'believed dry' (=0.00m). This approach was taken in order to avoid unnecessary travel.

As mentioned above, depth gauges were installed so as to indicate the water depth at the deepest point in each wetland. However, to facilitate monitoring they were usually not installed at this point, but closer to the shoreline where they could more-easily be read. Where the deepest point was some distance from the nearest accessible shoreline and the lakebed sloped significantly, several gauges were installed so that water levels could be readily measured over the full range of expected variation. Occasionally, a September or November water level has been lower than the lakebed level at the lowest gauge, but not dry. On these occasions the water level was recorded as 'less than 0.xx metres', 0.xx being the lakebed level at the gauge. In statistical computations, these records have been converted to ½ of the 'less than' value. In a very few instances, small negative depth values have been recorded due to movement of lakebed sediments.

No adjustments have been made for the effects of wind strength, direction, persistence or pattern when measuring water levels at depth gauge sites. Persistent winds have a tilting effect on the surface of open waterbodies, lowering the water level on the windward side and raising it on the leeward side. This is the reason for some of the atypical 'September to November depth differences'[1], both increases and decreases, that have been recorded. When winds have been strong enough to cause wave action at a gauge site, the water level has been recorded as the midway point between crests and troughs.

4.2 Salinities

Since 1977, water salinities have been determined from water samples taken at the water surface only[2] (i.e. within 20cm of the surface) at a point between the water's edge and the nearest readable (i.e. partially-immersed) depth gauge. Clean plastic containers, pre-rinsed with surface water from close to the sampling site, have been used to collect and temporarily store the samples. These samples have been taken to a laboratory at the WA Wildlife Research Centre (CALM's Woodvale Research Station) at the end of each monitoring trip.

Over the years, several instruments and methods have been used to determine the salinity of water samples. Instruments used at the CALM laboratory have been a Hamon Salinity Bridge, Salinity-Temperature Bridge Type MC5, Ale, TPS LC-81, TPS 90-FLMV and a variety of probes. All of these instruments operate by measuring the electrical conductivity of the water sample and then, after standardisation to 25°C, providing a conductivity reading and/or a salinity reading calculated from the conductivity measurement. Each instrument was selected and (except for the most-recently obtained) later replaced on the basis of salinity range, reputation, reliability, maintenance requirements, cost and ease of use. Over the years, the trend in replacements has been towards increased precision and suitability for the conductivity ranges being measured. Calibration procedures have also improved during the course of the monitoring project. Initially, seawater of known salinity (see Pearce *et al.* 1985) from a coastal location near the DFW Marine Research Laboratories at Waterman, Perth, was used as a standard. This was later replaced by commercially-prepared solutions of known salinity.

Since 1991, some batches of water samples have been sent to the WA Chemistry Centre (Department of Industry and Resources) for salinity and/or conductivity determination, either instead of determination at the CALM laboratory, or, more commonly, for comparison. In most instances the results obtained have been similar. On the few occasions when results have differed substantially, efforts have been made to identify the probable cause(s) and clearly-erroneous data have been discarded. Throughout this report, where two values (CALM and WACC) are available, the salinity value determined at the CALM laboratory has been used[3] for analysis as this maintains methodological continuity pre- and post-1991.

4.3 Sampling periods

The water level and salinity data presented in this report were collected in September and November each year, between 1977 and 2000. As indicated in Section 2, this monitoring was initiated in order to provide an objective basis for deciding annual waterfowl hunting season specifications (Lane & Munro 1981; Young 1981, Lane 1985). September was chosen as being approximately mid-way through the

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1 September depth minus following November depth, for each wetland.

2 Note that vertical or horizontal salinity stratification might occur at times or continuously at any of the monitored wetlands. Salinity values or descriptions reported here should not be regarded as necessarily definitive of entire waterbodies. Higher or lower salinities might occur in sub-surface waters and/or other, unsampled, surface waters of the wetlands.

3 Except Nov 1999 data, where WA Chemistry Centre values were used because comparison revealed an error in calibration of the CALM laboratory conductivity/salinity meter, and Nov 1992 data, where the results were very similar and an arbitrary decision was made at the time to use the WA Chemistry Centre results.

waterfowl breeding season in south-western Australia. Water level measurements at this time would provide an indication of the extent of wetland habitat adequately inundated for successful waterfowl breeding. November was chosen to give an indication of the likely availability of suitable habitat during the summer-autumn dry season in both waterfowl refuge areas and hunting areas. It was also the latest that water levels could be measured in order to make such an assessment before hunting season decisions (date of opening, bag limits, season length, etc.) would be made.

For enhanced comparability between years, the times of sampling were narrowed down in 1978[1] to 'the nine-day[2] periods commencing on the second Saturday in September and November each year'. From 1979 onwards the November sampling was brought forward one week to 'the nine-day period commencing on the *first* Saturday in November each year' in order to provide more time for hunting season recommendations and decisions to be made. The September monitoring period remained unchanged. These standardised September and November 'routine monitoring periods' have been strictly maintained since 1979[3].

4.4 Data management

At the commencement of this monitoring program, more than twenty years ago, Personal Computers (PCs) were almost unheard of. Field data were transcribed from field recording sheets to data entry sheets and then entered onto a main-frame computer, located at the University of Western Australia Computing Centre. All data were entered twice and compared electronically to check for entry errors. Printouts of the data were then checked against the original field recording sheets for possible transcription errors. In this way, data transcription and entry errors were almost entirely eliminated.

With the advent of PCs, all data entry and checking was undertaken at the WA Wildlife Research Centre. A computer program in Tektronix Basis was written by Wilfe Lehre from the then Department of Fisheries and Wildlife for entry, storage, analysis, reporting, checking and subsequent interpretation of data. This program was enhanced from time to time and totally re-written in dBase and Fortran in the mid 1980s. By the mid 1990s this program was out-dated and no longer able to store all the data that had been collected or report fully on the large number of records in the database. In 1998, with funding under the Salinity Action Plan, an entirely new database was developed, using Microsoft Access software, by Greenbase Consulting under contract to CALM, and 1977-1996 data were transferred to it. From 1999 onwards all subsequent (post-1996) data have been added directly to this database by Y. Winchcombe. Printouts of these data have also been checked against original field record sheets to eliminate transcription errors.

4.5 Data verification

In addition to the data checking referred to above, some data have been re-checked during preparation of this report. Data were both graphed and tabulated for each wetland and all values that appeared to be outside the general pattern for that wetland were checked against original field recording sheets. In particular, each November value was compared with the preceding September value as there are reasonably consistent relationships between these depths (decreasing; see section 5.3) and between these salinities (increasing; see section 5.3). Comparison of depth values with salinity values was also useful for checking as these typically show an inverse relationship (see section 5.3). Where unusually large and unexpected increases in water level were recorded, rainfall records were checked to verify that exceptional rains had occurred. Missing records were also investigated, as most were due to temporary markers, rather than surveyed gauges, being used to record exceptional water levels, or water levels at 'new' wetlands, during the 1990s. In these instances the actual depth values were subsequently obtained by field survey.

There were few problems with data collected prior to 1992, when the database was in frequent use. Most errors or missing records were from the period 1992 to 1996, a period when the monitoring

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[1] Only four wetlands were monitored in September-November 1977. Twenty six were monitored in September-November 1978. Of these, three (Byenup, Poorginup, Tordit-Gurrup) and four (the same three plus Yealering) respectively were monitored (in 1977 and/or 1978) within the 'routine monitoring periods' adopted in 1979.

[2] Nine-day periods, rather than five or seven-day periods, were chosen to provide sufficient opportunity for both Departmental staff and volunteers (who undertook monitoring during one or both of two weekends) to visit all of their allocated wetlands.

[3] Under this monitoring regime, data and sample collection over all years of monitoring, but not in any one year, can theoretically be any day 8-22 September and 1-15 November.

program was in temporary decline. Some depth gauges were missing or damaged, some temporary markers not surveyed to lakebed were being used and data checking was less frequent than before. With SAP funding support commencing in 1997, these and other problems were overcome. Between 1997 and 2001, standard survey (Department of Land Information) benchmarks and reference marks were installed at all monitored wetlands by licensed surveyors with CALM logistic support and CALM/DLI direction. Missing and damaged depth gauges were replaced, new gauges were installed where needed and all temporary markers, depth gauges and original concrete datums were surveyed to the new permanent benchmarks. This enabled most missing records to be obtained and most of a number of unusual or problematic records to be verified or corrected.

This SAP-funded survey work also provided an opportunity to check whether gauge boards had moved since installation. Most of the several hundred depth gauges installed since commencement of the program in 1977 had either not moved or had moved by less than 10mm. One or more gauges at five (Bryde, Clifton, Dobaderry, Esperance 26410, Toolibin) of the 100 wetlands that continue to be monitored under the Salinity Strategy had moved by more than 50mm. As a consequence of this experience, all gauges are now being individually labelled so that each future depth measurement can be linked to the gauge that is used. Where a wetland has more than one gauge[1], this will limit the impact of any future movement of individual gauges on the quality of the dataset for that wetland.

4.6 Descriptive statistics

For preparation of this report, all 1977-2000 September and November water depth and salinity data were exported from SWWMP to the spreadsheet application Microsoft Excel.

Microsoft Excel was then used to calculate the following descriptive statistics for each parameter, in each month, at each wetland:

- minimum, maximum, mean and median (50^{th} percentile[2]) values for all 151 wetlands, and
- 25^{th} and 75^{th} percentiles for all wetlands with 10 or more years of records, and
- 10^{th} and 90^{th} percentiles for all wetlands with 20 or more years of records.

A simple measure of variability for each parameter, in each month, at each wetland was then calculated for all wetlands with 10 or more records, this being: variability = (75^{th} percentile – 25^{th} percentile) / 50^{th} percentile. Note that this is a *relative* measure of variability, in that a measure of *absolute* variability in depth or salinity is being compared with the median depth or salinity of the same wetland. This measure has been used in preference to *absolute* variability because it highlights those wetlands that experience the most and least dramatic year-to-year changes in depths and salinities. This can be a useful starting point for consideration of the ecological significance of depth and salinity changes.

4.7 Trends analysis

Forty-one wetlands were selected for trends analyses on the basis that, at the end of 2000, they had 20 or more years of September or November depth data. Twenty years was chosen as the necessary minimum period of monitoring because the authors' primary interest for this report is in long term rather than short term trends and this was the longest period over which a substantial number of wetlands had been monitored. For each of these 41 wetlands, trends in September, November and September+November depth and salinity were determined where there were 20 or more years of data for that particular combination of month(s) and parameter. The reason for analysing trends in September and November data combined, as well as separately, was to increase the power of the analysis, and thus the ability to detect significant trends, by increasing the number of records in each analysis. It was acceptable to do this given the generally close relationship between September and subsequent November depth and salinity values.

The data from the 41 wetlands were imported into the statistical software package SAS (release 6.12) on CALM's mainframe computer Alphaserver Model 4100 and trends were determined by linear regression analysis. Depth and salinity were regressed against 'time', this being the number of months

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1 Most wetlands have two or more gauges; see Section 4.1 for explanation.

2 The 50^{th} percentile (i.e. the median) is the value below and above which 50% of recorded values lie. The 25^{th} percentile (first quartile) is the value below which 25% of recorded values lie and the 75^{th} percentile (3^{rd} quartile) is the value below which 75% of recorded values lie.

elapsed since January 1977. The data from all 41 wetlands were then analysed to test the regression assumption that residuals are normally distributed. They were not; so various transformations were then tested to determine which were optimal so that consistent models could be used to test each wetland. The transformations which gave the most-normally-distributed residuals were 'square root of depth' and 'log salinity' (the log transformation was the natural or 'Naperian' logarithm of the value).

The procedure used for trends analysis was a general purpose linear regression procedure using least-squares estimates. The models used were: 'sqrt(depth) = time' and 'log(salinity) = time'. Regression analyses were conducted on September data, November data and combined September+November data. The procedure's output provided parameter estimates (slope & intercept) of sqrt(depth) and log(salinity) over time and calculated a two-tailed significance probability (p value). The sign of the slope parameter determined if the trend in depth or salinity over time was increasing (+ve slope) or decreasing (-ve slope). The levels of significance that were adopted were $p \geq 0.05$ = 'not significant', $p < 0.05$ = 'significant', $p < 0.01$ = 'highly significant', $p < 0.001$ = 'very highly significant'.

Using the results of the regression equations, the annual rate of change over time was calculated for depth and salinity, as at September 2000 for September results, and as at November 2000 for November and combined September+November results.

Annual rainfall records were obtained from the Bureau of Meteorology for the two recording stations nearest to each wetland. Trends in annual rainfall at the nearest recording stations were calculated for comparison with the trends in depths and salinities. Records from the second-nearest recording stations were used to provide an indication of rainfall variation in the general vicinity of the wetland and, from this, an indication of the likelihood that nearest-station rainfall is a reasonable reflection of rainfall in the wetland's catchment. Rainfall trends were calculated from the year of the earliest depth or salinity record (of each wetland) to year 2000, except for Eganu where an annual rainfall figure was not obtainable for the first year (1979) of depth and salinity monitoring. Earliest depth and salinity records were in the same year for all but 11 of the 41 wetlands monitored for 20 or more years. Eight (Bryde, Casuarina, Crackers, Dobaderry, Dulbinning, Taarblin, Toolibin, Walbyring) of these wetlands were dry in the first year of monitoring so no salinity measurement could be taken. Salinity monitoring began[1] before depth monitoring at the remaining three wetlands (Byenup, Poorginup, Tordit-Gurrup).

As mentioned in section 4.2, in this report, where two salinity values (CALM and WACC) are available, the salinity value determined at the CALM laboratory has in most instances been used as this maintains methodological continuity with data from previous years. Nonetheless, all salinity values, whether determined at the CALM laboratory or at the WA Chemistry Centre, or calculated by CALM on the basis of conductivities determined at the WA Chemistry Centre, are shown in the graphs of salinity trends (Figures 8-48). This is to enable readers to make their own visual comparisons between CALM and Chemistry Centre results.

5. RESULTS AND DISCUSSION

All monitored wetlands are listed alphabetically by code (four character name abbreviation) in Appendices 2-5 together with the years in which the September depth (Appendix 2), November depth (Appendix 3), September salinity (Appendix 4) and November salinity (Appendix 5) of each was measured, the years in which wetlands were dry or believed dry in the relevant month, the number of records and the mean (arithmetic average), minimum, median (50th percentile) and maximum depth and salinity values of each wetland. For wetlands with 10 or more records (= years of monitoring), the 25th and 75th percentiles are presented, and the variability of the relevant parameter. For wetlands with 20 or more records, the 10th and 90th percentiles are also presented, together with the 'p' value, significance and direction (none, increasing or decreasing) of trends. The Figures referred to below are based on these data.

5.1 Descriptive statistics (means, minima, maxima, percentiles, variability, etc)

For the purposes of Figures 2-5, a number of depth, salinity and variability categories have been adopted.

[1] As a consequence of a proposal, later rejected on environmental grounds, to mine peat from these wetlands.

The depth categories (dry[1], <1m, 1<2m, 2<3m, 3<5m, 5<7m, ≥7m) are largely arbitrary. They have been selected on the basis of ease of visualisation, both of individual wetlands and of the statistical and geographic distributions of wetland depths.

The salinity categories 'very fresh' (<1ppt), 'fresh' (1<3ppt), 'brackish' (3<10ppt), 'saline' (10<50ppt), 'hypersaline' (≥50ppt) are very similar (<1ppt is additional) to those used by Halse *et al.* (1998). Analysis of invertebrate salinity tolerance data (Pinder *et al.* 2005) from the Biological Survey of the Wheatbelt showed a natural boundary occurs around 3ppt. Radke *et al.* (2003) suggested chemical reasons for this boundary and the frequently cited 1ppt (see Hart *et al.* 1991). Evidence for definite boundaries at higher salinities is lacking because tolerances become broader as animals become more salt tolerant (S.A. Halse pers. comm.). Nevertheless, community richness and composition are markedly different at 10 and 50ppt and this provides some justification for the somewhat arbitrary categorisation (see Pinder *et al.* 2005 and references therein).

The depth and salinity variability categories (low, medium, high) are entirely arbitrary. Wetlands with variabilities within the lowest third of variability values of all SWWMP wetlands with 10 or more years of monitoring are categorised as 'low'; wetlands in the middle third are 'medium' and those in the top third are 'high'.

In considering the above it should be noted that there are no single, widely-accepted, standard categorisations of wetland depth, salinity, depth variability or salinity variability that might alternatively have been used.

5.1.1 September Depths

Median, minimum and maximum September depths of all 151 monitored wetlands (historical and current) are shown in Figures 2(a), 2(b), 2(c). The statistical distributions of median, minimum and maximum September depths are also provided, in tabular form, and the 10 deepest wetlands (highest medians, highest minima and highest maxima) are listed. September depth variabilities of all wetlands monitored for 10 or more years are shown in Figure 2(d). The 10 wetlands with least variability in September depths are listed, together with their variabilities and the statistics used to compute them (see section 4.6). The circles representing all listed wetlands, and other wetlands of interest, have been labelled to assist in locating them. The results may be summarised as follows.

Medians (Figure 2a)
Most monitored wetlands have median September depths <1m (54%) or dry (3%). Few (9%) have median depths ≥3m. The deepest is Jasper (median 9.68m), which is almost 50% deeper than the next-deepest wetland (Maringup; median 6.50m). Deep wetlands (median ≥3m) are generally closest to the coast. Many inland wetlands are typically shallow (median <1m) in September.

Minima (Figure 2b)
Most monitored wetlands have minimum September depths <1m (52%) or dry (30%). Few (6%) have minimum depths ≥3m. The deepest is Jasper (minimum 9.21m). Deep wetlands (minimum ≥3m) are generally closest to the coast. Many inland wetlands are dry in some Septembers.

Maxima (Figure 2c)
34% of monitored wetlands have maximum September depths of 1<2m; 24% have maximum depths 2<3m, and 14% have maximum depths ≥3m. The deepest is Jasper (maximum 9.79m). While deep wetlands (maximum ≥3m) are generally closest to the coast, some inland wetlands are also ≥3m in some Septembers.

Variability (Figure 2d)
Wetlands with least September depth variability are generally those closest to the coast, while those with most variability are generally inland. Jasper has the least September depth variability, relative to its median depth.

[1] Note that in this report the dry category is additional to and not included in the <1m category.

5.1.2 November Depths

Median, minimum and maximum November depths of all 151 monitored wetlands (historical and current) are shown in Figures 3(a), 3(b), 3(c). The statistical distributions of median, minimum and maximum November depths are also provided, in tabular form, and the 10 deepest wetlands (highest medians, highest minima and highest maxima) are listed. November depth variabilities of all wetlands monitored for 10 or more years are shown in Figure 3(d). The 10 wetlands with least variability in November depths are listed, together with their variabilities and the statistics used to compute them (see section 4.6). The circles representing all listed wetlands, and others of interest, have been labelled to assist in locating them. The results may be summarised as follows.

<u>Medians (Figure 3a)</u>
Most monitored wetlands have median November depths <1m (49%) or dry (15%). Few (8%) have median depths ≥3m. The deepest is Jasper (median 9.59m). Deep wetlands (median ≥3m) are generally closest to the coast. Many inland wetlands are typically shallow (median <1m) in November.

<u>Minima (Figure 3b)</u>
Most monitored wetlands have minimum November depths <1m (30%) or dry (53%). Few (6%) have minimum depths ≥3m. The deepest is Jasper (minimum 9.14m). Deep wetlands (minimum ≥3m) are generally closest to the coast. Many inland wetlands are dry in some Novembers.

<u>Maxima (Figure 3c)</u>
34% of monitored wetlands have maximum November depths of 1<2m, 21% have maximum depths 2<3m, and 11% have maximum depths ≥3m. The deepest is Jasper (maximum 9.68m). While deep wetlands (maximum ≥3m) are generally closest to the coast, some inland wetlands are also ≥3m in some Novembers.

<u>Variability (Figure 3d)</u> [1]
Wetlands with least November depth variability are generally those closest to the coast and those with most variability are generally inland. Jasper has the least November depth variability, relative to its median depth.

5.1.3 September Salinities

Median, minimum and maximum September salinities of all 151 monitored wetlands (historical and current) are shown in Figures 4(a), 4(b), 4(c). The statistical distributions of median, minimum and maximum September salinities are also provided, in tabular form, and the 10 least saline wetlands (lowest medians, lowest minima and lowest maxima) are listed. September salinity variabilities of all wetlands monitored for 10 or more years are shown in Figure 4(d). The 10 wetlands with least variability in September salinities are listed, together with their variabilities and the statistics used to compute them (see section 4.6). The circles representing all listed wetlands, and others of interest, have been labelled to assist in locating them. The results may be summarised as follows.

<u>Medians (Figure 4a)</u>
Many (42%) monitored wetlands have median September salinities of <1 ppt (29%) or 1<3 ppt (13%) and are thus very fresh or fresh. More (45%) have salinities of 10<50 ppt (25%) or ≥50 (20%) and are thus saline or hypersaline. The freshest wetland in September is typically Dobaderry (median 0.04 ppt). Most inland wetlands are typically saline or hypersaline in September. Fresh and very fresh wetlands in September are found both inland and close to the coast. Wetlands on the eastern south coast are typically more saline than elsewhere on the coast.

<u>Minima (Figure 4b)</u>
Most (56%) monitored wetlands have minimum September salinities of <1 ppt (42%) or 1<3 ppt (14%) and are thus very fresh or fresh. Relatively few (23%) have minimum salinities of 10<50 ppt (16%) or ≥50 ppt (7%) and are thus saline or hypersaline. Dobaderry is the freshest (minimum 0.02 ppt). Minimum September salinities of inland wetlands range widely, from very fresh to hypersaline. Most

[1] Altham, Dundas 33113, Egret and Varley had ‘undefined’ November depth variabilities, due to their 50th percentiles equalling zero. Esperance 27985, Mount Marshall 26687 and Pallarup had ‘indeterminate’ November depth variabilities, due to their 75th (and therefore 25th and 50th) percentiles equalling zero.

coastal wetlands have very fresh minima, however those on the eastern south coast are generally more saline.

Maxima (Figure 4c)
More than one third (36%) of monitored wetlands have maximum September salinities of <1 ppt (20%) or 1<3 ppt (16%) and are thus fresh or very fresh. More than one half (57%) have maximum salinities of 10<50 ppt (18%) or ≥50 ppt (39%) and are thus saline or hypersaline. The freshest is Goonapping (0.05 ppt). Many inland wetlands have hypersaline maxima in September. Wetlands with fresh or very fresh maxima are mostly found near the coast. Most wetlands on the eastern south coast have saline or hypersaline maxima.

Variability (Figure 4d)
Wetlands with medium or high salinity variability ((75%-25%)/50%) are generally inland or near the eastern south coast, whereas those with low variability are generally closer to other parts of the coast. Davies has the least September salinity variability, relative to its median salinity. Nine of the 10 wetlands with lowest September salinity variability are typically 'fresh' (1<3ppt) or 'very fresh' (<1ppt). In contrast, Clifton is typically saline (10<50ppt).

5.1.4 November Salinities

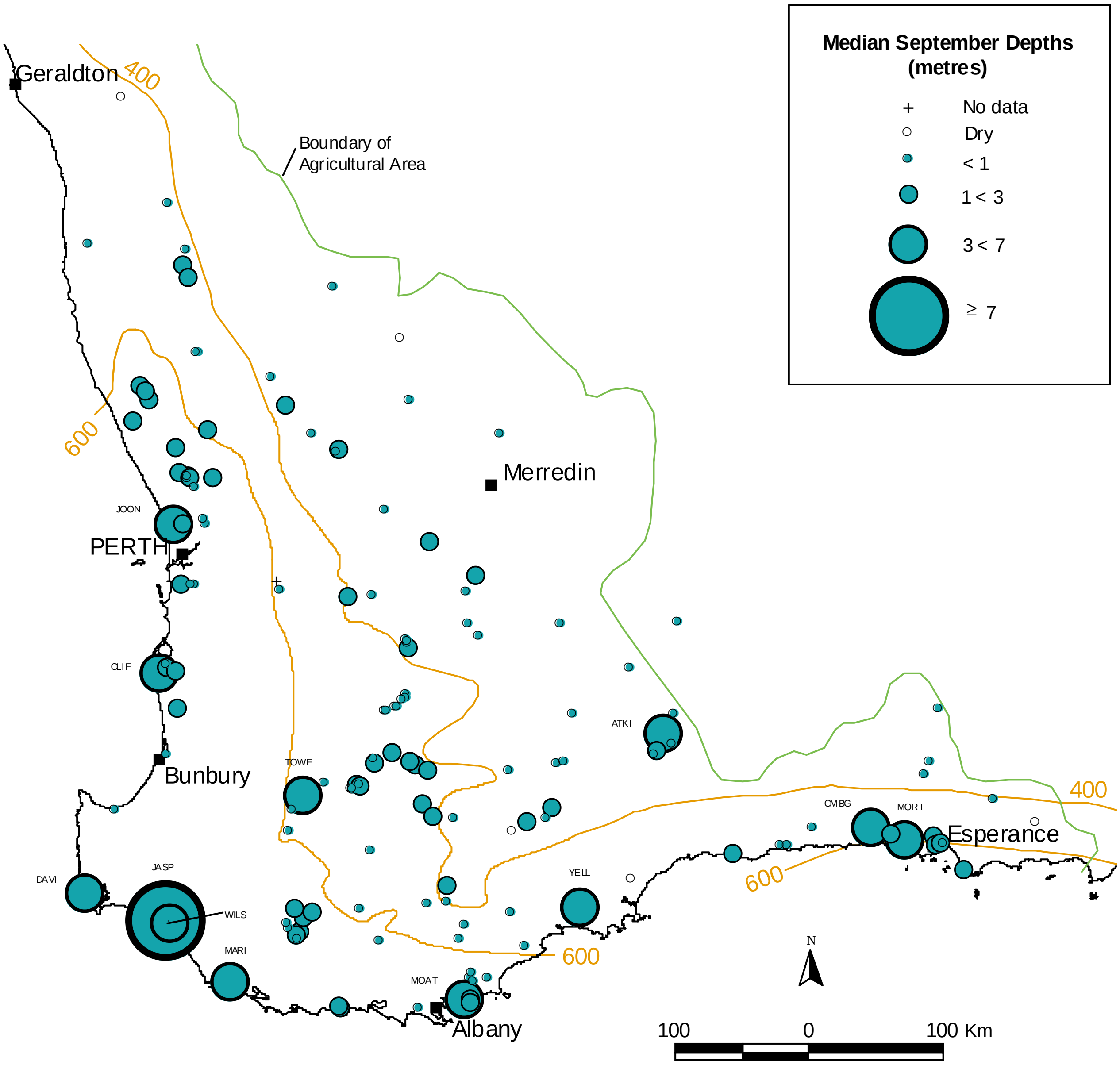
Median, minimum and maximum November salinities of all 151 monitored wetlands (historical and current) are shown in Figures 5(a), 5(b), 5(c). The statistical distributions of median, minimum and maximum November salinities are also provided, in tabular form, and the 10 least saline wetlands (lowest medians, lowest minima and lowest maxima) are listed. November salinity variabilities of all wetlands monitored for 10 or more years are shown in Figure 5(d). The 10 wetlands with least variability in November salinities are listed, together with their variabilities and the statistics used to compute them (see section 4.6). The circles representing all listed wetlands, and others of interest, have been labelled to assist in locating them. The results may be summarised as follows.

Medians (Figure 5a)
Many (41%) monitored wetlands have median November salinities of <1 ppt (25%) or 1<3 ppt (16%) and are thus very fresh or fresh. More (46%) have salinities of 10<50 ppt (28%) or ≥50 (18%) and are thus saline or hypersaline. The freshest wetland in November is typically Dobaderry (median 0.07 ppt). Most inland wetlands are typically saline or hypersaline in November. Fresh and very fresh wetlands in November are found both inland and close to the coast. Wetlands on the eastern south coast are typically more saline than elsewhere on the coast.

Minima (Figure 5b)
Most (52%) monitored wetlands have minimum November salinities of <1 ppt (36%) or 1<3 ppt (16%) and are thus very fresh or fresh. Relatively few (26%) have minimum salinities of 10<50 ppt (19%) or ≥50 ppt (7%) and are thus saline or hypersaline. Dobaderry is the freshest (minimum 0.05 ppt). Minimum November salinities of inland wetlands range widely, from very fresh to hypersaline. Most coastal wetlands have very fresh minima, however those on the eastern south coast are generally more saline.

Maxima (Figure 5c)
Almost one third (32%) of monitored wetlands have maximum November salinities of <1 ppt (17%) or 1<3 ppt (15%) and are thus fresh or very fresh. More than one half (56%) have maximum salinities of 10<50 ppt (15%) or ≥50 ppt (41%) and are thus saline or hypersaline. The freshest is Wilson (0.16 ppt). Many inland wetlands have hypersaline maxima in November. Wetlands with fresh or very fresh maxima are mostly found near the coast. Those on the eastern south coast are more saline.

Variability (Figure 5d)
Wetlands with medium or high November salinity variability are generally inland or near the eastern south coast, whereas those with low variability are generally closer to other parts of the coast. Jasper has the least November salinity variability, relative to its median salinity. Eight of the 10 wetlands with lowest November salinity variability are typically 'fresh' (1<3ppt) or 'very fresh' (<1ppt). In contrast, Clifton and Station are typically saline (10<50ppt).



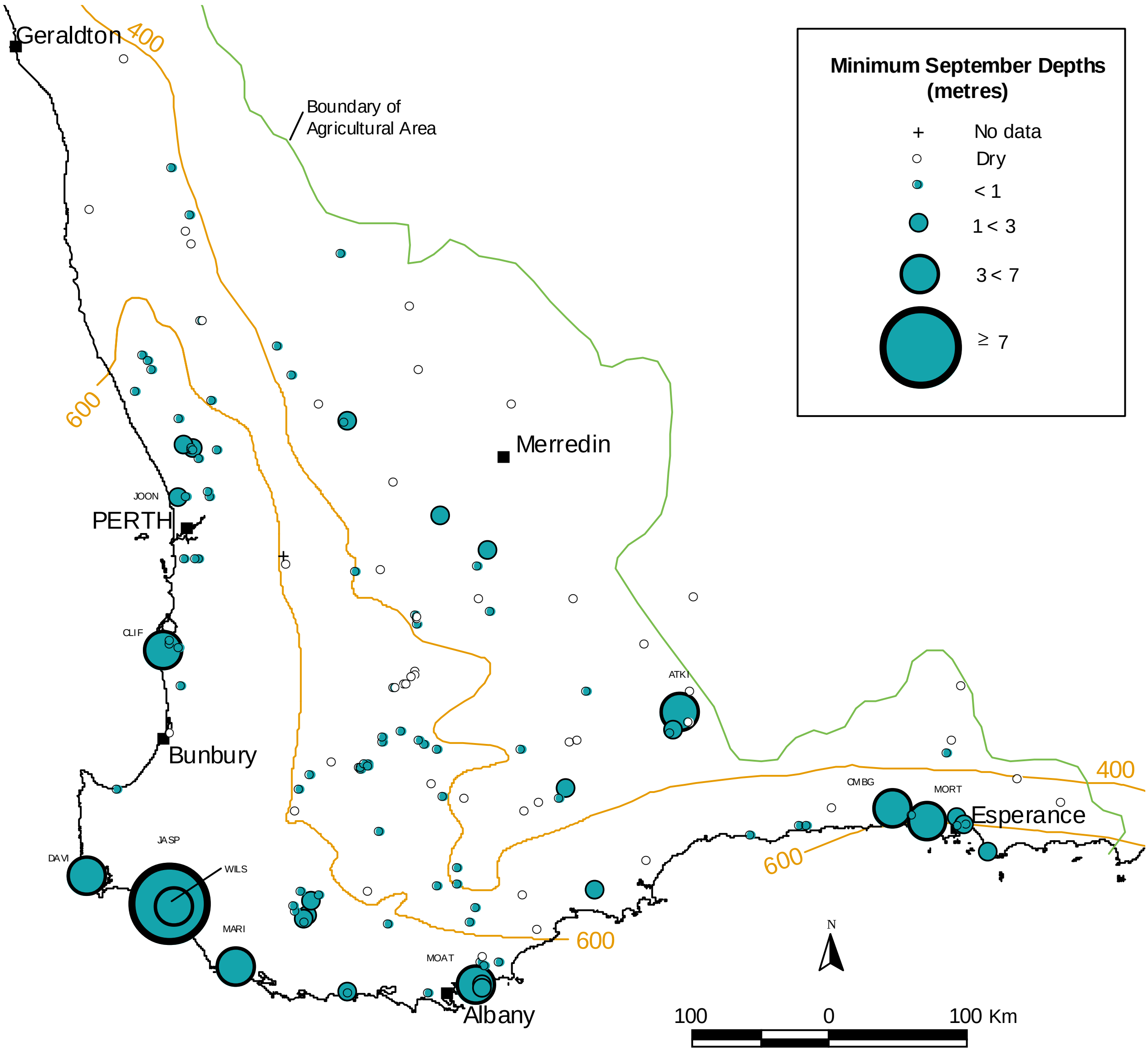
MEDIAN SEPTEMBER DEPTH DISTRIBUTION

Depth Categories (metres)	No. of Wetlands	(%)
No depth data	1	-
Dry	5	3
<1	82	54
1<2	41	27
2<3	10	7
3<5	10	7
5<7	1	1
≥7	1	1
Total	**151**	**100**

TEN DEEPEST WETLANDS IN SEPTEMBER

Wetland	No. of Records	Median Depth (metres)
Jasper	15	9.68
Maringup	6	6.50
Davies	8	4.73
Atkins Yate	1	4.67
Moates	19	4.51
Clifton	14	4.43
Wilson	9	3.90
Mortijinup	1	3.45
Towerrinning	20	3.17
Yellilup	13	3.13

Figure 2 (a): Median September Depths



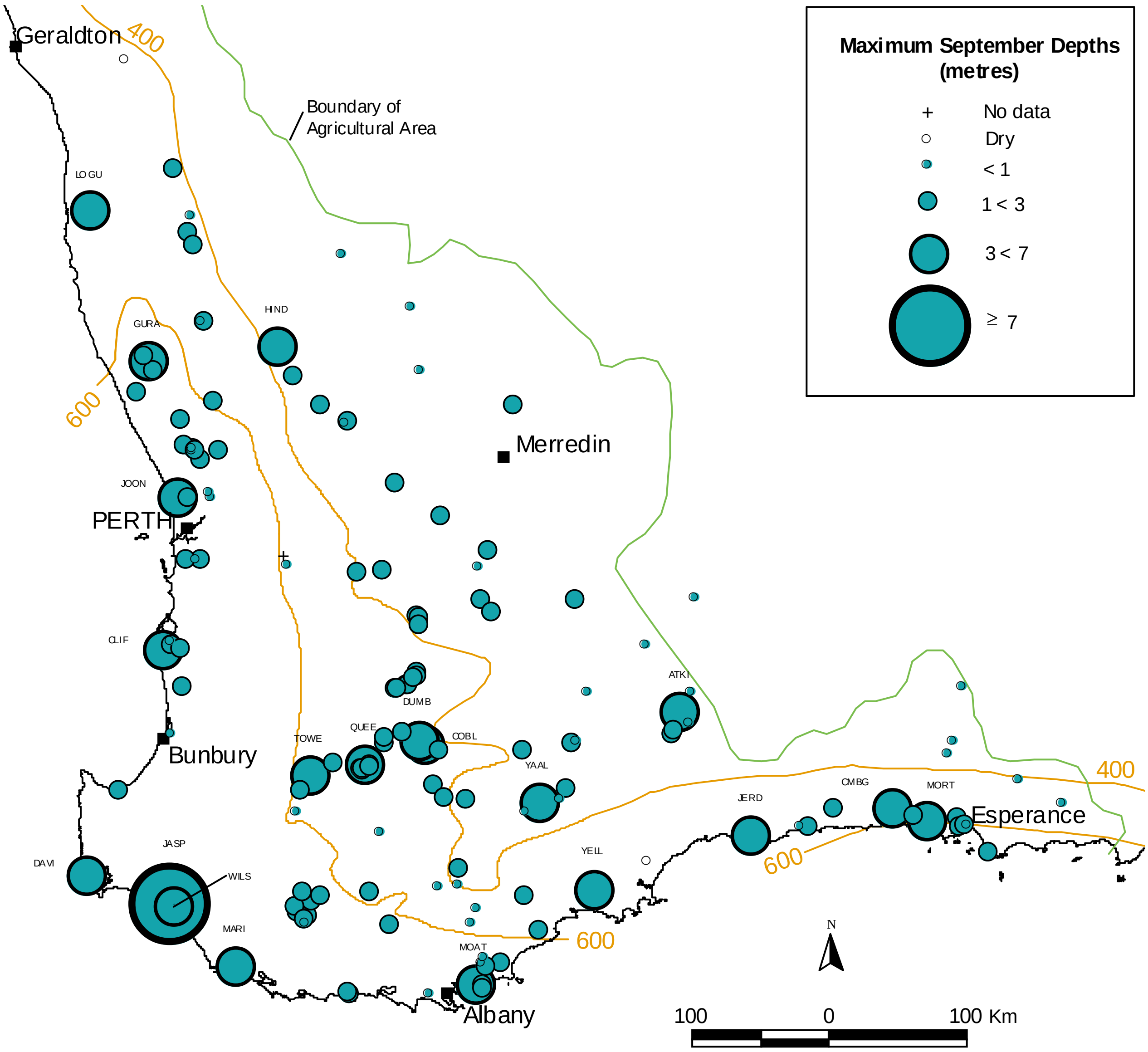
MINIMUM SEPTEMBER DEPTH DISTRIBUTION

Depth Categories (metres)	No. of Wetlands	(%)
No depth data	1	-
Dry	45	30
<1	78	52
1<2	12	8
2<3	6	4
3<5	7	4
5<7	1	1
≥7	1	1
Total	**151**	**100**

TEN DEEPEST WETLANDS IN SEPTEMBER

Wetland	No. of Records	Minimum Depth (metres)
Jasper	15	9.21
Maringup	6	6.28
Atkins Yate	1	4.67
Davies	8	4.53
Moates	19	4.41
Clifton	14	4.20
Wilson	9	3.50
Mortijinup	1	3.45
Coomalbidgup	1	3.09
Joondalup	20	2.62

Figure 2 (b): Minimum September Depths



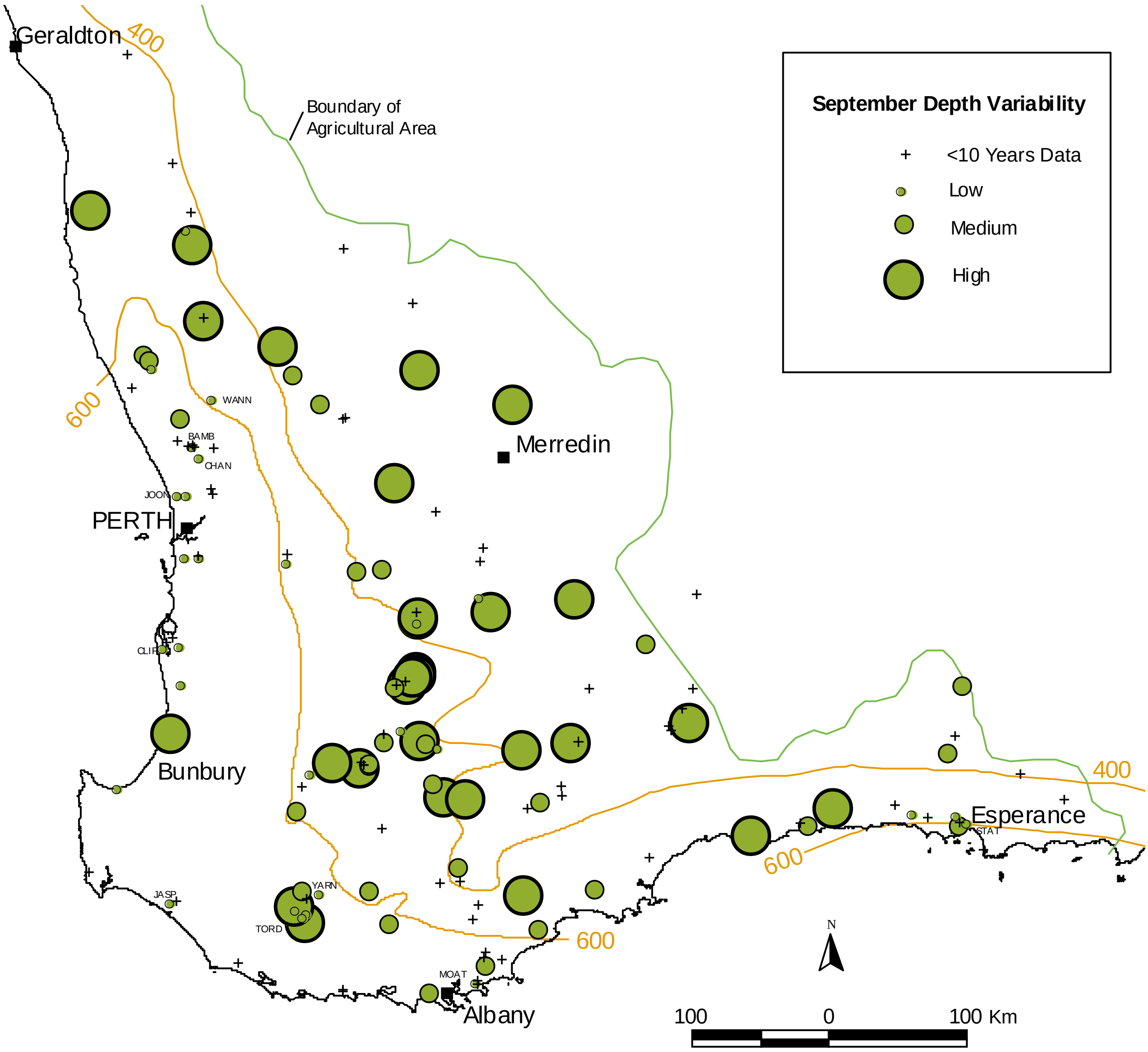
MAXIMUM SEPTEMBER DEPTH DISTRIBUTION

Depth Categories (metres)	No. of Wetlands	(%)
No depth data	1	-
Dry	2	1
<1	40	27
1<2	51	34
2<3	37	24
3<5	18	12
5<7	1	1
≥7	1	1
Total	**151**	**100**

TEN DEEPEST WETLANDS IN SEPTEMBER

Wetland	No. of Records	Maximum Depth (metres)
Jasper	15	9.79
Maringup	6	6.59
Davies	8	4.88
Yellilup	13	4.84
Moates	19	4.82
Coblinine	13	4.80
Clifton	14	4.68
Atkins Yate	1	4.67
Hinds	17	4.45
Jerdacuttup	21	4.45

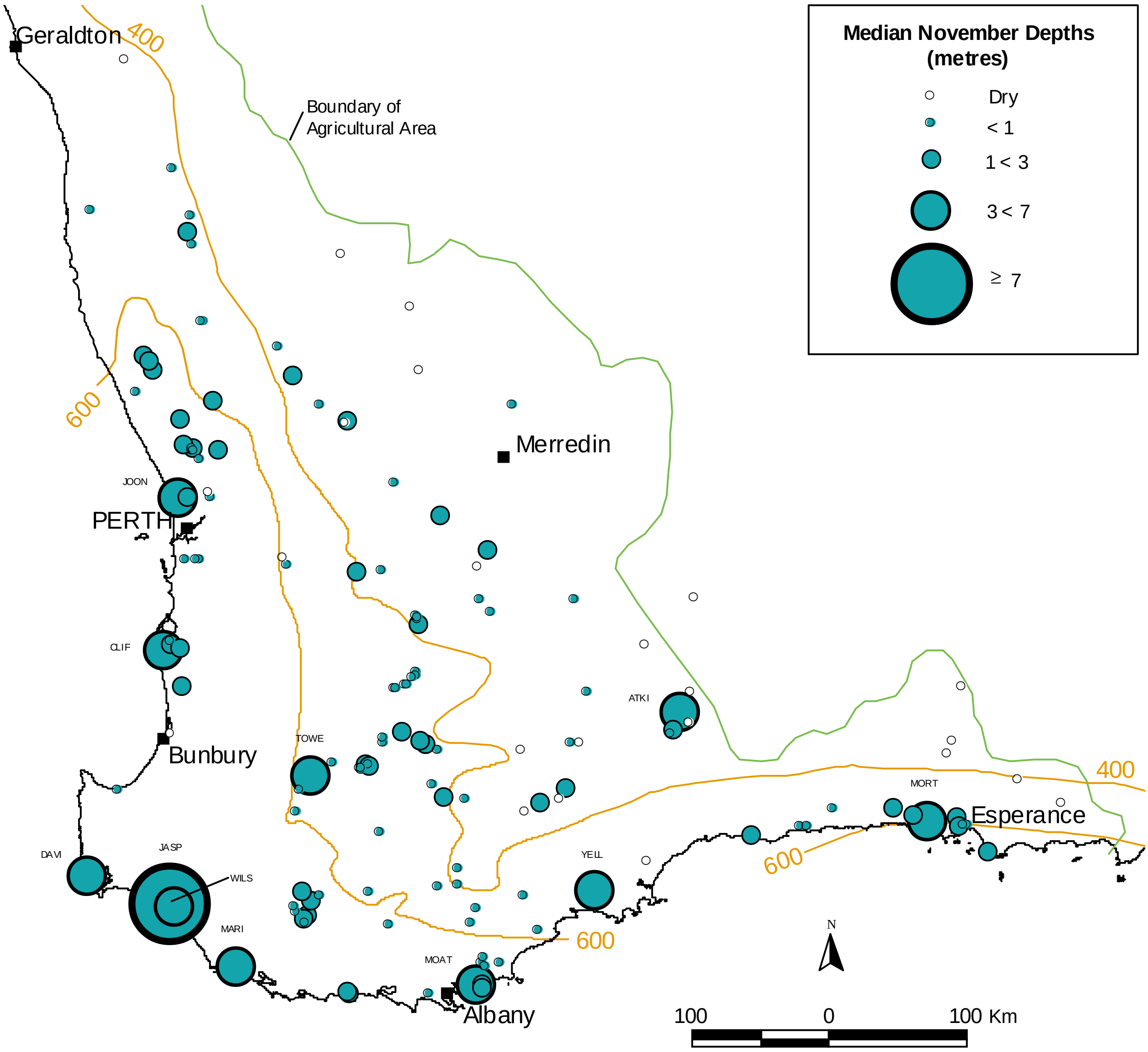
Figure 2 (c): Maximum September Depths



TEN LEAST VARIABLE WETLANDS IN SEPTEMBER

Wetland	No. of Records	Median Depth (metres)	25%-75% Range	Depth Variability
Jasper	15	9.68	9.58 – 9.72	0.01
Bambun	18	2.50	2.47 – 2.52	0.02
Moates	19	4.51	4.46 – 4.57	0.02
Clifton	14	4.43	4.30 – 4.49	0.04
Station	21	0.70	0.68 – 0.73	0.07
Joondalup	20	3.03	2.90 – 3.12	0.07
Tordit-Gurrup	22	2.54	2.49 – 2.70	0.08
Chandala	20	0.94	0.90 – 0.99	0.10
Wannamal	22	1.51	1.44 – 1.59	0.10
Yarnup	20	1.07	1.03 – 1.14	0.10

Figure 2 (d): Median September Depth Variability



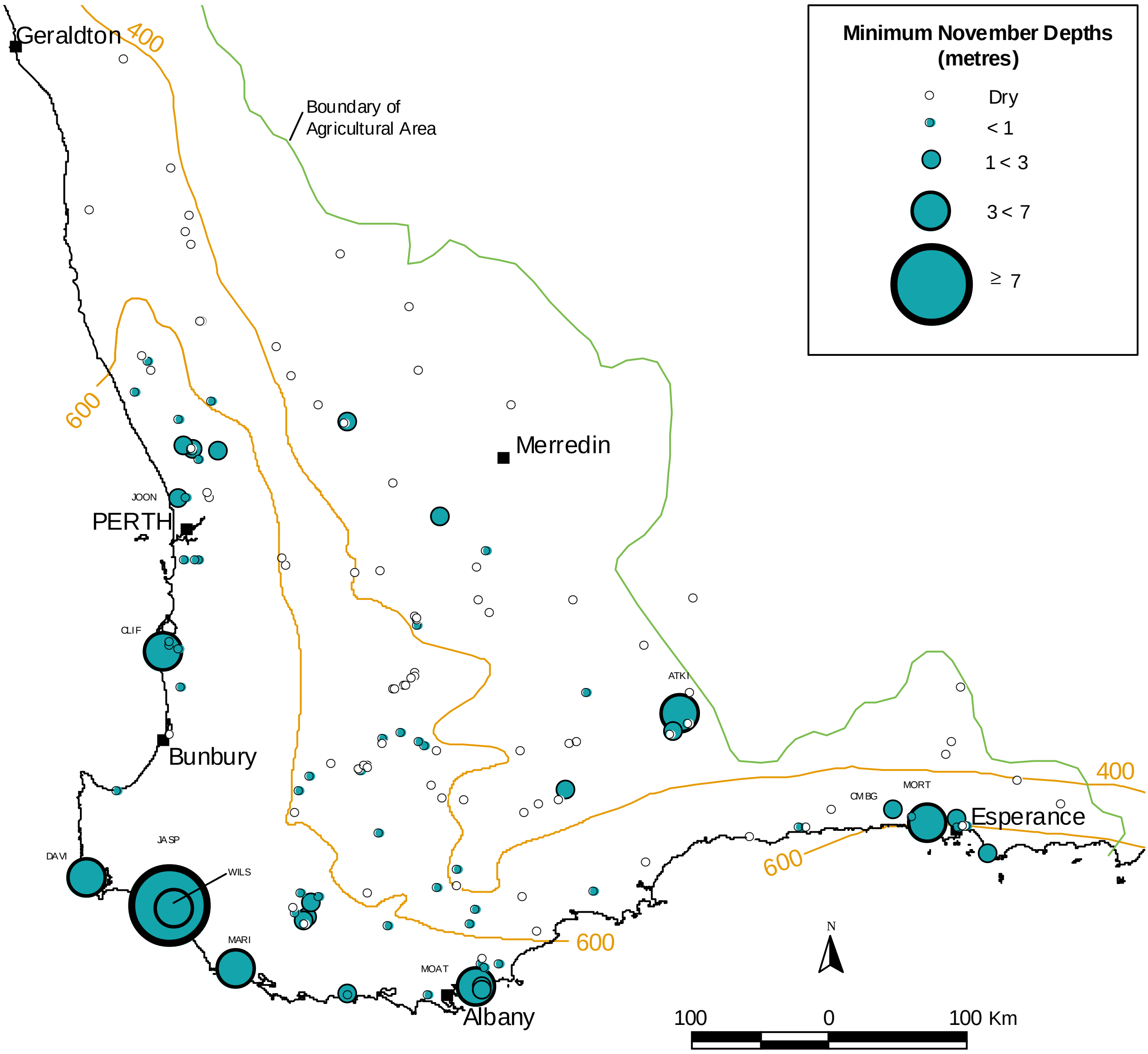
MEDIAN NOVEMBER DEPTH DISTRIBUTION

Depth Categories (metres)	No. of Wetlands	(%)
Dry	23	15
<1	75	49
1<2	33	22
2<3	9	6
3<5	9	6
5<7	1	1
≥7	1	1
Total	**151**	**100**

TEN DEEPEST WETLANDS IN NOVEMBER

Wetland	No. of Records	Median Depth (metres)
Jasper	15	9.59
Maringup	8	6.22
Davies	8	4.51
Atkins Yate	1	4.40
Clifton	17	4.35
Moates	22	4.34
Wilson	8	3.69
Yellilup	16	3.23
Mortijinup	1	3.15
Towerrinning	22	3.08

Figure 3 (a): Median November Depths



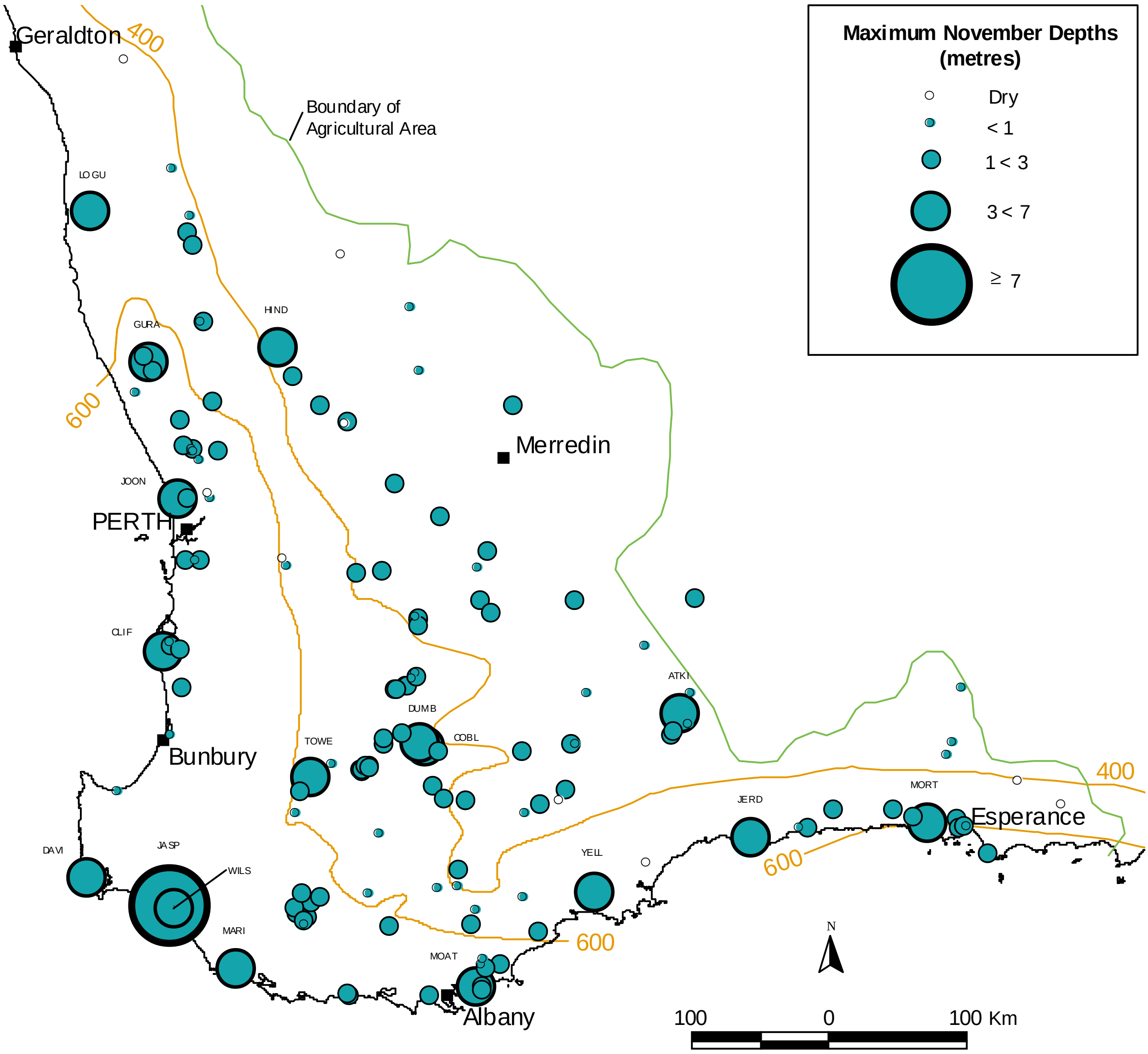
MINIMUM NOVEMBER DEPTH DISTRIBUTION

Depth Categories (metres)	No. of Wetlands	(%)
Dry	80	53
<1	46	30
1<2	13	8
2<3	4	3
3<5	6	4
5<7	1	1
≥7	1	1
Total	**151**	**100**

TEN DEEPEST WETLANDS IN NOVEMBER

Wetland	No. of Records	Minimum Depth (metres)
Jasper	15	9.14
Maringup	8	6.13
Atkins Yate	1	4.40
Davies	8	4.33
Moates	22	4.22
Clifton	17	4.09
Wilson	8	3.46
Mortijinup	1	3.15
Coomalbidgup	2	2.64
Joondalup	20	2.58

Figure 3 (b): Minimum November Depths



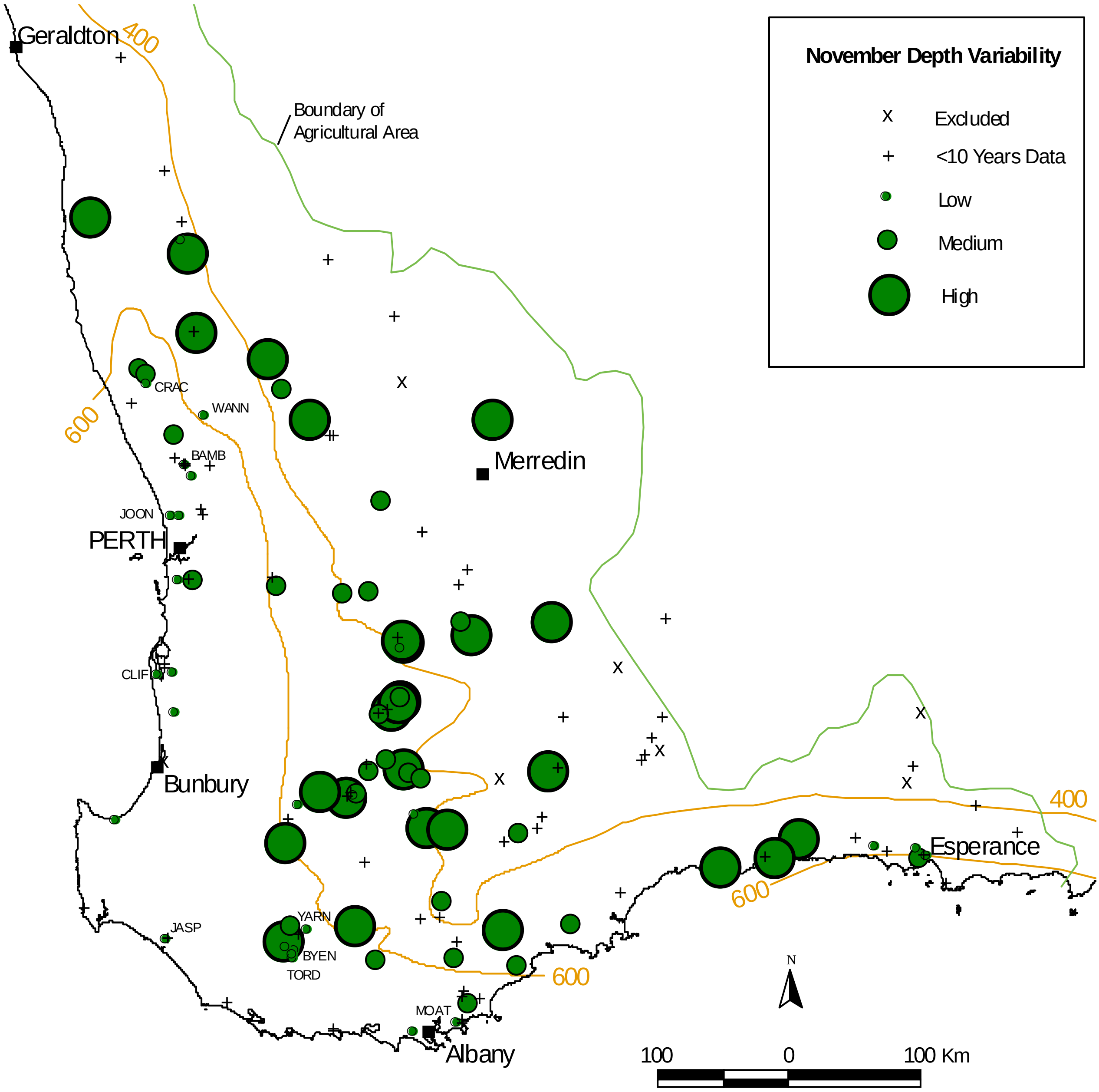
MAXIMUM NOVEMBER DEPTH DISTRIBUTION

Depth Categories (metres)	No. of Wetlands	(%)
Dry	9	6
<1	42	28
1<2	52	34
2<3	31	21
3<5	14	9
5<7	2	1
≥7	1	1
Total	**151**	**100**

TEN DEEPEST WETLANDS IN NOVEMBER

Wetland	No. of Records	Maximum Depth (metres)
Jasper	15	9.68
Maringup	8	6.36
Coblinine	13	5.06
Yellilup	16	4.76
Davies	8	4.66
Clifton	17	4.55
Moates	22	4.51
Dumbleyung	22	4.45
Atkins Yate	1	4.40
Hinds	17	4.23

Figure 3 (c): Maximum November Depths

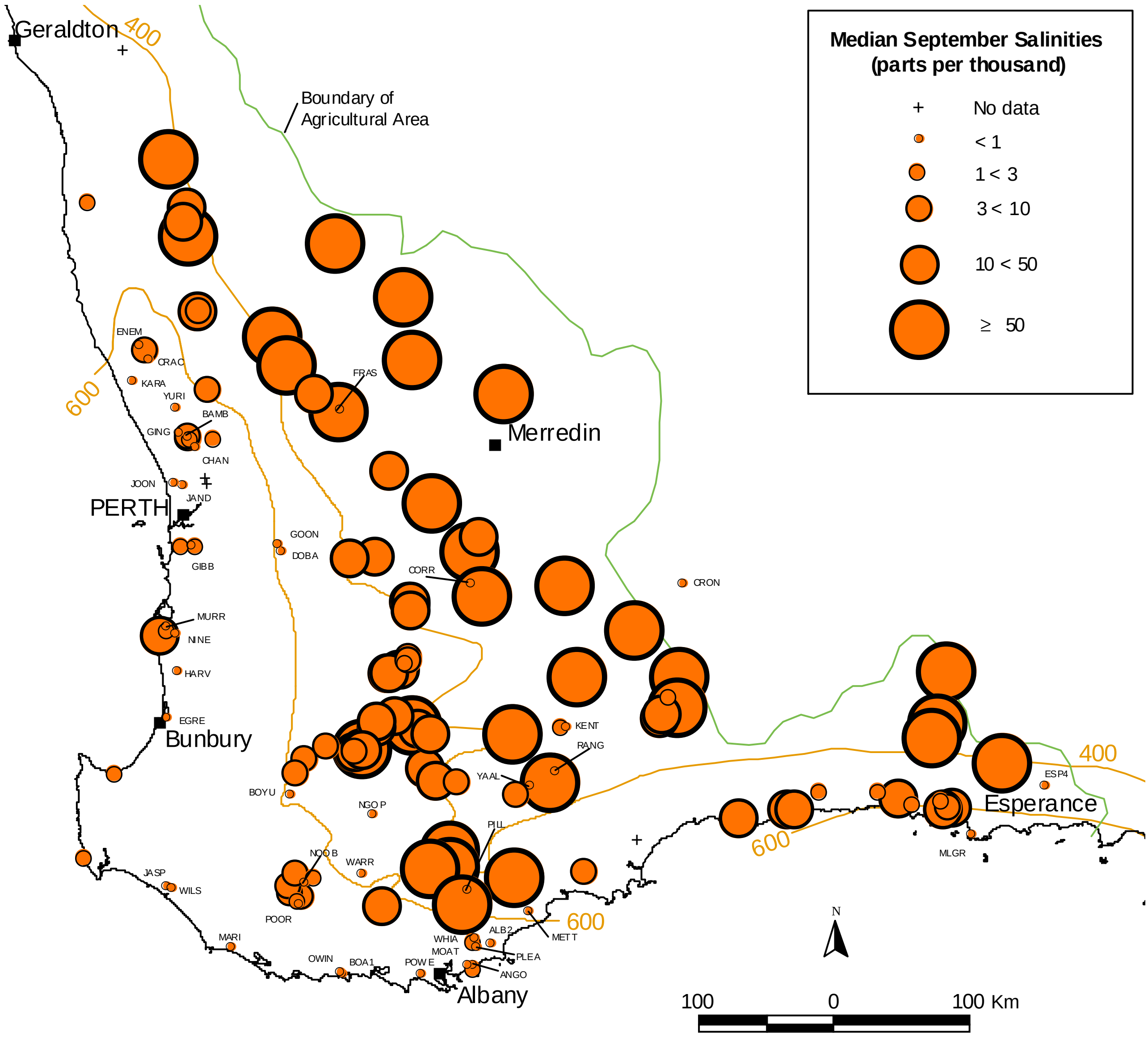


TEN LEAST VARIABLE WETLANDS IN NOVEMBER

Wetland	No. of Records	Median Depth (metres)	25%-75% Range	Depth Variability
Jasper	15	9.59	9.54 – 9.61	0.01
Moates	22	4.34	4.30 – 4.38	0.02
Bambun	21	2.33	2.27 – 2.37	0.04
Clifton	17	4.35	4.20 – 4.41	0.05
Byenup	21	2.34	2.27 – 2.41	0.06
Yarnup	21	0.94	0.91 – 0.97	0.06
Crackers	21	1.00	0.96 – 1.03	0.07
Wannamal	22	1.28	1.23 – 1.32	0.07
Joondalup	20	3.00	2.85 – 3.09	0.08
Tordit-Gurrup	21	2.57	2.51 – 2.72	0.08

Figure 3 (d): Median November Depth Variability

* Excluded wetlands (7) have variabilities that are undefined (4) or indeterminate (3) (see section 5.1.2).



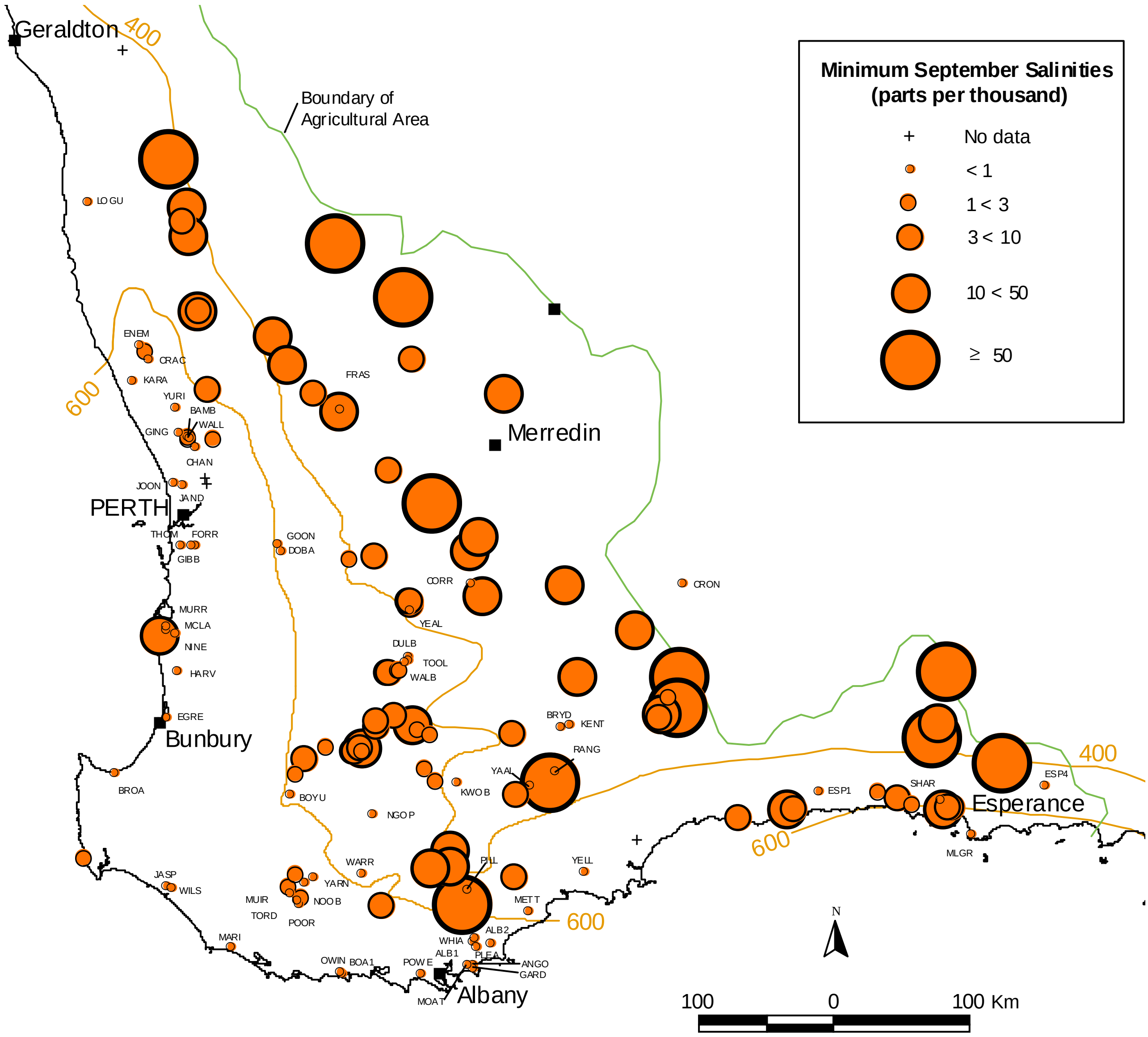
MEDIAN SEPTEMBER SALINITY DISTRIBUTION

Salinity Categories (ppt)	No. of Wetlands	(%)
No salinity data	4	-
<1	42	29
1<3	19	13
3<10	19	13
10<50	37	25
≥50	30	20
Total	**151**	**100**

TEN FRESHEST WETLANDS IN SEPTEMBER

Wetland	No. of Records	Median Salinity (ppt)
Dobaderry	20	0.04
Goonaping	1	0.05
Warrinup	17	0.11
Ngopitchup	1	0.12
Gibb Road	9	0.13
Wilson	9	0.13
Jasper	15	0.20
Range Road Yate	1	0.21
Maringup	6	0.22
Mettler	16	0.22

Figure 4 (a): Median September Salinities



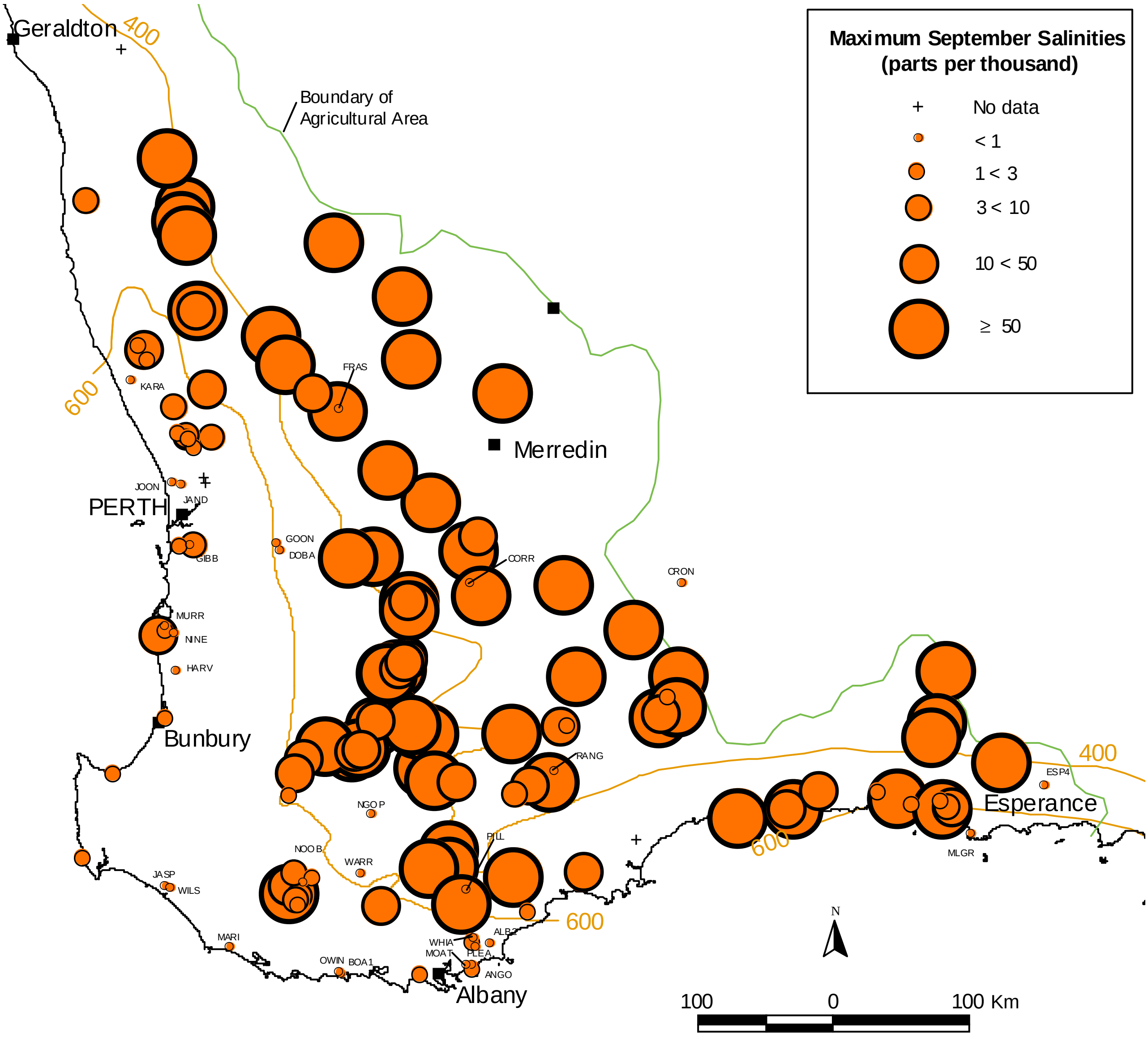
MINIMUM SEPTEMBER SALINITY DISTRIBUTION

Salinity Categories (ppt)	No. of Wetlands	(%)
No salinity data	4	-
<1	62	42
1<3	21	14
3<10	30	21
10<50	23	16
≥50	11	7
Total	**151**	**100**

TEN FRESHEST WETLANDS IN SEPTEMBER

Wetland	No. of Records	Minimum Salinity (ppt)
Dobaderry	20	0.02
Goonaping	1	0.05
Tordit-Gurrup	24	0.07
Warrinup	17	0.08
Mettler	16	0.08
Albany 27157	5	0.08
Pleasant View	19	0.09
Gibb Road	9	0.10
Wilson	9	0.10
Jandabup	20	0.11

Figure 4 (b): Minimum September Salinities



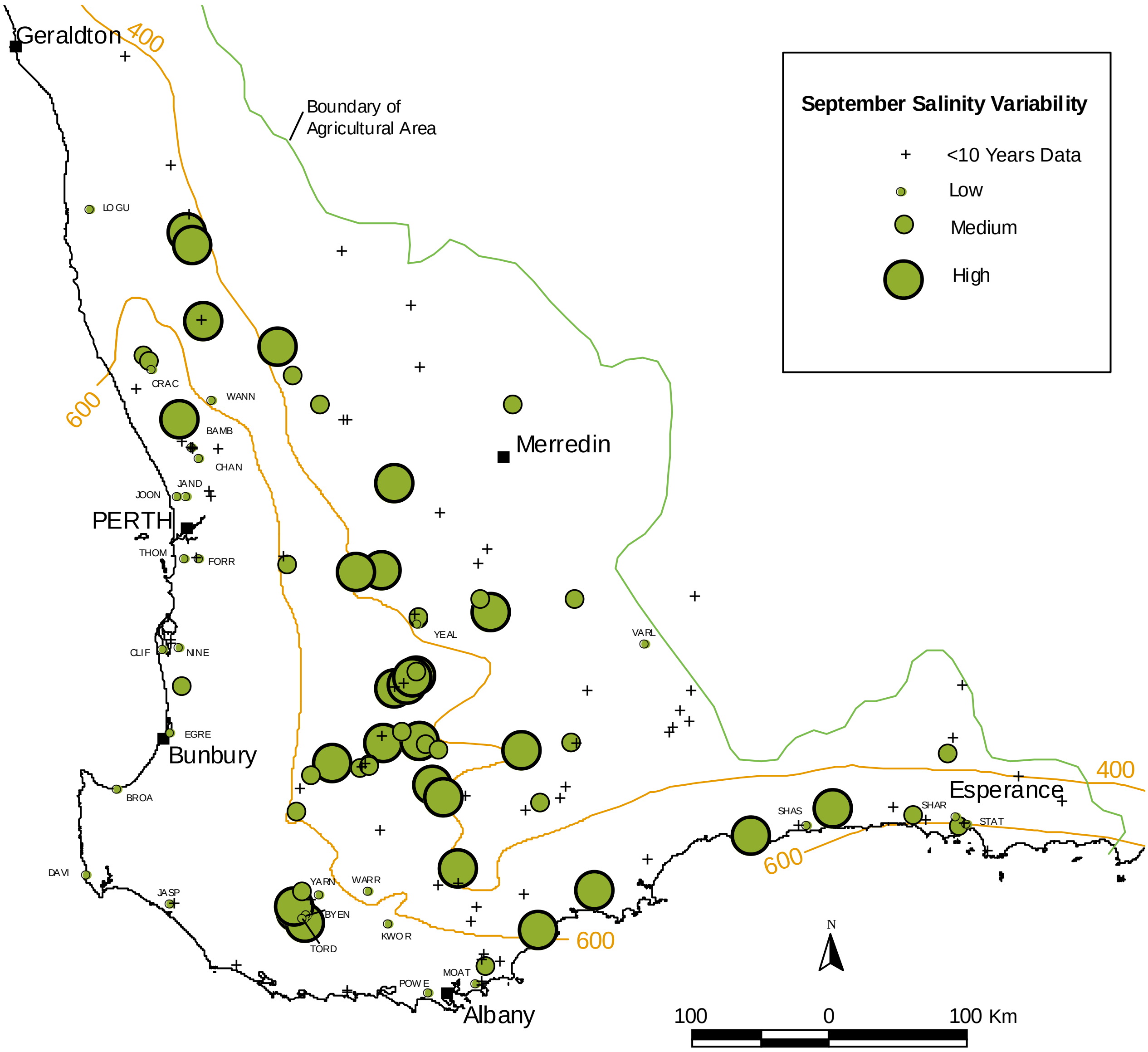
MAXIMUM SEPTEMBER SALINITY DISTRIBUTION

Salinity Categories (ppt)	No. of Wetlands	(%)
No salinity data	4	-
<1	29	20
1<3	23	16
3<10	11	7
10<50	27	18
≥50	57	39
Total	**151**	**100**

TEN FRESHEST WETLANDS IN SEPTEMBER

Wetland	No. of Records	Maximum Salinity (ppt)
Goonaping	1	0.05
Ngopitchup	1	0.12
Wilson	9	0.17
Gibb Road	9	0.20
Range Road Yate	1	0.21
Jasper	15	0.22
Maringup	6	0.24
Mt Le Grand	1	0.36
Warrinup	17	0.40
Albany 27157	5	0.40

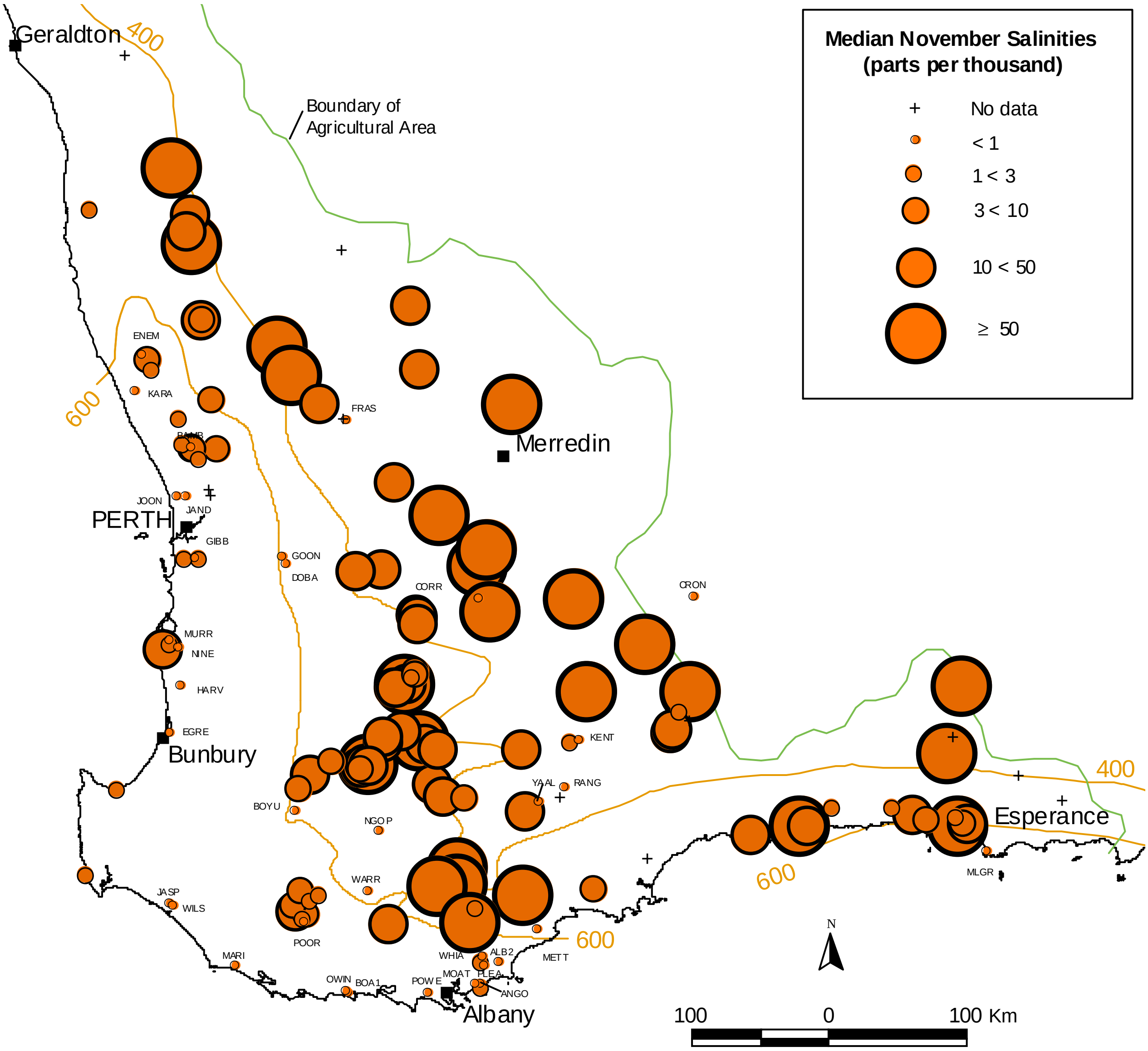
Figure 4 (c): Maximum September Salinities



TEN LEAST VARIABLE WETLANDS IN SEPTEMBER

Wetland	No. of Records	Median Salinity (ppt)	25%-75% Range	Salinity Variability
Davies	10	1.66	1.62 – 1.69	0.04
Jasper	15	0.20	0.19 – 0.21	0.10
Joondalup	20	0.63	0.57 – 0.68	0.17
Nine Mile	19	0.33	0.30 – 0.36	0.18
Tordit-Gurrup	24	1.09	1.00 – 1.21	0.19
Clifton	14	20.60	17.40 – 22.35	0.24
Chandala	20	0.71	0.61 – 0.86	0.35
Bambun	19	0.81	0.76 – 1.05	0.36
Forrestdale	20	1.47	1.20 – 1.77	0.39
Egret	12	0.71	0.54 – 0.82	0.39

Figure 4 (d): Median September Salinity Variability



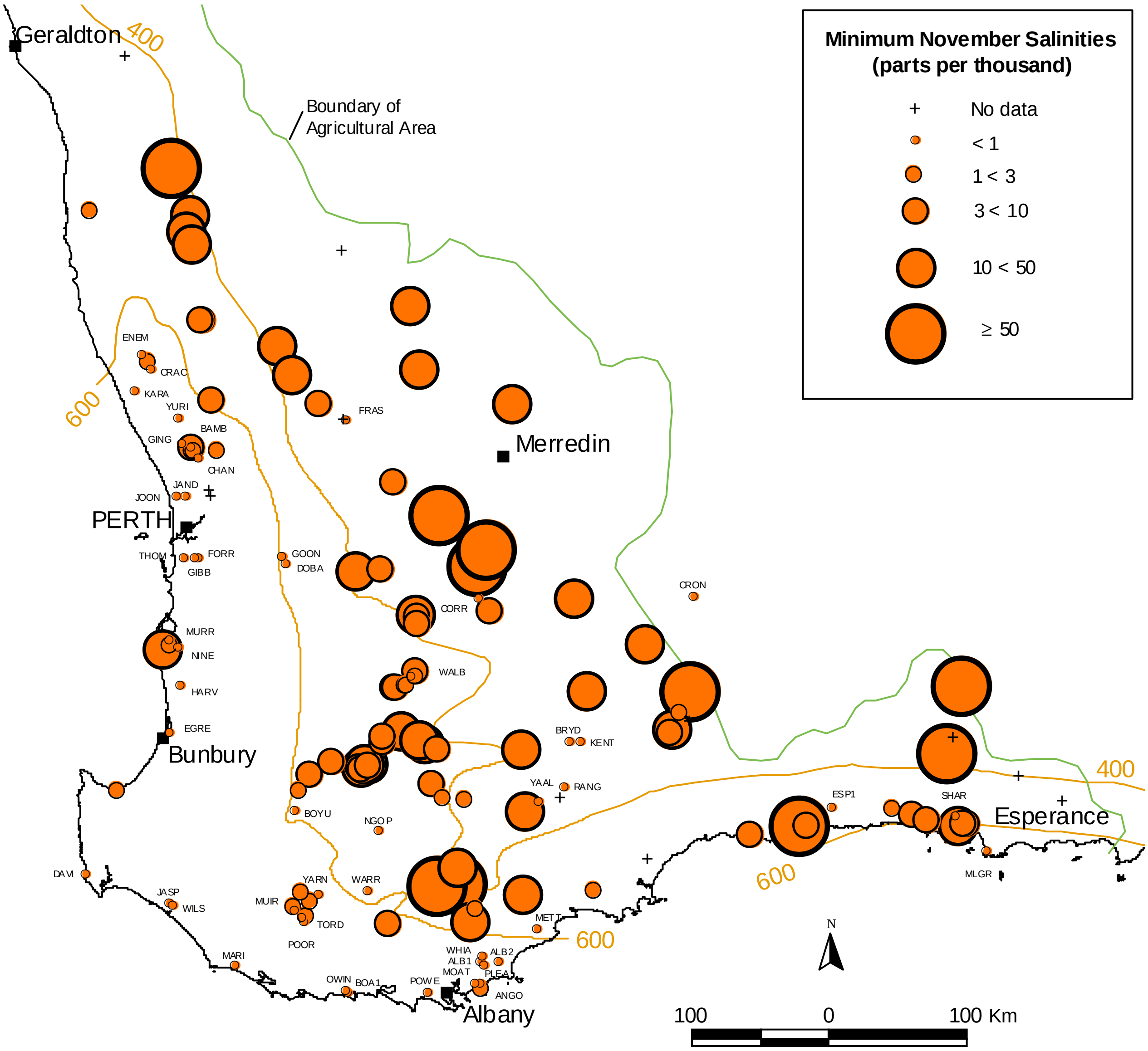
MEDIAN NOVEMBER SALINITY DISTRIBUTION

Salinity Categories (ppt)	No. of Wetlands	(%)
No salinity data	11	-
<1	35	25
1<3	22	16
3<10	19	13
10<50	39	28
≥50	25	18
Total	**151**	**100**

TEN FRESHEST WETLANDS IN NOVEMBER

Wetland	No. of Records	Median Salinity (ppt)
Dobaderry	15	0.07
Warrinup	18	0.15
Wilson	8	0.15
Gibb Road	9	0.19
Goonaping	1	0.19
Jasper	15	0.22
Maringup	8	0.22
Mettler	17	0.24
Range Road Yate	1	0.25
Poorginup	20	0.26

Figure 5 (a): Median November Salinities



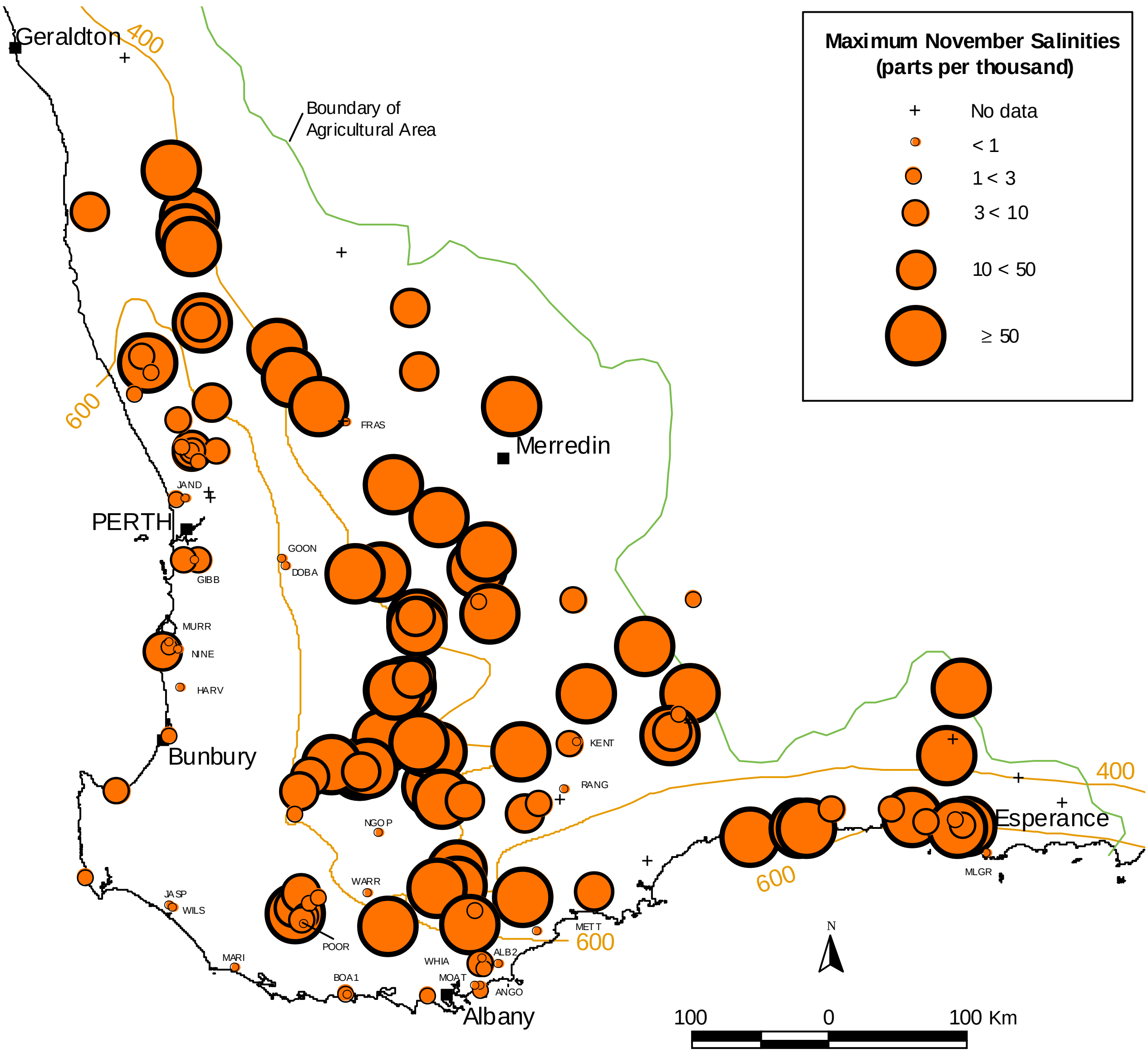
MINIMUM NOVEMBER SALINITY DISTRIBUTION

Salinity Categories (ppt)	No. of Wetlands	(%)
No salinity data	11	-
<1	50	36
1<3	22	16
3<10	31	22
10<50	27	19
≥50	10	7
Total	**151**	**100**

TEN FRESHEST WETLANDS IN NOVEMBER

Wetland	No. of Records	Minimum Salinity (ppt)
Dobaderry	15	0.05
Mettler	17	0.10
Poorginup	20	0.10
Warrinup	18	0.10
Wilson	8	0.12
Cronin	2	0.12
Gibb Road	9	0.14
Albany 27157	5	0.15
Eneminga	11	0.16
Yaalup	15	0.16

Figure 5 (b): Minimum November Salinities



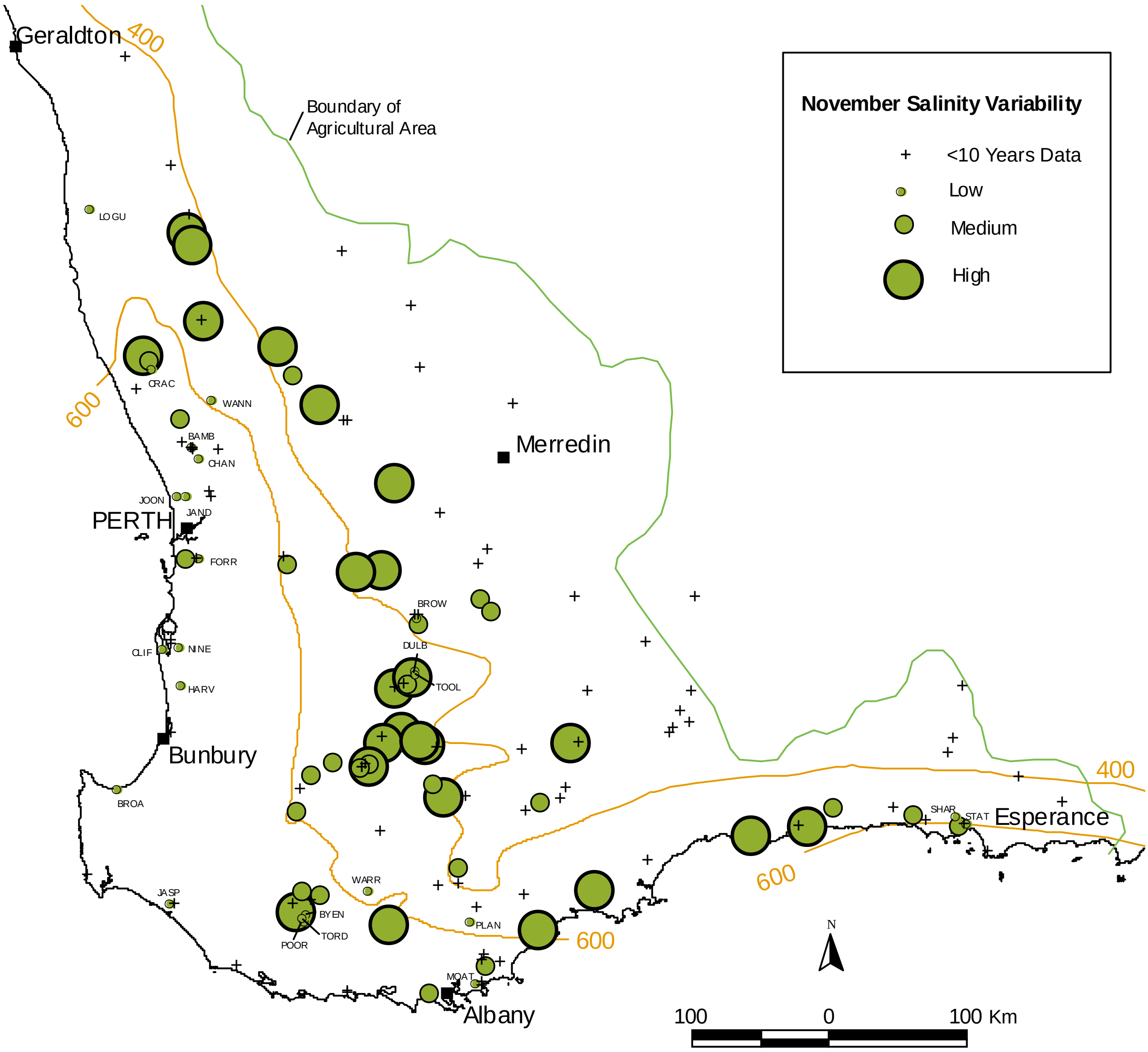
MAXIMUM NOVEMBER SALINITY DISTRIBUTION

Salinity Categories (ppt)	No. of Wetlands	(%)
No salinity data	11	-
<1	23	17
1<3	21	15
3<10	17	12
10<50	21	15
≥50	58	41
Total	**151**	**100**

TEN FRESHEST WETLANDS IN NOVEMBER

Wetland	No. of Records	Maximum Salinity (ppt)
Wilson	8	0.16
Goonaping	1	0.19
Jasper	15	0.23
Range Road Yate	1	0.25
Maringup	8	0.27
Dobaderry	15	0.40
Mt Le Grand	1	0.43
Ngopitchup	1	0.44
Warrinup	18	0.50
Gibb Road	9	0.50

Figure 5 (c): Maximum November Salinities



TEN LEAST VARIABLE WETLANDS IN NOVEMBER

Wetland	No. of Records	Median Salinity (ppt)	25%-75% Range	Salinity Variability
Jasper	15	0.22	0.19 – 0.23	0.18
Joondalup	20	0.72	0.67 – 0.82	0.21
Clifton	16	20.72	17.98 – 23.90	0.29
Tordit-Gurrup	21	1.20	0.91 – 1.26	0.29
Crackers	19	1.06	0.84 – 1.15	0.29
Chandala	22	1.20	1.00 – 1.36	0.30
Nine Mile	20	0.36	0.31 – 0.43	0.33
Station	21	16.55	15.10 – 21.00	0.36
Moates	22	0.46	0.39 – 0.57	0.39
Broadwater	15	2.37	1.96 – 2.90	0.40

Figure 5 (d): Median November Salinity Variability

5.2 Trends in depths and salinities over 20 or more years

Trends in September, November and September+November depths and salinities of all wetlands monitored for 20 or more years are shown in Figures 6(a-c) & 7(a-c). Trends are for the entire periods of monitoring of each wetland. The statistical distributions of trends and levels of significance are presented in tabular form. Where p is ≥0.05 any apparent trend is regarded as 'not significant'. Trends are considered 'significant' where p<0.05; 'highly significant' where p<0.01, and 'very highly significant' where p<0.001. In addition, all wetlands with statistically significant trends are tabulated, sorted firstly by direction of change (increasing or decreasing) and secondly by significance (p) values. The p values are not shown, however the Trend & Significance Codes, which are shown, are based on these. The average rates of change (metres per year; parts per thousand per year) in depth or salinity of each of these wetlands over their periods of monitoring are also presented. Results are summarised below. Note that trends at each wetland are presented individually in Figures 8-48, together with trends in rainfall. These are discussed more fully in Sections 5.3-5.5.

5.2.1 September Depth Trends

Most (76%) of the 33 wetlands that have been monitored for 20 or more Septembers show no significant trend in September depths. 21% (7 wetlands) show an increasing trend. Only 3% (one wetland - Forrestdale) show a decreasing trend. There has been a 'very highly significant' increase in September depth of Unicup over the period 1980-2000. Its September depth has increased at an average rate of 0.10m per year. Towerrinning and Crackers have shown 'highly significant' increases over their respective periods of monitoring and have average rates of change of 0.11 and 0.05 metres per year, respectively.

5.2.2 November Depth Trends

Most (80%) of the 39 wetlands that have been monitored for 20 or more Novembers show no significant trend in November depths. 17.5% (7 wetlands) show an increasing trend. Only 2.5% (one wetland – Nine Mile) show a decreasing trend. There has been a 'very highly significant' increase in November depth of Unicup over the period 1980-2000. Its November depth has increased at an average rate of 0.12m per year. Warrinup, Towerrinning and Crackers have shown 'highly significant' increases over their respective periods of monitoring and have average rates of change of 0.04, 0.12 and 0.08 metres per year, respectively. Nine Mile's decrease has been 'very highly significant' and has been at an average rate of –0.04m per year.

5.2.3 Combined September-November Depth Trends

Most (66%) of the 41 wetlands that have been monitored for 20 or more Septembers or Novembers show no significant trend in depths. 30% (12 wetlands) show an increasing trend. Only 4% (2 wetlands – Forrestdale and Nine Mile) show a decreasing trend. There have been 'very highly significant' increases in September+November depths of Towerrinning, Unicup, Crackers and Warrinup over their respective periods of monitoring. Their September+November depths have increased at average rates of 0.12, 0.11, 0.07 and 0.04 metres per year, respectively. Eganu, Warden, Dulbinning, Yealering and Muir have shown 'highly significant' increases and have average rates of change of 0.08, 0.06, 0.05, 0.04 and 0.02 metres per year, respectively. Nine Mile's decrease has been 'very highly significant' and has been at an average rate of –0.04m per year.

5.2.4 September Salinity Trends

Most (73%) of the 33 wetlands that have been monitored for 20 or more Septembers show no significant trend in September salinities. 18% (6 wetlands) show an increasing trend. 9% (3 wetlands) show a decreasing trend. Toolibin, Yarnup and Thomsons have shown 'highly significant' increases in September salinities over their respective periods of monitoring and have average rates of change of 1.02, 0.09 and 0.07 ppt/yr, respectively. Chandala and Poorginup have shown 'highly significant' decreases in September salinities and have average rates of change of –0.02 and –0.01 ppt/yr, respectively.

5.2.5 November Salinity Trends

Most (87%) of the 39 wetlands that have been monitored for 20 or more Novembers show no significant trend in November salinities. 5% (2 wetlands – Yarnup and Bryde) show an increasing trend. 8% (3 wetlands) show a decreasing trend. There has been a 'very highly significant' increase in

November salinity of Yarnup over the period 1980-2000. Its November salinity has increased at an average rate of 0.11 ppt/yr. Bryde has shown a 'highly significant' increase over its period of monitoring and has an average rate of change of 0.68 ppt/yr. Bambun has shown a 'very highly significant' decrease in November salinity and this has been at an average rate of –0.02 ppt/yr.

5.2.6 Combined September-November Salinity Trends

Most (76%) of the 41 wetlands that have been monitored for 20 or more Septembers or Novembers show no significant trend in salinities. 12% (5 wetlands) show an increasing trend and the same number of wetlands show a decreasing trend. There have been 'very highly significant' increases in September+November salinities of Bryde and Yarnup over their respective periods of monitoring. Their September+November salinities have increased at average rates of 0.46 and 0.10 ppt/yr, respectively. Toolibin and Thomsons have shown 'highly significant' increases and have average rates of change of 0.58 and 0.07 ppt/yr, respectively. There have been 'very highly significant' decreases in September+November salinities of Towerrinning, Bambun and Poorginup. Their September+November salinities have changed at average rates of –0.27, –0.02 and –0.01 ppt/yr, respectively.

5.3 Patterns of depth and salinity variation

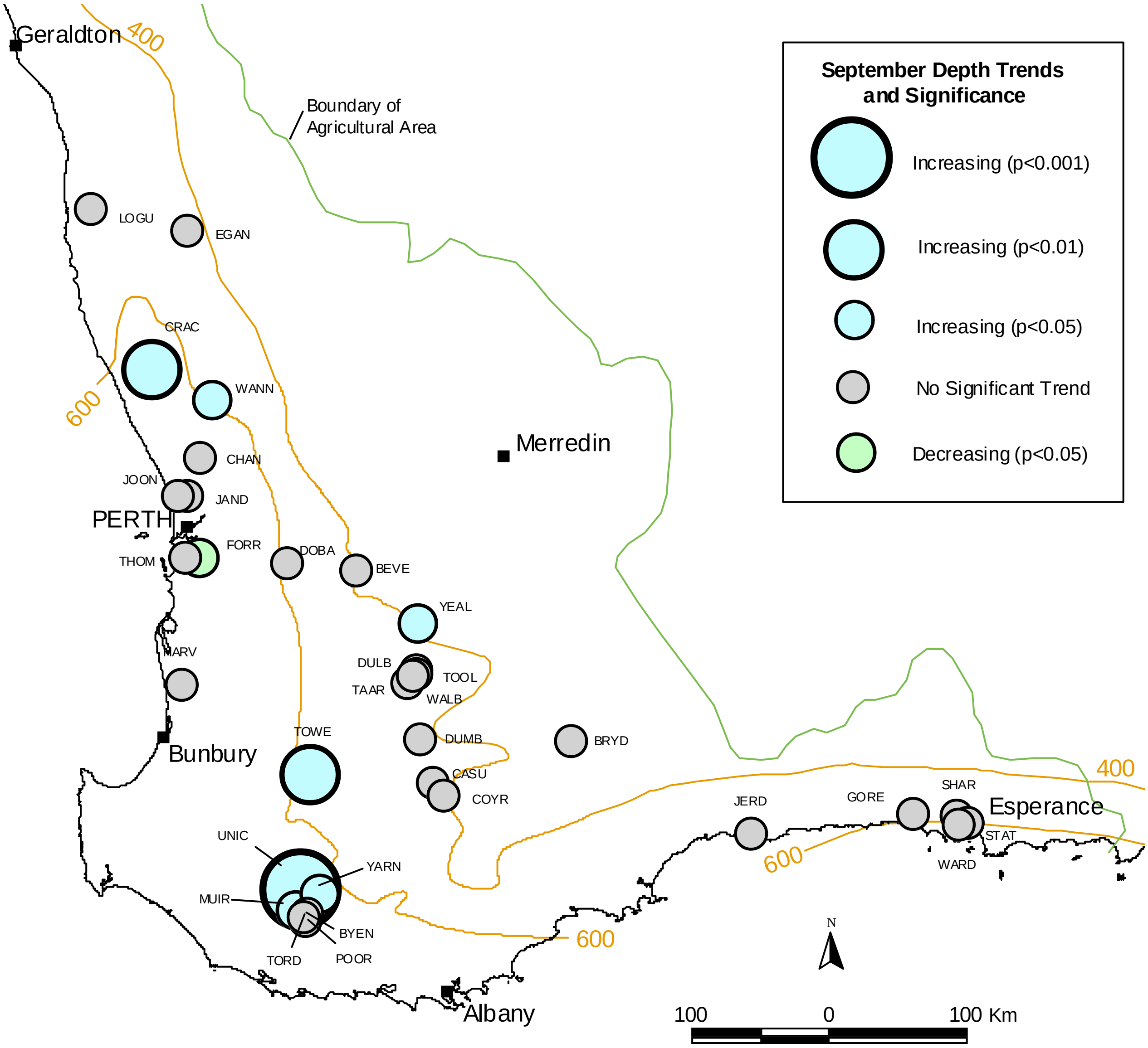
All September and November depth and salinity records of the 41 wetlands monitored for 20 or more years are presented, by individual wetland, in Figures 8 to 48. Annual rainfall recordings at the two nearest Meteorological Stations are also shown. The direction (increasing or decreasing) and significance (p value) of trends in these data are indicated.

Some general patterns in September and November depths are apparent from visual examination of these Figures:

1. Several wetlands show **sudden, large increases subsequently maintained**, e.g. Crackers, Towerrinning, Unicup.
2. Other wetlands show **occasional large increases not subsequently maintained**, e.g. Dumbleyung, Kwornicup, Taarblin, Warrinup.
3. One wetland (Nine Mile) shows an obvious, **long term decline** in depths.
4. Some wetlands generally show little variation from year to year, with **occasional dramatic declines** from which they have rapidly recovered, e.g. Byenup, Poorginup and Tordit-Gurrup (three connected wetlands in the Muir-Unicup catchment) and Station (near Esperance).
5. Depths of some wetlands have shown **pronounced, recurring, long-term patterns of increase and decline**, e.g. Jerdacuttup, Pleasant View.
6. Some wetlands show **dramatic year-to-year variation** in depths, e.g. Bryde, Logue.
7. Some wetlands show **little year-to-year variation** in depths, e.g. Bambun, Moates.
8. Some wetlands show a **combination of patterns**, e.g. Dulbinning.
9. Most monitored wetlands show a general pattern of **November depths being less than immediately-preceding September depths**, reflecting the general pattern of declining rainfall and increasing evaporation in the south-west from September to November each year. November depths of Powell are often much greater than immediately-preceding September depths. This is due to seasonal manipulation for district drainage objectives.

Some general patterns in September and November salinities are apparent from visual examination of these Figures:

1. Some wetlands show an unambiguous **long term increase** in salinities, e.g. Yarnup.
2. Other wetlands show **occasional large increases not subsequently maintained**, e.g. Bryde, Casuarina, Coyrecup, Eganu, Gore, Muir, Poorginup, Station, Toolibin, Tordit-Gurrup, Warrinup, Yealering.



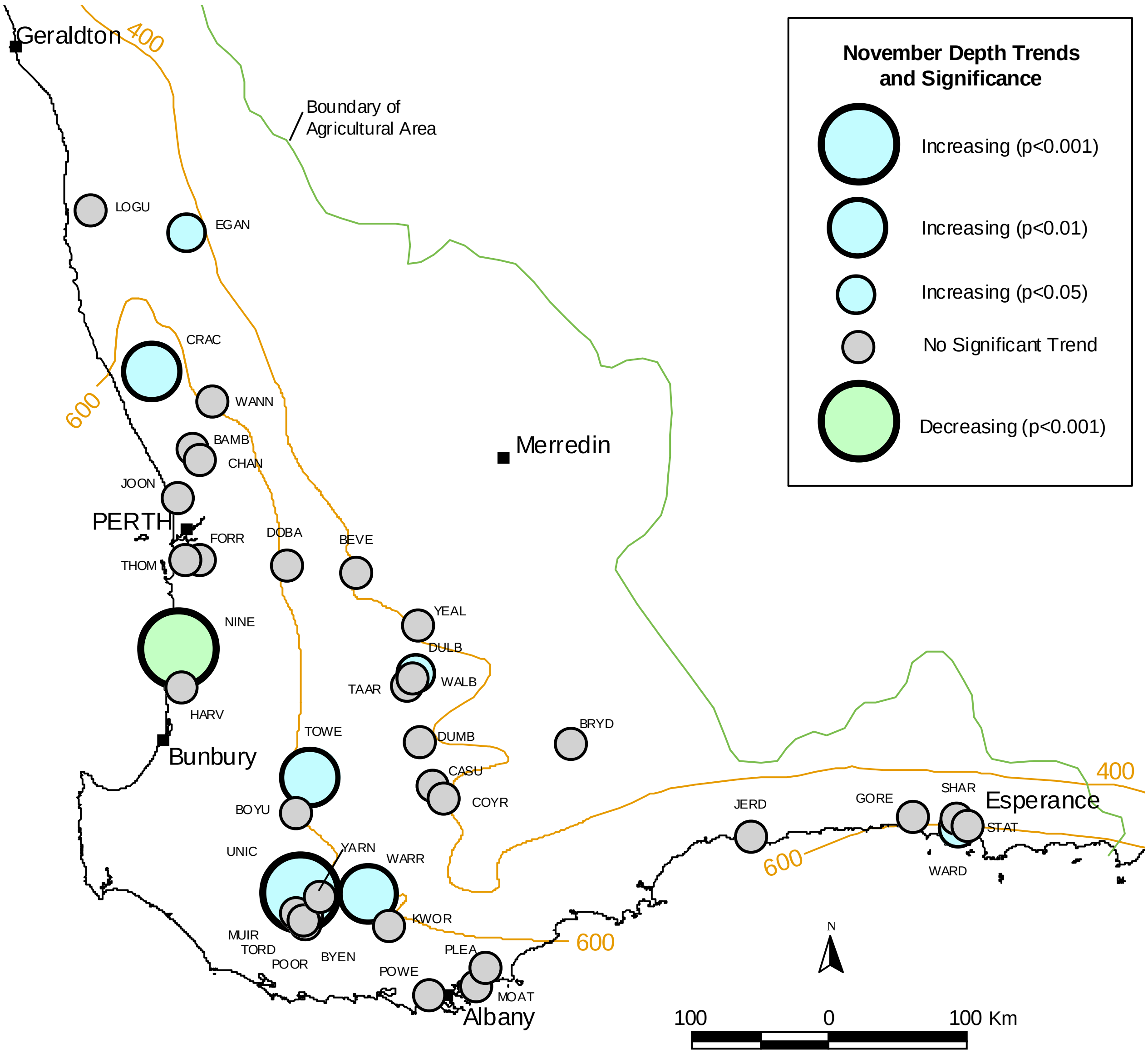
SEPTEMBER DEPTH TRENDS AND SIGNIFICANCE

Category	Code	No. of Wetlands	(%)
Increasing (p<0.001)	+ + +	1	3
Increasing (p<0.01)	+ +	2	6
Increasing (p<0.05)	+	4	12
No Significant Trend		25	76
Decreasing (p<0.05)	–	1	3
Decreasing (p<0.01)	– –	0	0
Decreasing (p<0.001)	– – –	0	0
Total		**33**	**100**

WETLANDS WITH SIGNIFICANT SEPTEMBER DEPTH TRENDS

Wetland	No. of Sep. Records	Period	Trend and Significance Code	Rate of Change at September 2000 (metres per year)
Unicup	20	1980-2000	+ + +	0.10
Towerrinning	20	1979-2000	+ +	0.11
Crackers	20	1981-2000	+ +	0.048
Yealering	22	1979-2000	+	0.056
Yarnup	20	1980-2000	+	0.010
Wannamal	22	1979-2000	+	0.013
Muir	20	1980-2000	+	0.017
Forrestdale	23	1981-2000	–	-0.016

Figure 6 (a): September Depth Trends and Significance



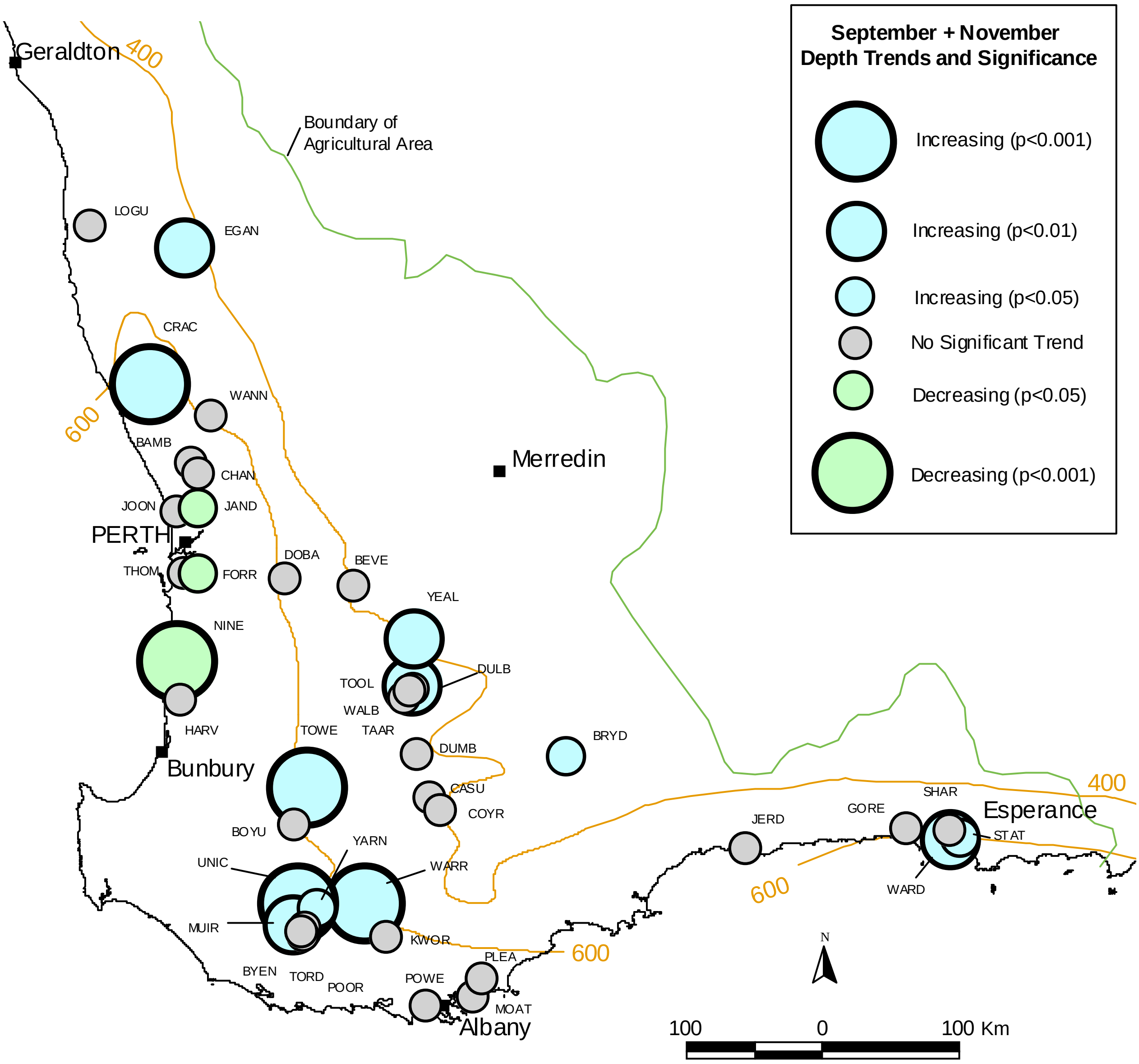
NOVEMBER DEPTH TRENDS AND SIGNIFICANCE

Category	Code	No. of Wetlands	(%)
Increasing (p<0.001)	+ + +	1	2.5
Increasing (p<0.01)	+ +	3	7.5
Increasing (p<0.05)	+	3	7.5
No Significant Trend		31	80
Decreasing (p<0.05)	–	0	0
Decreasing (p<0.01)	– –	0	0
Decreasing (p<0.001)	– – –	1	2.5
Total		**39**	**100**

WETLANDS WITH SIGNIFICANT NOVEMBER DEPTH TRENDS

Wetland	No. of Nov. Records	Period	Trend and Significance Code	Rate of Change at November 2000 (metres per year)
Unicup	21	1980-2000	+ + +	0.12
Warrinup	21	1980-2000	+ +	0.039
Towerrinning	22	1979-2000	+ +	0.12
Crackers	21	1980-2000	+ +	0.082
Warden	22	1979-2000	+	0.063
Eganu	21	1979-2000	+	0.085
Dulbinning	20	1979-2000	+	0.057
Nine Mile	20	1981-2000	– – –	-0.040

Figure 6 (b): November Depth Trends and Significance



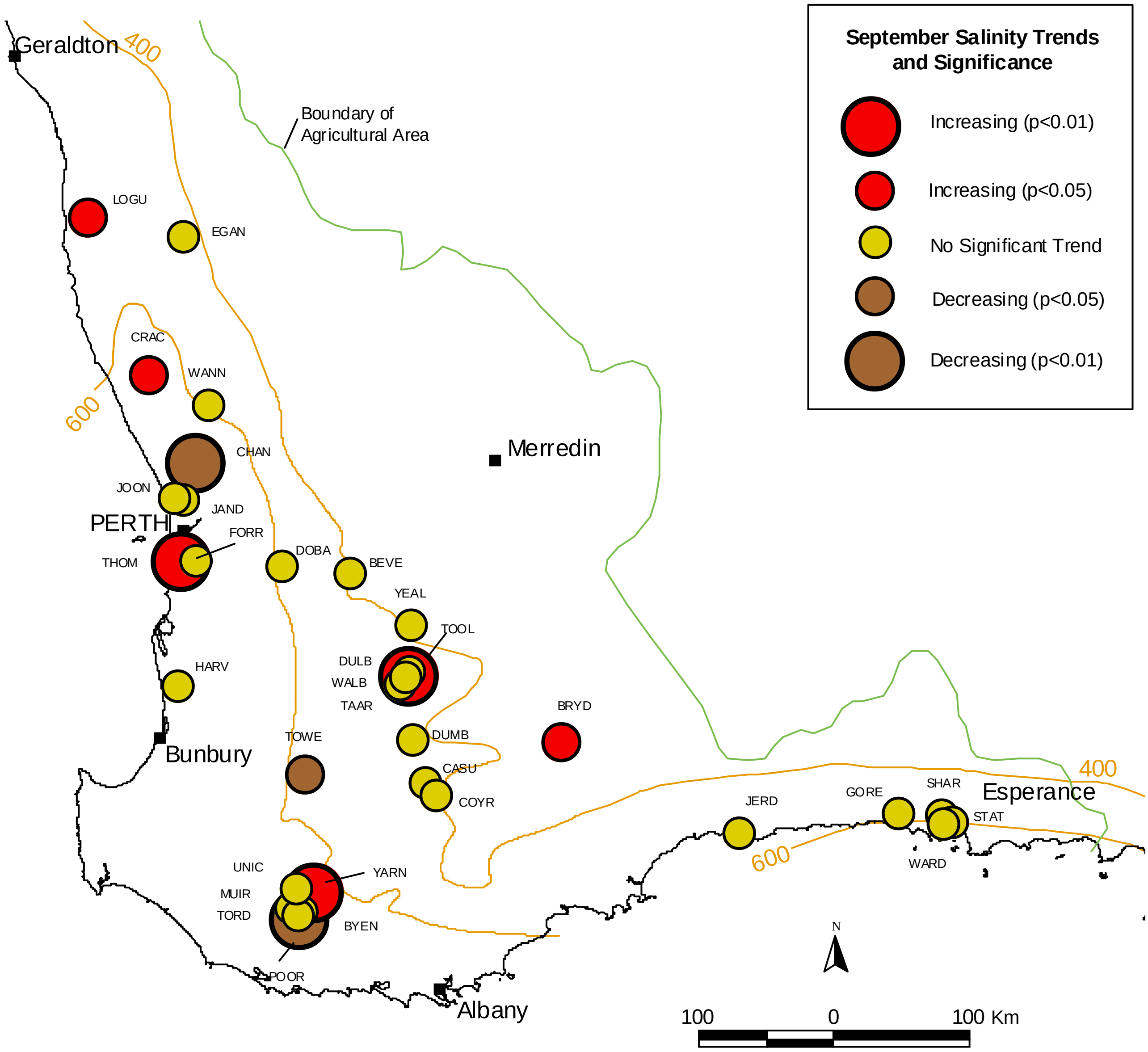
SEPTEMBER + NOVEMBER DEPTH TRENDS AND SIGNIFICANCE

Category	Code	No. of Wetlands	(%)
Increasing (p<0.001)	+ + +	4	10
Increasing (p<0.01)	+ +	5	12
Increasing (p<0.05)	+	3	8
No Significant Trend		26	63
Decreasing (p<0.05)	–	2	5
Decreasing (p<0.01)	– –	0	0
Decreasing (p<0.001)	– – –	1	2
Total		**41**	**100**

WETLANDS WITH SIGNIFICANT SEPTEMBER + NOVEMBER DEPTH TRENDS

Wetland	No. of Records	Period	Trend and Significance Code	Rate of Change at November 2000 (metres per year)
Towerrinning	42	1979-2000	+ + +	0.12
Unicup	41	1980-2000	+ + +	0.11
Crackers	41	1980-2000	+ + +	0.068
Warrinup	40	1980-2000	+ + +	0.036
Eganu	43	1979-2000	+ +	0.085
Warden	43	1979-2000	+ +	0.060
Dulbinning	42	1979-2000	+ +	0.051
Yealering	44	1978-2000	+ +	0.043
Muir	42	1979-2000	+ +	0.017
Bryde	44	1979-2000	+	0.054
Station	42	1980-2000	+	0.011
Yarnup	41	1980-2000	+	0.0071
Jandabup	38	1981-2000	–	-0.011
Forrestdale	48	1979-2000	–	-0.015
Nine Mile	39	1981-2000	– – –	-0.040

Figure 6 (c): Combined September+November Depth Trends and Significance



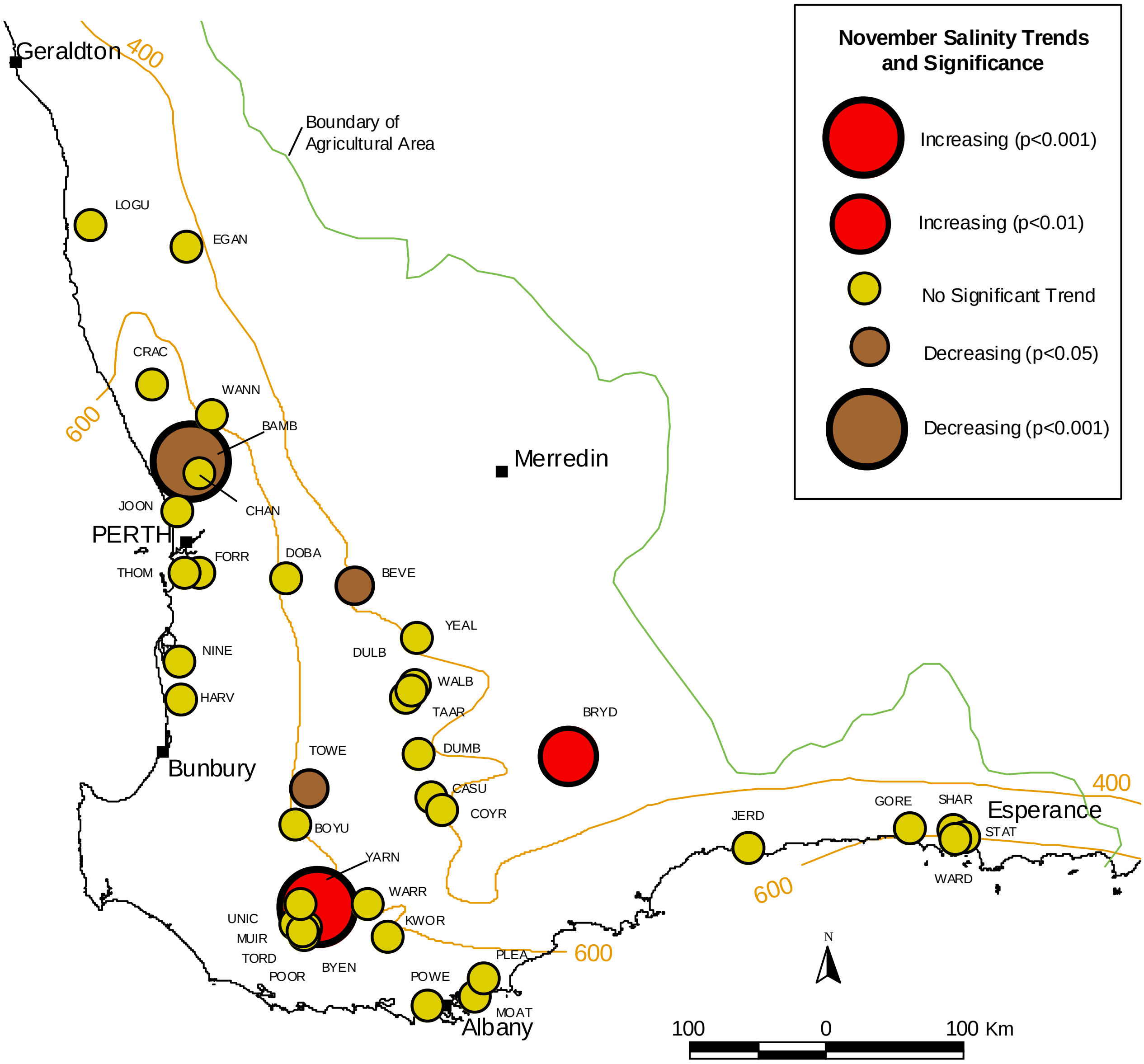
SEPTEMBER SALINITY TRENDS AND SIGNIFICANCE

Category	Code	No. of Wetlands	(%)
Increasing (p<0.001)	+ + +	0	0
Increasing (p<0.01)	+ +	3	9
Increasing (p<0.05)	+	3	9
No Significant Trend		24	73
Decreasing (p<0.05)	–	1	3
Decreasing (p<0.01)	– –	2	6
Decreasing (p<0.001)	– – –	0	0
Total		**33**	**100**

WETLANDS WITH SIGNIFICANT SEPTEMBER SALINITY TRENDS

Wetland	No. of Sep. Records	Period	Trend and Significance Code	Rate of Change at September 2000 (ppt per year)
Toolibin	15	1981-1999	+ +	1.0200
Yarnup	20	1980-2000	+ +	0.0925
Thomsons	20	1981-2000	+ +	0.0659
Bryde	16	1981-2000	+	0.3816
Logue	18	1979-2000	+	0.1579
Crackers	20	1981-2000	+	0.0270
Towerrinning	20	1979-2000	–	-0.2442
Poorginup	24	1977-2000	– –	-0.0069
Chandala	20	1979-2000	– –	-0.0151

Figure 7 (a): September Salinity Trends and Significance



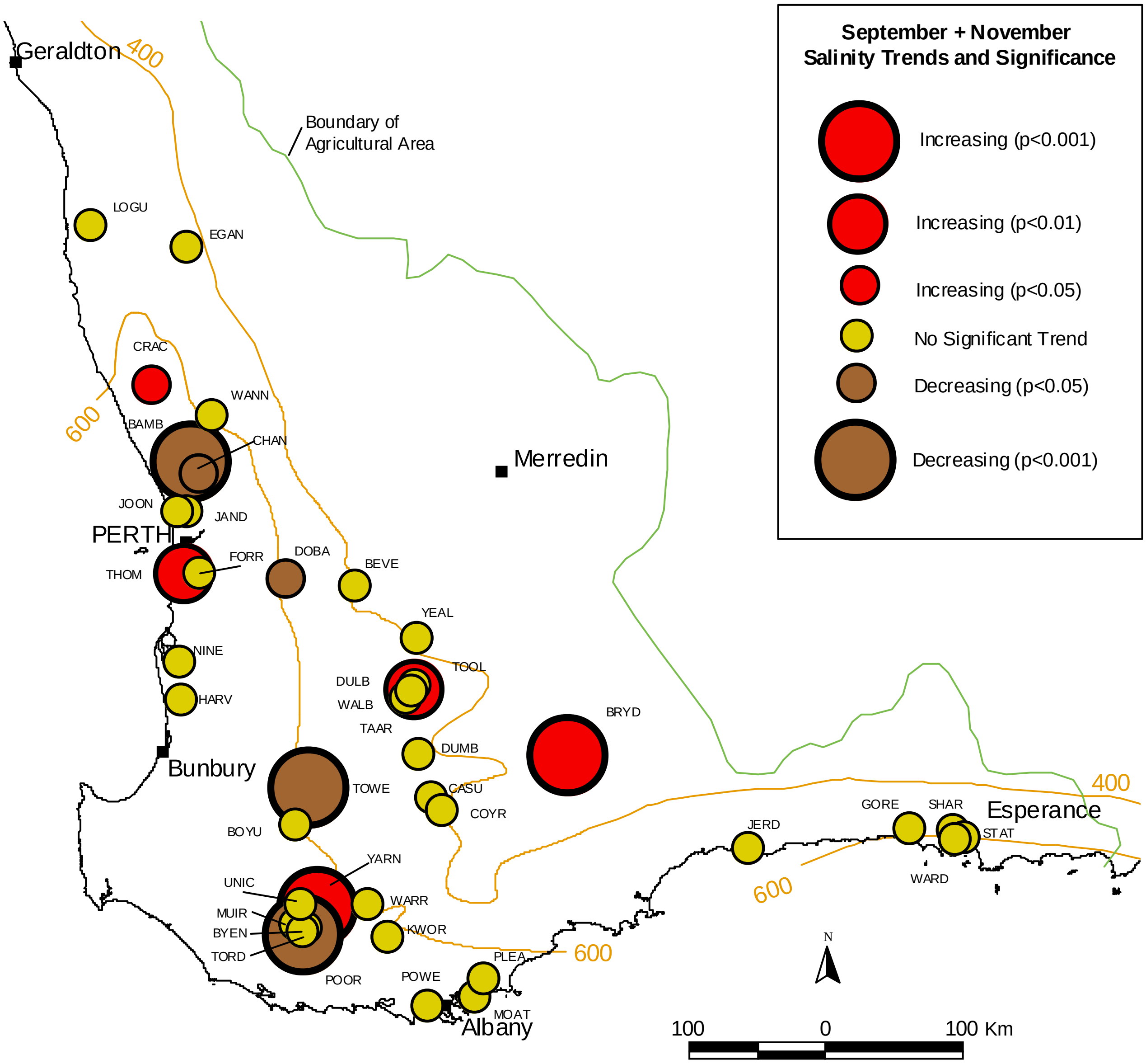
NOVEMBER SALINITY TRENDS AND SIGNIFICANCE

Category	Code	No. of Wetlands	(%)
Increasing (p<0.001)	+ + +	1	3
Increasing (p<0.01)	+ +	1	2
Increasing (p<0.05)	+	0	0
No Significant Trend		34	87
Decreasing (p<0.05)	–	2	5
Decreasing (p<0.01)	– –	0	0
Decreasing (p<0.001)	– – –	1	3
Total		**39**	**100**

WETLANDS WITH SIGNIFICANT NOVEMBER SALINITY TRENDS

Wetland	No. of Nov. Records	Period	Trend and Significance Code	Rate of Change at November 2000 (ppt per year)
Yarnup	21	1980-2000	+ + +	0.1089
Bryde	12	1983-2000	+ +	0.6807
Towerrinning	22	1979-2000	–	-0.2975
Beverley	21	1979-2000	–	-1.7079
Bambun	22	1979-2000	– – –	-0.0224

Figure 7 (b): November Salinity Trends and Significance



SEPTEMBER + NOVEMBER SALINITY TRENDS AND SIGNIFICANCE

Category	Code	No. of Wetlands	(%)
Increasing (p<0.001)	+ + +	2	5
Increasing (p<0.01)	+ +	2	5
Increasing (p<0.05)	+	1	2
No Significant Trend		31	76
Decreasing (p<0.05)	–	2	5
Decreasing (p<0.01)	– –	0	0
Decreasing (p<0.001)	– – –	3	7
Total		**41**	**100**

WETLANDS WITH SIGNIFICANT SEPTEMBER + NOVEMBER SALINITY TRENDS

Wetland	No. of Records	Period	Trend and Significance Code	Rate of Change at November 2000 (ppt per year)
Bryde	28	1981-2000	+ + +	0.4622
Yarnup	41	1980-2000	+ + +	0.1024
Toolibin	25	1981-1999	+ +	0.5849
Thomsons	42	1979-2000	+ +	0.0655
Crackers	39	1981-2000	+	0.0201
Dobaderry	35	1981-2000	–	-0.0021
Chandala	42	1979-2000	–	-0.0171
Poorginup	44	1977-2000	– – –	-0.0064
Bambun	41	1979-2000	– – –	-0.0214
Towerrinning	42	1979-2000	– – –	-0.2684

Figure 7 (c): Combined September+November Salinity Trends and Significance

3. Some wetlands show an unambiguous **long term decline** in salinities, e.g. Bambun.
4. Several wetlands (e.g. Dobaderry, Towerrinning) show **sudden, large decreases subsequently maintained**.
5. Salinities of some wetlands have shown **pronounced, recurring, long-term patterns of increase and decline**, e.g. Byenup, Dumbleyung, Jerdacuttup, Moates, Pleasant View, Shark, Wannamal, Warden.
6. Some wetlands show **substantial year-to-year variation** in salinities, e.g. Beverley, Kwornicup, Wannamal, Warden.
7. Some wetlands show **little year-to-year variation** in salinities, e.g. Nine Mile.
8. While several wetlands (Dobaderry, Harvey 12632, Jandabup, Moates, Nine Mile and Warrinup) have been **'very fresh' (<1ppt) for the entire period of monitoring,** none has consistently been 'fresh', 'brackish', 'saline' or 'hypersaline'.
9. Most monitored wetlands show a general pattern of **November salinities being greater than September salinities** due to concentration of salts as depths decline due to evaporation.

Two general patterns are immediately apparent from visual **comparison of depths and salinities** of individual wetlands.

1. The most obvious pattern is the **inverse relationship** between depth and salinity of most monitored wetlands. This is most apparent from the graphs of Byenup, Casuarina, Coyrecup, Dumbleyung, Eganu, Jerdacuttup, Pleasant View, Station, Thomsons, Tordit-Gurrup, Towerrinning, Unicup, Yealering, but is also discernible at other wetlands.
2. For many wetlands there is a **dramatic increase** in salinity when depth approaches zero, i.e. as a wetland dries. This is well demonstrated at, for example, Bryde[1] where a depth of 0.13m in September 1999 coincided with an exceptionally high salinity value (for this wetland) of 19.7 ppt; and at Casuarina, Coyrecup, Dumbleyung, Forrestdale, Gore, Jerdacuttup, Station, Towerrinning, Yealering.

5.4 Relationships between depth and salinity trends

The 41 wetlands monitored for 20 or more years are grouped according to their trends in depths and salinities in Table 1.

Eighteen (44%) of the 41 wetlands monitored for 20 or more years showed no significant trends in depths or salinities. Only two (5%) decreased in depth and neither of these changed in salinity. Thirteen (32%) increased in depth and, of these, one decreased and nine showed no change in salinity. Of particular interest are the six (15%) wetlands that showed trends of increasing salinity. Four (Bryde, Yarnup, Thomsons, Toolibin) showed 'highly' or 'very highly' significant salinity increases and two (Bryde, Yarnup) of these also increased in depth, strongly suggesting increasing salt loads. Yarnup's salinity increase was the most significant statistically. These and other wetlands are considered individually in section 5.5.

5.5 Significant long-term trends in depths and salinities

Seventeen (41%) of the 41 wetlands monitored for 20 or more years show 'highly significant' or 'very highly significant' trends in September, November, or September+November depths or salinities (Table 1). Summary descriptions of these trends are presented below, together with known or suggested reasons for them.

[1] Note however that very low depths in Septembers of 1981, 1982, 1987 did not 'result in' high salinities. This wetland is clearly becoming more saline

Table 1. Trends in depths and salinities of 41 wetlands monitored for 20 or more years.

	Depth Increasing (13 wetlands)	**Depth Not Changing** (26 wetlands)	**Depth Decreasing** (2 wetlands)
Salinity Increasing (6 wetlands)	**Bryde**[bm rc] d + (S+N) s + (S) **s ++ (N)** **s +++ (S+N)** Crackers d ++ (S) d ++ (N) d +++ (S+N) s + (S) s + (S+N) **Yarnup**[rc] d + (S) d + (S+N) **s ++ (S)** **s +++ (N)** **s +++ (S+N)**	Logue[bm] s + (S) **Thomsons s ++ (S)** **s ++ (S+N)** **Toolibin**[bm rc] **s ++ (S)** **s ++ (S+N)**	
Salinity Not Changing (29 wetlands)	Dulbinning d + (N) d ++ (S+N) Eganu[bm] d + (N) d ++ (S+N) Muir[rc] d + (S) d ++ (S+N) Station[rc] d + (S+N) Unicup[rc] d +++ (S) d +++ (N) d +++ (S+N) Wannamal d + (S) Warden[rc] d + (N) d ++ (S+N) Warrinup d ++ (N) d +++ (S+N) Yealering d + (S) d ++ (S+N)	**18 wetlands** Boyup Brook 18239[bm] Byenup[rc] Casuarina Coyrecup[bm] Dumbleyung[bm] Gore[rc] Harvey 12632 Jandabup Jerdacuttup Joondalup Kwornicup Moates Pleasant View[bm] Powell Shark[rc] Taarblin Tordit-Gurrup[rc] Walbyring	Forrestdale d - (S) d - (S+N) Nine Mile d --- (N) d --- (S+N)
Salinity Decreasing (6 wetlands)	**Towerrinning**[bm] d ++ (S) d ++ (N) d +++ (S+N) s - (S) s - (N) **s --- (S+N)**	**Bambun s --- (N)** **s --- (S+N)** Beverley s - (N) **Chandala s -- (S)** s - (S+N) Dobaderry s - (S+N) **Poorginup**[rc] **s -- (S)** **s --- (S+N)**	

d = depth trend; s = salinity trend
+ or - = ‘significant’ (p<0.05) increase or decrease respectively
++ or -- = ‘highly significant’ (p<0.01) increase or decrease respectively
+++ or --- = ‘very highly significant’ (p<0.001) increase or decrease respectively
(S) = September records
(N) = November records
(S+N) = September and November records
Bold = wetlands with ‘highly significant’ or ‘very highly significant’ increases or decreases in salinity.
Underline = wetlands with ‘highly significant’ or ‘very highly significant’ increases or decreases in depth.
[rc] = ‘recovery catchment’ wetland (see section 7.2)
[bm] = ‘biological monitoring’ wetland (see section 7.2; note that the biological monitoring program refers to Boyup Brook 18239 as Kulicup Swamp).

5.5.1. Salinity increasing - depth increasing (3 wetlands)

Bryde (depth increase 'significant'; salinity increases 'significant' to 'very highly significant')

Bryde is a wetland whose September and November depths vary considerably from year to year (Figure 11). While the upward trend in September+November depths is 'significant' ($p<0.05$) it is not a strong trend. Highest depths were recorded in 1992. From 1993 onwards, depths have been markedly lower in five of the eight years to 2000.

There has been a pronounced increase in September and November salinities of Bryde since 1992, with salinities being markedly higher in 1994, 1998 and 1999 than in preceding years. This increase in salinity (and salt load) has been attributed to a rise in regional saline groundwater aquifers, resulting in higher salinity surface flows to the lake and saline groundwater interception with the lakebed (VRA 2002).

Bryde is one of 25 'biological monitoring' wetlands under the Salinity Strategy. Results of water chemistry, groundwater, invertebrate, waterbird and additional depth sampling in 1997-98 and 1999-00 are presented in Cale *et al.* (2004), together with some earlier data from other studies. Four plant community monitoring transects have been established at the margins of the lake and early results have been reported by Ogden & Froend (1998).

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. During this three-year period depths were low and salinities varied widely, similar to 1998-1999. The lake was dry in 2002.

Conclusion: Bryde's monitoring data indicate that this wetland warrants urgent management attention. Bryde has high nature conservation values (Jaensch *et al.* 1988; Hamilton-Brown & Blyth 1999) that could be severely impacted by the rising salinities revealed by SWWMP. The salinity 'Situation Statement' for Western Australia (Government of Western Australia 1996b) recognised Bryde as a wetland under threat of salinisation. In 1999, Bryde was declared a Key Wetland and Natural Diversity Recovery Catchment. The lake and its catchment have recently been the subject of detailed hydrological investigations (JDA 1996, 2002; SKM 2000; VRA 2002).

Crackers (depth increases 'highly significant' to 'very highly significant'; salinity increases 'significant')

September and November depths of Crackers in the first three years (1980-1982) of monitoring of this wetland were very low (0.0-0.3m; see Figure 16). In 1983 they increased to 1-1.2m. They remained within the range 1-1.3m from that year until 2000. There was no corresponding change in total annual rainfall at the nearest Meteorological Station.

A 1987 report by D.R. Munro on CALM departmental file indicates that the increase in depths in 1983 and subsequent years was almost certainly due to redirection (due to a man-made 'plug' washing out) of some flow from Caren Caren Brook into Crackers via other intervening wetlands on private property and in Namming Nature Reserve. There is a long history of manipulation of flows to Crackers, at least since the 1930s or thereabouts (FW/CALM files).

Crackers' September salinity records of 1981 and 1982 were low, however the single November salinity record from this period was relatively high, corresponding with the wetland being near dry. There was a rising trend in salinities from 1983 to 1990, however this rise did not continue in subsequent years. Over the entire period (1981-2000) of salinity monitoring, Crackers has been within the salinity categories 'very fresh' (<1ppt) to 'fresh' (1<3ppt).

Crackers' low salinities of 1981 and 1982 might have been due to Crackers only receiving localised inflows in those years. In September 1986, D.R. Munro found the salinity of water entering Crackers from Caren Caren Brook (780 ppm) to be higher than water flowing out of Crackers from its north-western outlet (540 ppm), suggesting localised inflows were fresher than those of the Brook. Salinity variations in years following 1983 might also be due to variable salt load and water volume contributions from Caren Caren Brook and Crackers' localised catchment.

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. Visual comparison indicates that 2001-2003 depths are similar to those of 1983-2000. However, 2001-2003 salinities are slightly higher than most records from the preceding decade.

Conclusion: Crackers' monitoring data indicate that inflows to this wetland warrant further investigation and possible management attention. Crackers has high nature conservation values (Jaensch *et al.* 1988) that would be greatly reduced by further increases in salinity or substantial changes to water levels.

Yarnup (depth increase 'significant'; salinity increases 'highly significant' to 'very highly significant')

Yarnup depths have increased 'significantly', but it is not a strong trend and there was little variation from 1988 onwards (Figure 47).

Yarnup salinities have increased markedly. This rising trend has been most evident from 1989 onwards (noting that the high salinities of 1987 were associated with record low water levels). Given the inverse relationship that exists between depths and salinities of most south-west wetlands (see Section 5.3), it is instructive to compare salinities at similar depths over time. At Yarnup, salinities were substantially higher from 1994 to 2000 than they were in years of comparable depths in the 1980s. Though Yarnup is 'fresh' (1<3ppt), it is showing signs of becoming salinised.

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. 2001 depths were very low, however 2002 and 2003 depths were similar to those of most preceding years. Salinities increased further, indicating that this wetland is becoming more salinised.

Conclusion: Yarnup's monitoring data indicate that the salt balance of this wetland requires management attention. Yarnup has high nature conservation values (Jaensch *et al.* 1988; Storey 1998) which will be greatly reduced if salinities continue to increase. In 1996, the Muir-Unicup wetland system, of which Yarnup is a part, was declared a Key Wetland and Natural Diversity Recovery Catchment under SAP (Government of Western Australia 1996a). The Muir-Unicup catchment is now the subject of detailed hydrological investigations and management actions aimed at *inter alia* reducing salt inputs to Yarnup and other wetlands (DCLM 1998; Smith 2003; New *et al* 2004; New in prep.). Transects have been established through fringing and emergent vegetation communities of Yarnup in order to examine relationships between vegetation, wetland water levels and salinity (Froend & Loomes 2001).

5.5.2. Salinity increasing - depth not changing (2 wetlands)

Thomsons (depth changes 'not significant'; salinity increases 'highly significant'

While there is no significant trend in September and November depths of Thomsons over the *total* period of monitoring (1979-2000), there have been increases (1979 to 1992) and substantial decreases (1992 to 1998) during this period (Figure 38). While there is clearly a relationship between these depth changes and total annual rainfall at the nearest Meteorological Station, other factors are also involved. Groundwater abstraction, urbanisation and new and altered drainage infrastructure have all had some influence on flows to the lake during the period of monitoring. Several studies aimed at quantifying their contributions have been conducted (e.g. Davidson 1984; Kazemi & Rathur 1995; Davis *et al.* 2001) and efforts have been made to ameliorate their impacts on water levels and water quality (e.g. TAG 1989; G.B. Hill & Partners 1990, 1991; TRC 1993; EPA 1990, 1996).

Thomsons' September and September+November salinities have shown 'highly significant' increases to 2000. These increases appear to be largely, but perhaps not entirely, attributable to the salt-concentrating effect of decreases in water depth in the late 1990s.

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. Depths during this three-year period were low, similar to those of 1997-1999. 2001-2003 September salinities were slightly lower than those of 1997-1999. November salinities were highly variable, as in 1997-1999.

Conclusion: Thomsons' monitoring data suggest the lake is not becoming salinised, however year-to-year depth changes warrant close attention due to the potential for activities in this wetland's catchment to impact upon them. Thomsons is part of the Thomsons-Forrestdale Ramsar Site[1] (Government of Western Australia 1990; Wetlands International 2002) and has high nature conservation values (DEH 2003) that could be adversely affected by altered water depth regimes.

Toolibin (depth changes 'not significant'; salinity increases 'highly significant')

Toolibin is another wetland whose September and November depths vary considerably (0-2m) from year to year (Figure 39). In one year (1983), September depth reached 2.5m. Since 1995, some small surface flows that would otherwise have entered the lake have been diverted around it, due to the relatively high salinity (>1ppt) of these flows (Dogramaci *et al.* 2002).

Toolibin September and September+November salinities have shown 'highly significant' increases. Same-depth comparisons are interesting. 1990, 1992 and 1993 depths were similar, yet salinities increased in 1992 and again in 1993. 1982, 1984, 1991, 1994 and 1996 depths and salinities were similar, except in 1994 when salinities were markedly higher. There appears to have been a marked increase in the salt load (tonnes) of Toolibin commencing 1992, however the extent to which this has continued beyond 1994 is unclear. More-detailed discussion of trends can be found in Froend & Storey (1996) and Dogramaci *et al.* (2002).

Toolibin is one of 25 'biological monitoring' wetlands under the Salinity Strategy. The lake was dry when water chemistry, groundwater, invertebrate, waterbird and additional depth sampling was to have been undertaken in 1998-99 and 2000-01 (Cale *et al.* 2004). Plant community monitoring transects have been established at the margins of the lake and early results have been reported by Ogden & Froend (1998). Vegetation on the lakebed has been monitored over a longer period (Ogden & Froend 2002).

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. Toolibin was dry in all Septembers and Novembers.

Conclusion: Toolibin's monitoring data indicate the lake was becoming more saline during the period 1992-94. However, given the low water levels and paucity of salinity records since that time, the subsequent trend is uncertain. Toolibin salinities warrant ongoing, close scrutiny. This is happening under the Toolibin Lake Recovery Plan (TLRT 1994). Toolibin is a Ramsar Site (Government of Western Australia 1990, 2000; Wetlands International 2002) and Natural Diversity Recovery Catchment (Government of Western Australia 1996a) with high nature conservation values (DEH 2003). It is also listed as a Threatened Ecological Community under the Commonwealth Environment Protection and Biodiversity Conservation Act (1999). Considerable effort has gone into rescuing Toolibin from secondary salinisation during the past three decades. While some gains have been made, success is not yet assured (Wallace 2001, 2003).

5.5.3. Salinity not changing - depth increasing (7 wetlands)

Dulbinning (depth increases 'significant' to 'highly significant'; salinity changes 'not significant')

September and November depths of Dulbinning were very consistent (around 0.85m and 0.7m respectively) from 1988 to 2000, except for years in which they were slightly lower (2000) or the lake was dry (1989, 1995) (Figure 18). Low rainfall may explain the generally lower water levels from 1979 to 1987, and the 'significant' to 'highly significant' upward trends in depth when calculated for the entire monitoring period of 1979-2000. The water level in September 1983 (1.4m) was higher than the lake's outflow level, hence there was a larger than usual decrease (0.7m) in water level between then and November 1983. Drainage to Dulbinning has apparently been altered several times since 1980 (K.J. Wallace pers. comm.).

Dulbinning salinities were most-commonly 'brackish', however they showed considerable variation, from 'very fresh' to 'saline'. Salinity was lowest (0.8ppt) when depth was highest (1.4m; Sep 1983) and substantial through-flow was occurring.

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[1] Wetland of International Importance under the 'Ramsar' Convention on Wetlands.

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. 2001 and 2003 depths and salinities were similar to those of most years from 1988 to 1999. Dulbinning was dry in 2002.

Conclusion: Dulbinning's monitoring data do not indicate that this wetland, which is immediately upstream of Toolibin, is becoming more saline, nor do they provide convincing evidence that the lake's depth regime is changing. Dulbinning has some significance for nature conservation (Jaensch *et al.* 1988) which would be reduced if the lake became more saline. Toolibin receives most surface inflow via Dulbinning and some measures being taken in Toolibin's catchment to reduce the threat of further salinisation of Toolibin will also benefit Dulbinning if successful.

Eganu (depth increases 'significant' to 'highly significant'; salinity changes 'not significant')

September and November depths of Eganu were reasonably consistent (around 2.25m to 2.75m) from 1981 to 2000, except for years in which they were somewhat lower (1989, 1997, 2000) or much lower (1985, 1987, 1994) (Figure 20). Low rainfall appears to be the most likely explanation for these lower levels and the very low levels at the beginning (1979, 1980) of the monitoring period. This is also a probable explanation for the 'significant' to 'highly significant' upward trends in depths when calculated for the entire monitoring period.

Eganu salinities were most-commonly 'saline', however they showed considerable variation, from 'brackish' to 'hypersaline'. While initial analysis of the salinity data indicates no significant trend, there appears to be an upward trend in same-depth salinities.

Eganu is one of 25 'biological monitoring' wetlands under the Salinity Strategy. Results of water chemistry, groundwater, invertebrate, waterbird and additional depth sampling in 1998-99 and 2000-01 are presented in Cale *et al.* (2004), together with some earlier data from other studies. Three plant community monitoring transects have been established at the margins of the lake and early results have been reported by Gurner *et al.* (1999) and Kabay (2002).

A 'Drainage Strategy' has been proposed for Eganu's catchment with the aim of managing changes to surface and groundwater flows resulting from clearing of native vegetation for agriculture (WRC 2001).

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. Depths and salinities varied considerably, within the ranges of previous years. There was no obvious pattern, other than the usual inverse relationship between these two parameters.

Conclusion: Eganu's monitoring data do not provide convincing evidence that the lake's depth regime is changing. While initial analysis indicates no significant trend in salinity, analysis of same-depth salinities is proposed as it appears this might reveal an upward trend, which would indicate increasing salinisation. Despite the fact that it is already secondarily salinised[1], Eganu has significant conservation value (Jaensch *et al.* 1988; Raines 1994) which could be reduced if the lake became more saline.

Muir (depth increases 'significant' to 'highly significant'; salinity changes 'not significant')

September and November depths of Muir show a close relationship with annual rainfall (Figure 30). Muir depths and total annual rainfall at the nearest Meteorological Station have shown significant rising trends over the 1979-2000 monitoring period, with occasional temporary declines as in 1982, 1987, 1994.

Some salinity records, and possibly some depth records, from Muir are problematic. From 1979 to 1989, water sampling was from the northern end of the wetland. On some occasions during this period, salinities at this sampling point were probably lower than those in most parts of the wetland, due to relatively-fresh inflow from a nearby, seasonally-flowing drain. From 1990 onwards, water sampling

[1] Secondarily salinised wetlands are wetlands which were naturally fresh, but have become saline as a consequence of European settlement in Western Australia. Primarily salinised wetlands are those which are naturally saline.

was from a more-satisfactory, deeper-water location[1] near the eastern shoreline of Muir, away from drainage discharge points. Salinities were generally less than 20ppt throughout the monitoring period. However, in November 1986 and September and November 1987 several extraordinarily high values (45-60ppt) were recorded. These were possibly due to localised concentration of salts (due to shallow water conditions) in the marshes at the northern end of the wetland and are considered unlikely to have been representative of the wetland as a whole.

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. 2001 depths were very low, similar to those of 1982, but increased in 2002 and 2003 to levels resembling those of the early to mid 1990s. Salinities were high in 2001, but subsequently decreased to levels of most preceding years.

Conclusion: Muir's monitoring data indicate a trend of increasing depths, which, if real, appears to be due to increasing annual rainfall. More-detailed examination of individual depth and salinity records from Muir is required before conclusions about trends in either parameter can confidently be reached. Muir is part of the Byenup-Muir Ramsar Site (Government of Western Australia 2000; Wetlands International 2002) and has high nature conservation values (Jaensch *et al.* 1988; Halse *et al.* 1990; DEH 2003) that would be reduced if the lake became more saline. In 1996, the Muir-Unicup wetland system was declared a Key Wetland and Natural Diversity Recovery Catchment under SAP (Government of Western Australia 1996a). The Muir-Unicup catchment is now the subject of detailed hydrological investigations and management actions aimed at *inter alia* maintaining and restoring natural depth and salinity regimes of Muir and other wetlands (DCLM 1998; Smith 2003; New in prep.). Transects have been established through fringing and emergent vegetation communities of Muir in order to examine relationships with wetland water levels and salinity (Froend & Loomes 2001).

Unicup (depth increases 'very highly significant'; salinity changes 'not significant')

September and November depths increased dramatically in 1988 and remained relatively high until 2000 (Figure 42). It seems unlikely, but not impossible, that this sudden and sustained increase can be explained by rainfall alone. Rainfall at the two nearest Meteorological Stations increased in 1988, but over the entire period of monitoring did not show a significant upward trend[2]. Also, other monitored wetlands in the same district (Poorginup, Tordit-Gurrup, Byenup, Yarnup) did not show comparable sustained changes in water levels from pre- to post-1988, though there is a similarity with Muir. There were no obvious changes to surface drainage within Unicup's catchment, or to the lake's outflow level, that would explain the change in depths (R. Hearn, pers. comm.).

Unicup salinities were highly variable from the beginning of monitoring (1980) until 1987. In 1988 they dropped to their lowest levels (<1ppt), but since then they have steadily increased, to approximately 5ppt from 1994 to 2000. They have also become less variable.

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. Depths were low during this three-year period, similar to those of 1994, 1995 and approaching those of 1983. Salinities rose to their highest levels since 1987. Same-depth salinities appear to have increased in recent years.

Conclusion: Unicup's monitoring data reveal a pronounced shift in depth regime that warrants further investigation to determine the likely cause(s). Salinities also warrant closer examination as these have steadily increased since 1988. Unicup has significant nature conservation values (Jaensch *et al.* 1988) which have no doubt been altered by the change in depth regime and could be adversely affected if the lake becomes more saline. In 1996, the Muir-Unicup wetland system was declared a Key Wetland and Natural Diversity Recovery Catchment under SAP (Government of Western Australia 1996a). The Muir-Unicup catchment is now the subject of detailed hydrological investigations and management actions aimed at *inter alia* maintaining and restoring natural depth and salinity regimes of Unicup and other wetlands (DCLM 1998; Smith 2003; New in prep.). Transects have been established through fringing and emergent vegetation communities of Unicup in order to examine relationships with wetland water levels and salinity (Froend & Loomes 2001).

[1] A depth gauge was installed at this new location in January 1989, however this was not used routinely until 1990.

[2] See Figure 47 for trend analysis of Bangalup Meteorological Station rainfall over the same period (1980-2000).

Warden (depth increases 'significant' to 'highly significant'; salinity changes 'not significant')

November and September+November depths of Warden have trended upwards during the period (1979-2000) of monitoring, however annual rainfalls at the two nearest Meteorological Stations have not shown similar trends (Figure 45). The upward trend is probably due mainly to a local rise in groundwater levels, which have risen as a consequence of catchment clearing (see Short *et al.* 2000; Simons & Alderman 2004). Preliminary studies indicate that groundwater levels in the surficial aquifer at Warden have risen by approximately 1m in the past 20 years and this wetland is primarily groundwater-fed (T. Massenbauer, pers. comm., Nov 2004). Exceptional rainfall in the Esperance district in March 2000 caused major flooding and, presumably, substantial surface flow into Warden. This would also have contributed to the upward trend in water levels.

Salinities have varied substantially during the period of monitoring, between 'saline' and 'hypersaline', but have not shown a statistically significant trend over this period. Because Warden's depths have also varied substantially, and there is an inverse relationship between depths and salinities, this is another wetland where same-depth comparison of salinities is warranted and might reveal significant trends.

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. During this three-year period depths and salinities have been similar to those of 1999 and 2000.

Conclusion: Warden's monitoring data indicate depths are rising. Preliminary studies suggest that this is primarily due to a local rise in groundwater levels discharging into this lake. Warden is a Ramsar Site (Government of Western Australia 1990; Wetlands International 2002) and Natural Diversity Recovery Catchment (Government of Western Australia 1996a) with high nature conservation values (DEH 2003). Its catchment is now the subject of detailed hydrological investigations and management actions (DCLM 1999) aimed at *inter alia* maintaining and restoring natural depth and salinity regimes of Warden and other wetlands.

Warrinup (depth increases 'highly significant' to 'very highly significant'; salinity changes 'not significant')

The depth pattern of Warrinup (Figure 46) is somewhat similar to that of Unicup (50 km west). September and November depths increased dramatically in 1988 and were generally higher (though this difference was not as pronounced as at Unicup) until 2000. As in the case of Unicup, rainfall at the nearest Meteorological Station increased in 1988 and was higher in several subsequent years than pre-1988, but when measured over the entire period of monitoring did not show a statistically significant upward trend. It is therefore questionable whether the significant upward trend in depths can be explained by rainfall alone.

Warrinup salinities show no significant trend over the 1980-2000 period of monitoring. This wetland has remained 'very fresh' (<1ppt) for the entire period.

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. Depths were low (September) to dry (November) in 2001, but in 2002 and 2003 were similar to those of 1996, 1998 and 2000. Salinities remained low (0.1-0.2ppt).

Conclusion: Warrinup's monitoring data reveal an upward trend in depths that warrants further investigation to determine whether change in rainfall is the only causative factor. Warrinup is a near-pristine, very fresh wetland reserved for nature conservation. An assessment of potential threats should be sought.

Yealering (depth increases 'significant' to 'highly significant'; salinity changes 'not significant')

September and September+November depths showed statistically significant upward trends (Figure 48). This might simply have been a consequence of rainfall (despite the lack of a significant trend in total annual rainfall at the nearest Meteorological Station) or there could perhaps have been some form of management intervention or change in catchment properties. In 1976 several options for raising water levels in the lake were investigated (Pelham-Thorman *et al.* 1976) and in 1986 dredging of the lake was proposed. It is thought that no consequent actions were undertaken, however recent enquiries suggest that one or more changes might have been made to inflows and outflow levels during the past couple of decades, with one change perhaps as recent as 1997 or 1998. Further enquiries are needed to clarify events. There might also have been earlier (pre-1976) changes to flows and lake water levels (see Sanders 1991).

Yealering salinities show no significant trend over the period of monitoring. Salinities were exceptionally high ('hypersaline') when depths were lowest, in 1979 and 1980. In subsequent years they have been 'brackish' (1981), 'fresh' (1983) or 'saline' (all other years, and in 1978). The outcomes of the statistical analysis have been considerably affected by the very high salinities recorded in 1979 and 1980, years when depths were exceptionally low. Same-depth salinity comparisons might yield different results.

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. Depths were lower, and salinities higher, in 2001 and 2003 than in most of the 1990s. Yealering was near-dry (September) to dry (November) in 2002.

Conclusion: Yealering's monitoring data do not provide convincing evidence that the lake's depth regime is changing. Statistical analyses indicated no significant increase in salinities, however further analysis is warranted. Yealering is a Shire reserve and has significant recreational values for the local community. These will be reduced if salinities increase.

5.5.4. Salinity not changing - depth decreasing (1 wetland)

Nine Mile (depth decreases 'very highly significant'; salinity changes 'not significant')

November and September+November depths of Nine Mile show statistically significant downward trends (Figure 31). This does not appear to be due to declining rainfall, as this has not shown a significant trend (though note that 1995 and 1999 annual rainfall data for the nearest Meteorological Station were not available for inclusion in the analysis). The decline in depths might be at least partly due to management intervention or a change in catchment properties or activities, including water use.

September and November salinities have been 'very fresh' throughout the entire period (1981-2000) of monitoring and have shown little seasonal (September to November) or year-to-year variation.

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. Nine Mile depths were at record low levels during 2001-2003, thus continuing the downward trend. Salinities were similar to those of preceding years; except in 2001 (the year of lowest water levels) when they were somewhat higher than usual.

Conclusion: Nine Mile's monitoring data reveal a pronounced long-term downward trend in depths that has not been seen at any other SWWMP wetland during the current program of monitoring. This persistent trend does not appear to be due to declining rainfall, though this possibility cannot yet be entirely ruled out. Further investigation is needed to determine the probable cause. Nine Mile is also unusual in that it has shown very little year-to-year variation in salinities, which are always very low. Nine Mile has significant nature conservation values (Jaensch *et al.* 1988) which could be lost if depths continue to decline.

5.5.5. Salinity decreasing – depth increasing (1 wetland)

Towerrinning (depth increases 'highly significant' to 'very highly significant'; salinity decreases 'significant' to 'very highly significant')

September and November depths of Towerrinning were within the range 0.5-1.2 metres from 1979 to 1981, but in 1982 suddenly increased to approximately 3.2 metres (Figure 41). In subsequent years (1983-2000) they have been within the range 3.0-3.8 metres, except during 1986-1990 when they dropped to a low (in 1987) of 1.6 metres.

The low water levels of 1979-1981 were said to be due to very low rainfall in those years[1] (George & Bennett 1994) and partial diversion of catchment flows, a situation which had been ongoing since the 1950s (Anon 1994). The lake filled in early 1982 as a result of rain produced by Cyclones Errol and

[1] Figure 41 indicates that total annual rainfall at the two nearest Meteorological Stations was not particularly low in 1980 or 1981, suggesting that this is perhaps too coarse a measure in some years. See Section 7.3 for approach to be considered for future reports.

Bruno (George & Bennett 1994). Levels declined in 1986 and 1987 due to low rainfall in those years and only partially recovered in 1988. University of Western Australia researchers undertook a study of the lake's condition in 1986, at the local Shire's request (Froend 1986; Froend & McComb 1991). In 1989 the Towerrinning Catchment Group was formed. Its members pursued an idea (first put forward by the Shire of West Arthur in 1979) of recapturing low-salinity flows from Morlup and Cordering Creeks to benefit recreational activities and nature conservation values of Towerrinning (Anon 1994). In 1993 a rediversion structure was built and from then until 2000, water levels in Towerrinning remained high despite several years (1994, 1997, 2000) of low annual rainfall.

In 1994, Towerrinning's outflow level was lowered from 3.46[1] to 3.0 mCALM (George & Bennett 1994) to increase the rate at which salt is flushed from the lake. Salinities were little changed in 1995, however from 1996 to 2000 they were markedly lower than during the preceding decade and comparable with the salinities that followed the flooding rains of 1982. The lake's outflow level can be varied by the addition or removal of one or more 'stop boards' from the spillway structure.

Towerrinning is one of 25 'biological monitoring' wetlands under the Salinity Strategy. Results of water chemistry, groundwater, invertebrate, waterbird and additional depth sampling in 1997-98 and 1999-00 are presented in Cale *et al.* (2004), together with some earlier data from other studies. Three plant community monitoring transects have been established at the margins of the lake and early results have been reported by Gurner *et al.* (1999) and Franke *et al.* (2001).

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. Depths in 2003 were similar to those of 1991-2000. In 2001 and 2002 they were lower, similar to those of 1989 and 1990. Salinities during 2001-2003 were within the range of 1981-2000 values.

Conclusion: Towerrinning's 1979-2000 monitoring data provide a useful record of lake depths and salinities before and after remedial engineering works undertaken in 1993 and 1994. The Towerrinning Catchment Group's aims of lower salinities and higher water levels in years of low rainfall have been achieved to 2000. This lake has significant recreational and nature conservation values (Jaensch *et al.* 1988) which warrant ongoing management attention.

5.5.6. Salinity decreasing – depth not changing (3 wetlands)

Bambun (depth changes 'not significant'; salinity changes 'very highly significant')

There has been little year-to-year variation in September and November depths of Bambun during the period of monitoring (1978-2000) and no significant change long term (Figure 8).

Bambun salinities have shown a 'very highly significant' decrease over the period of monitoring. Two distinct periods are discernible. Salinities were higher in all years from 1979-1985 (range 1.1-1.9 ppt) compared with 1986-2000 (range 0.6-1.1 ppt). An explanation for this decrease is not apparent from the depth or annual rainfall data. It might have been at least partly due to alterations to surface flows. Correspondence from the Department of Agriculture (1983) and the Gingin Soil Conservation Committee (1985) to the Department of Fisheries and Wildlife / CALM appears to suggest that some uncoordinated drainage works possibly affecting flows to Bambun were previously undertaken. Jaensch *et al.* (1988) noted that Bambun received water from local drains as well as groundwater and direct rainfall.

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. Bambun depths were similar to those of all preceding years (1979-2000). Salinities were similar to those of most years from 1986 onwards. They show no signs of increasing to 1979-1985 levels.

Conclusion: Bambun's monitoring data reveal a decrease in salinities in the mid-1980s. While this is not in itself of concern, it would be useful to identify the probable cause of this decline. Bambun has significant nature conservation values (Jaensch *et al.* 1988).

[1] This level was determined by D.R. Munro from a field survey conducted by him in 1985 and reported by Froend (1986).

Chandala (depth changes 'not significant'; salinity changes 'significant' to 'highly significant')

Chandala has shown little year-to-year variation in September and November depths and no significant long-term trend (Figure 14).

Chandala salinities show a significant downward trend when analysed for the entire period of monitoring (1979-2000). Highest values (1.3-2.1 ppt) were recorded during 1980-1982. Salinities in 1979 (0.75, 1.2 ppt) were within the range (0.45-1.45 ppt) of 1983-2000 records. There is no obvious explanation for the relatively high values of 1980-1982. Local drainage works might have been a contributing factor. Several efforts to divert flows to or from the lake were apparently made in the 1950s and 1970s. Some of these were considered at least partially successful (Tingay & Tingay 1976; DFW/CALM file)

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. Chandala depths were similar to those of most preceding years (1979-2000). Salinities were similar to those of 1979 and most years from 1983 onwards. They show no signs of increasing to 1980-1982 levels.

Conclusion: Chandala's monitoring data reveal salinity trends that are similar to those of nearby Bambun. Both had higher salinities in the early 1980s than subsequently. Though these trends are not in themselves of concern, they invite investigation. A more-complete understanding of the history of attempts to drain water to and from the lake would be useful for management. In some years Chandala has very significant nature conservation value as a major breeding site for Straw-necked Ibis *Threskiornis spinicollis* and other colonial nesting waterbirds (Jaensch *et al.* 1988; Jaensch & Watkins 1999).

Poorginup (depth changes 'not significant'; salinity changes 'highly significant' to 'very highly significant')

There is no significant long-term trend (1979-2000) in water levels of Poorginup, though there were pronounced drops in 1986 and 1987 (Figure 33).

September and September+November salinities of Poorginup have shown 'highly significant' to 'very highly significant' downward trends over the period of monitoring. This might be related to the significant upward trend in rainfall at the nearest Meteorological Station, with increased rainfall perhaps having a flushing effect in this instance. There were short-term increases in salinity in 1981, 1982 and 1987, the last coinciding with the particularly low water levels referred to above.

Latest data: 2001-2003 data have become available since data preparation and analysis for this report began. Poorginup depths fell dramatically in 2001 to slightly less than those of 1986. They increased somewhat in 2002 and returned to usual levels in 2003. Salinities jumped in 2001 to levels comparable with those of 1982. In 2003 they fell again to levels most similar to those of 1996.

Conclusion: Poorginup's monitoring data (to 2003) are interesting in that they reveal long periods (up to 12 years) of little change punctuated by temporary (1-2 year) sharp declines in depth and spikes in salinity. Strangely, these troughs and peaks do not always coincide. There are similarities between these data and those of Bambun and Chandala, suggesting that the higher salinity values of those wetlands in the early 1980s are possibly within the range of natural variation, as seems to be the case at Poorginup.

Poorginup is part of the Byenup-Muir Ramsar Site (Government of Western Australia 2000; Wetlands International 2002) and has high nature conservation values (Jaensch *et al.* 1988; Harvey 1996; Storey 1998; Gibson & Keighery 1999; DEH 2003) that would be severely affected by salinisation. In 1996, the Muir-Unicup wetland system (which includes Poorginup) was declared a Key Wetland and Natural Diversity Recovery Catchment under SAP (Government of Western Australia 1996a). This catchment is now the subject of detailed hydrological investigations and management actions aimed *inter alia* at maintaining and restoring natural depth and salinity regimes of Poorginup and other wetlands (DCLM 1998; Smith 2003; New in prep.). Transects have been established through fringing and emergent vegetation communities of Poorginup in order to examine relationships with wetland water levels and salinity (Froend & Loomes 2001).

5.5.7. Other wetlands with significant trends

Six wetlands showing statistically significant trends in depths (Station, Wannamal, Forrestdale) or salinities (Logue, Beverley, Dobaderry) are not discussed in section 5.5 due to the relatively low level of significance ($p<0.05$) of these trends. Consideration will be given to discussing them individually in future reports, if significant trends persist.

6. GENERAL ISSUES

Some general issues arise from the preceding presentation and discussion of results from 1977-2000 monitoring under SWWMP.

6.1 Start and end years and the influence of rainfall

Monitoring at 30 of the 41 wetlands selected for trends analysis in this report began during a period (1976-1979) of severe drought (Bureau of Meteorology 1995a) in south-western Australia[1]. In contrast, the late 1990s to 2000 was a period of more-normal rainfall. This particular combination (for analysis) of start and end periods can be expected to result in more wetlands showing trends of increasing depth and decreasing salinity than would have been the case if start and end periods of similar annual rainfall had been chosen, due to the relationships that exist between rainfall, depths and salinities. It is not surprising, therefore, that several wetlands (see Table 1 and section 5.5) have shown depth increases that can be largely or entirely explained by differences in annual rainfall between the start and end periods.

6.2 Potential for hidden trends

From a management perspective, it is particularly important to be able to discover trends of concern that might not be revealed by simple analysis of all raw data (e.g. all salinity records). For example, secondary salinisation can be masked, for some years at least, by the diluting effect of increasing water levels (resulting in *lower* salinities) during periods of increasing rainfall. The high variance of salinity data from some wetlands can also result in trends of concern not being detected by routine statistical analysis. These issues were touched on in section 5.5 where the probable causes of highly significant trends in depths and/or salinities of 17 of the 41 wetlands monitored for 20 or more years were considered. Here, comments were made in relation to some wetlands to the effect that, whereas analysis of all salinity data had not revealed significant trends, comparisons of same-depth salinities appeared likely to do so. Visual examination of data from the 24 wetlands not addressed individually in that section suggests that same-depth comparisons of Byenup and Coyrecup data might also reveal 'hidden' trends of salinisation.

It is apparent from the discussion above and in the preceding section that same-depth or similar analyses should be conducted on the data from all wetlands monitored for 20 or more years, in order to test for salinisation as opposed to trends in salinity alone.

Other trends of concern, such as increasing inundation (e.g. due to increased runoff from cleared catchments) or reduced inundation (e.g. due to water extraction or diversion), may also escape detection for some years if analyses are restricted to all raw data. More sophisticated statistical methods may need to be applied in future to separate depth trends due to changes in rainfall from trends due to other factors of possible concern.

6.3 Protocol for early detection of change

While one monitoring event is sufficient to reveal that a wetland's depth or salinity has changed since the previous monitoring event, it will usually take several monitoring events to identify statistically significant changes, i.e. trends, and perhaps longer to determine if these trends are outside past limits. If the change is of a potentially threatening nature, it is important that it be detected and responded to

[1] It should be noted, however, that south-western Australia is a large region (700km N-S and E-W) and that, even in years of widespread drought, some parts may experience higher than average rainfall. This was the case during the severe drought of the late 1970s, when Esperance and nearby districts experienced some well-above-average rainfalls. Selection of a single, common, start year or start year period therefore has less effect on results overall than might be first thought.

as soon as possible. On the other hand unwarranted responses should be avoided. It is therefore desirable that a protocol be developed for detection and appropriate response to potentially adverse changes as revealed by SWWMP. Particular attention will need to be focussed on wetlands with high conservation values potentially at risk. It is preferable, of course, that potential threats be identified and forestalled before they are able to impact upon wetlands, however this does not obviate the need for timely detection of within-wetland changes.

6.4 Period required to determine 'normal' hydrological regimes

It is evident from the results presented in this report that September and November depths and salinities of south-west wetlands vary from year to year. In some wetlands these variations have been very small for the entire period of monitoring (i.e. for 20 years or more) and there has been no significant trend over this period. It is tempting, in these cases at least, to conclude that the period of monitoring has been adequate, perhaps more than adequate, to define the 'normal' September and November depth and salinity regimes of these wetlands. There are also, however, other wetlands that have undergone dramatic, short-term, apparently-natural changes in depth and/or salinity that have not occurred at any other time throughout the entire period of monitoring. In these instances, some shorter or different periods of monitoring would have missed these infrequent, but highly significant, hydrological events. These cases raise the possibility that some highly significant, natural, hydrological events might happen even less frequently than once every 20 or so years, and that longer periods of monitoring may be required before the 'normal' regimes of these wetlands can be properly and confidently described.

Wetland water levels are closely linked to climate, particularly rainfall and evaporation. Meteorologists have studied climatic data for centuries, using it to describe the 'normal' climate of particular locations and regions, and searching for trends. Their findings are relevant to the study of normalcy and trends in wetlands.

Colls & Whitaker (1990 p151) quote *The Meteorological Glossary*[1] as stating that climatic data are usually determined over a period of about 30 years, this being regarded as a long enough period to ensure that representative values for months or seasons are obtained. However, as Gentilli (1995) pointed out, a lot may depend upon which 30 year period is selected, as very significant changes may happen to occur just outside the chosen period. Gibbs *et al.* (1978) had similar thoughts and suggested: 'With weather as variable as that in Australia, rainfall records for 150 years and temperature records for 50 years or more may be considered necessary adequately to determine and describe the climate'. If 150 years of rainfall records are required to describe the climate of a particular locality or region, it seems reasonable to conclude that a similar number of years might be needed to adequately determine and describe the hydrological regime of a wetland whose catchment includes or lies within that locality or region. In south-western Australia, a region of relatively reliable rainfall, 150 years could be unnecessarily long, however a period of at least several decades, perhaps more, does seem warranted.

6.5 A search for pre-SWWMP data

Average May-October (wet season) rainfall in south-western Australia from 1976 to 2001 was 85-90% of the preceding 50-year average (IOCI 2002)[2]. This reduction resulted in a sharp fall in stream flows (IOCI 2002) and has no doubt impacted on the water levels and salinities of many wetlands across the south-west. SWWMP monitoring began in 1977, two years into the 26 year period of lower average rainfall. Descriptions of 'normal' hydrological regimes that are based on SWWMP data are therefore likely to be significantly different from descriptions based on the preceding 50 years or both periods combined. This serves to illustrate the long time periods that are required to determine and describe 'normal' hydrological regimes. It also indicates that understanding of these regimes could be significantly enhanced by comparison of pre-1977 water level and salinity data with the SWWMP dataset. Except in the case of some wetlands near Perth (see Cake 1998), these early data (particularly water levels) are relatively few in number and widely scattered. Nonetheless their potential value warrants efforts being made to locate them. One potential source (K.J. Wallace pers. comm.) is the collection of verbatim transcripts referred to in Sanders' (1991) paper analysing oral histories of

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1 Not referenced, but almost certainly that published by the U.K Meteorological Office (6th edn in 1991).

2 The cause of this decrease is not certain. It might simply reflect natural climate variability, or it could be a 'greenhouse' effect, or perhaps a combination of both. Other factors such as global land use changes or ozone depletion might also have contributed. A similar, but less severe, dry period occurred in the early 1900s (IOCI 2002).

changes to Wheatbelt wetlands since the early 1900s. Archived files of several State government agencies could also hold valuable records.

6.6 Land clearing and wetland hydrology

By 1969, some 13.77 million hectares (54%) of the south-western Australian agricultural region had been cleared of native vegetation (Burvill 1979; Government of Western Australia 1996b). Cleared areas included the catchments of many SWWMP wetlands and resulted in a rise in saline groundwaters and extensive waterlogging. As a consequence, many wetlands were already showing the effects of secondary salinisation and increased inundation long before SWWMP monitoring began. Oral histories collected and analysed by Sanders (1991) indicate that Yealering, Nonalling, White Water, Brown, Mears, Queerearrup and Beverley (Yenyenning) were becoming saline and/or excessively inundated in the 1930s; Coblinine in the 1940s; Toolibin, Taarblin, White Narrogin (Big White), Little White and Coyrecup in the 1950s; Walbyring and Dulbinning in the 1960s and Towerrinning in the early 1970s. It follows that 'no significant trend' in water depth or salinity of individual wetlands during the period of SWWMP monitoring does not necessarily mean the wetland under consideration is in pristine or near-pristine condition. In many cases, massive change had already occurred.

7. USES, RELATIONSHIPS, REPORTING AND SUPPLY OF SWWMP DATA

This section provides an overview of past, present and potential future uses of SWWMP data, relationships between SWWMP and other Salinity Strategy programs conducted by CALM with a focus on wetlands, an outline of proposed future reporting and a contact point for supply of SWWMP data.

7.1 Uses of SWWMP data

Data from SWWMP have been used by CALM personnel and made available to a variety of other organisations and individuals over the past 26 years for many purposes such as[1] determining duck hunting season specifications (Lane & Munro 1983); documenting wetland conditions during assessments of use by waterbirds (Jaensch *et al.* 1988); characterising wetlands (Halse *et al.* 1993); documenting baseline conditions of wetlands (ANCA 1993); confirming changes (Knott *et al.* 2003); assessing potential impacts (VRA 2002); investigating water diversion (URS 2002), drainage and saline water disposal (Dumbleyung) proposals; salt and water-balance studies (JDA 2002); management planning (Hopkinson 2004); setting limits for water abstraction (Shark), insect control (Bartle *et al.* 1987) and aquatic recreational activities (Towerrinning); assessment of wetland suitability for aquaculture (Yellilup) and ecological study (Halse 1981).

SWWMP data can be used in conjunction with results of wetland bathymetry surveys[2] to calculate the changes in wetland water levels and salinities that are likely to result from specific drainage, diversion, extraction and evaporative basin proposals. This is a necessary first step for prediction of impacts on biota. SWWMP data are also likely to prove useful in determining the flood mitigation role of specific wetlands and may contribute to 'State of the Environment' reporting.

7.2 SWWMP and other salinity programs of CALM

Six Natural Diversity Recovery Catchments have been established since SAP was initiated in November 1996. In most cases the recovery initiatives for these catchments and their wetlands provide for more-intensive monitoring of water depth, salinity, pH and nutrients than is currently undertaken under SWWMP. Nonetheless, SWWMP data provide an invaluable record of the state or condition of these wetlands prior to recovery actions being initiated and ongoing SWWMP monitoring provides contemporary data that can be directly compared with these historical records. SWWMP data can thereby contribute to assessments of the effectiveness of management actions aimed at catchment and wetland recovery.

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[1] Only one reference example is given above for each purpose. Where reports or other documentation are not readily available, only the wetland name is given. For a more-complete list of references in which use is made of SWWMP data, see Appendix 8.
[2] Being undertaken by CALM, with DLI support, under SWWMP and the Salinity Strategy.

The 1997–2000 Biological Survey of the Wheatbelt (Keighery *et al.* 2004) involved, *inter alia*, a survey of the aquatic invertebrates, waterbirds and wetland plants of 232 wetlands in the Wheatbelt region of south-western Australia (see Halse *et al*. 2004). Seventeen of the 60 SWWMP wetlands that were being monitored in 1996 were included in the biological survey and 35 biological survey wetlands are now being monitored under SWWMP. Application of the results of the biological survey in the selection of additional SWWMP wetlands has resulted in a greater diversity of wetlands being monitored.

All 25 biological monitoring wetlands (Cale *et al.* 2004) established since 1997 under the Salinity Strategy are included within the set of 100 wetlands currently monitored under SWWMP. SWWMP has contributed to this ongoing program by providing a record of several key parameters (depth, permanence, salinity, pH) affecting the plant and animal communities of 17 of these wetlands prior to commencement of biological monitoring. Current monitoring under SWWMP contributes valuable additional data[1] for all 25 wetlands of the biological monitoring program. SWWMP also provides and maintains the depth gauge network used in the biological monitoring program and facilitates linkage of vegetation transect and shallow groundwater elevations (Cale *et al.* 2004) to wetland water levels and bathymetry, including outflow levels.

7.3 Future reporting

A primary objective of this report has been to provide an overview of the data that have been collected under SWWMP in the expectation that this will prove useful for managers of wetlands in south-western Australia and for others with related responsibilities and interests, particularly where these may contribute to implementation of the Salinity Strategy. The format of the report, in particular the extensive use of figures, graphs and summary statistics, has been strongly influenced by this objective.

A report on results of pH (acidity/alkalinity) monitoring of all 151 SWWMP wetlands from 1981 to 2000 is currently being prepared and is similar in format to the present report.

The 1981-2000 pH report will be followed in 2005 by reports on monitoring to 2004 of the depth, salinity and pH of the 100 SWWMP wetlands that continue to be monitored under the Salinity Strategy. Some additional analyses are proposed for the 2005 reports. For example, salinity data from selected wetlands will be analysed for trends in 'same-depth' salinities, that is, salinities recorded when depths are within a narrow range or ranges not close to zero. By this means, the exceptionally high salinities that occur when many wetlands approach dryness will be removed from the analyses, thus reducing the variance of the salinity data and increasing the probability of detection of significant trends.

Rainfall data will be analysed for long-term trends by month as well as by year, as some months may show opposing trends (Gentilli 1995) and this has implications for interpretation. Possible use of some measures of rainfall intensity, for example those used by Gentilli & Bekle (1983) or Hennessy *et al.* (1999), will also be considered, given the influence of intensity on catchment runoff and flows to wetlands. It is expected that these additional rainfall analyses will further assist in the interpretation of wetland water level data and in ascertaining whether significant trends can be readily explained by changes in rainfall alone. Where this is not the case, further investigation may be recommended or initiated[2] to determine the probable cause or causes and any remedial action that might be desirable.

7.4 Data supply

In addition to the proposed reports referred to above, SWWMP data for individual wetlands and small groups of wetlands will continue to be made available to other organisations and individuals when requested, as in the past. Requests should be e-mailed to jiml@calm.wa.gov.au. The Department is also endeavouring to make some wetland data available via its website (www.calm.wa.gov.au) from 2006 onwards.

[1] SWWMP monitoring is in September and November each year. Biological monitoring is in winter (Aug-Sep), spring (Oct-Nov) and autumn (Feb-Apr) of every second year (Cale *et al.* 2004).

[2] The authors have a biological, not hydrological, bent and therefore do not propose to undertake intensive hydrological investigations on specific wetlands. Such studies are more-properly undertaken by experienced hydrological professionals.

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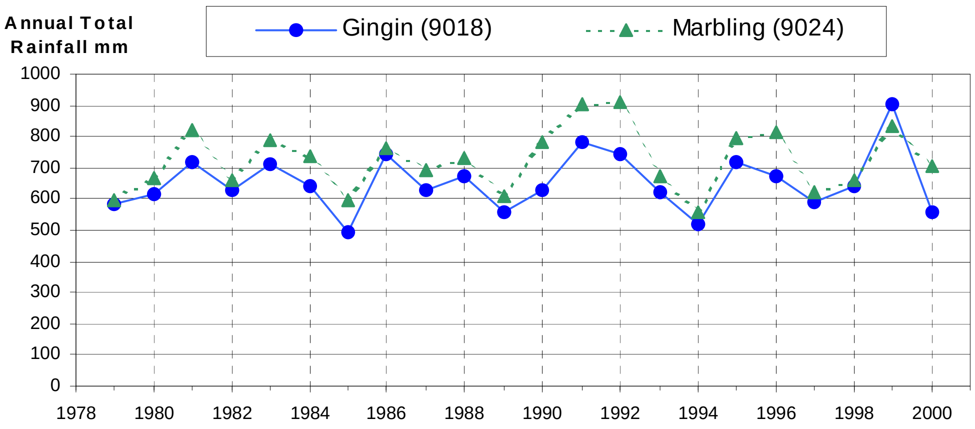
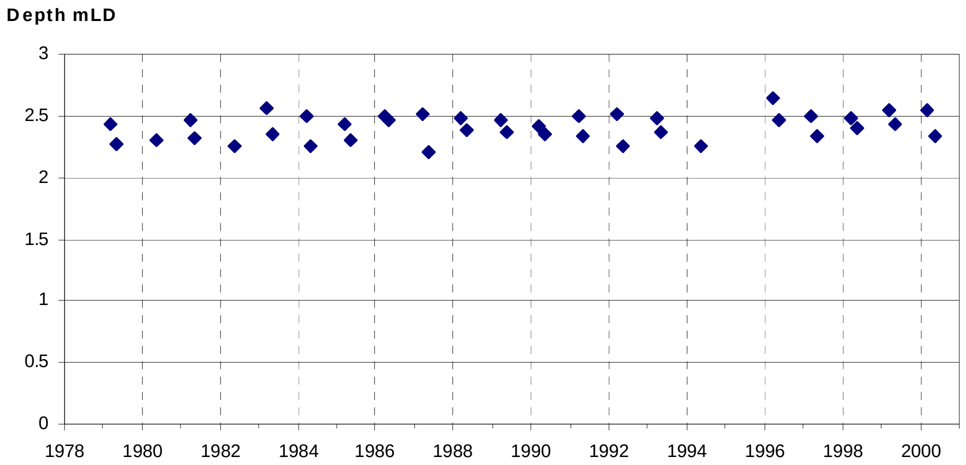
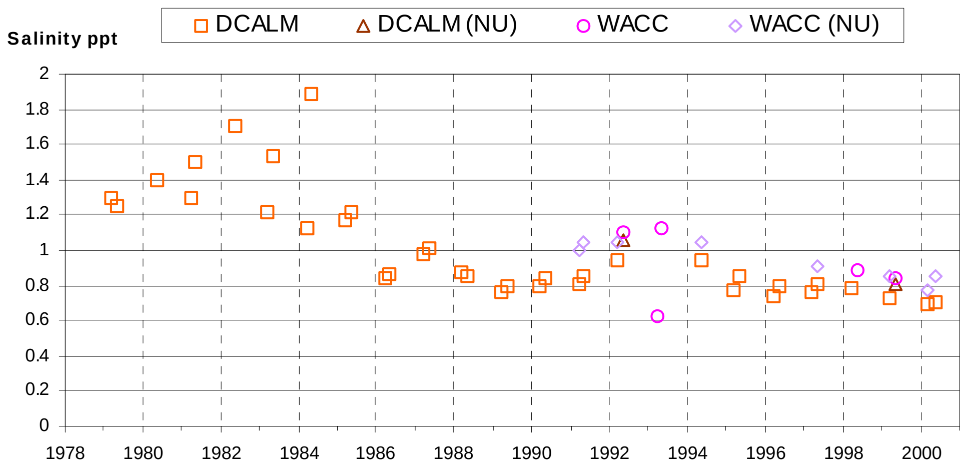
Figure 8: BAMBUN



Rainfall Trend
Not signif. p = 0.52



Depth Trends
SEP ONLY Insuff. data
NOV ONLY Not signif. p = 0.063
SEP & NOV Not signif. p = 0.085

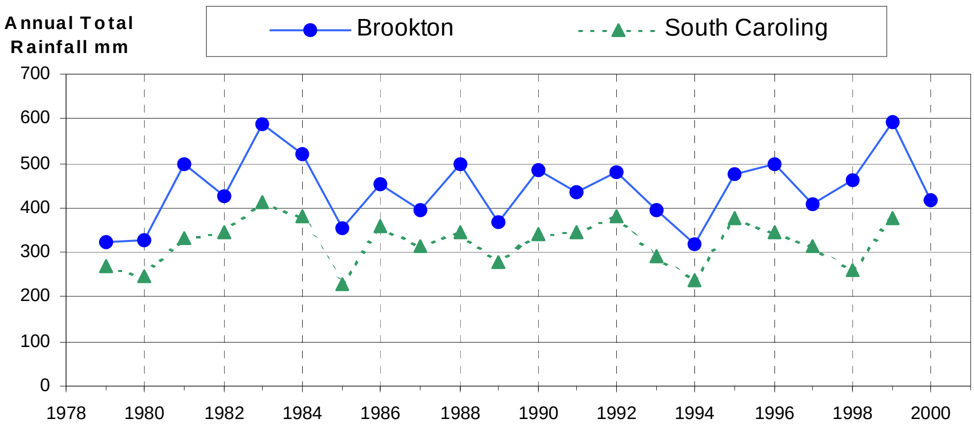


Salinity Trends
SEP ONLY Insuff. data
NOV ONLY **Decreasing** p = 0.0001
SEP & NOV **Decreasing** p = 0.0001

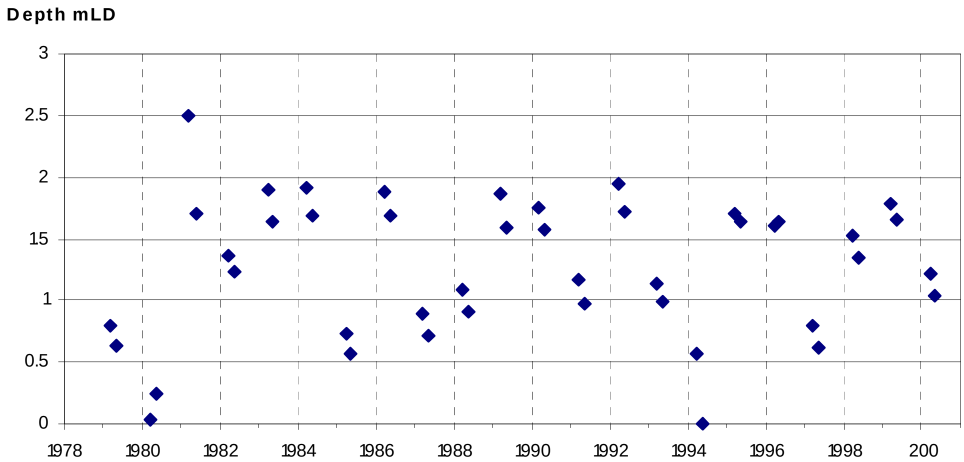
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).
6. For number of records considered sufficient for trend analysis refer to section 4.7.

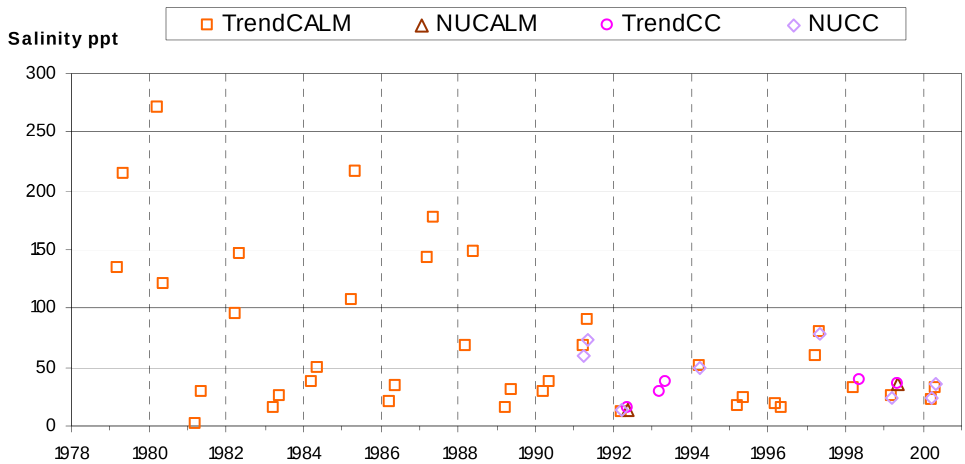
Figure 9: BEVERLEY



Rainfall Trend
Not signif. p = 0.38



Depth Trends
SEP ONLY Not signif. p = 0.468
NOV ONLY Not signif. p = 0.77
SEP & NOV Not signif. p = 0.483

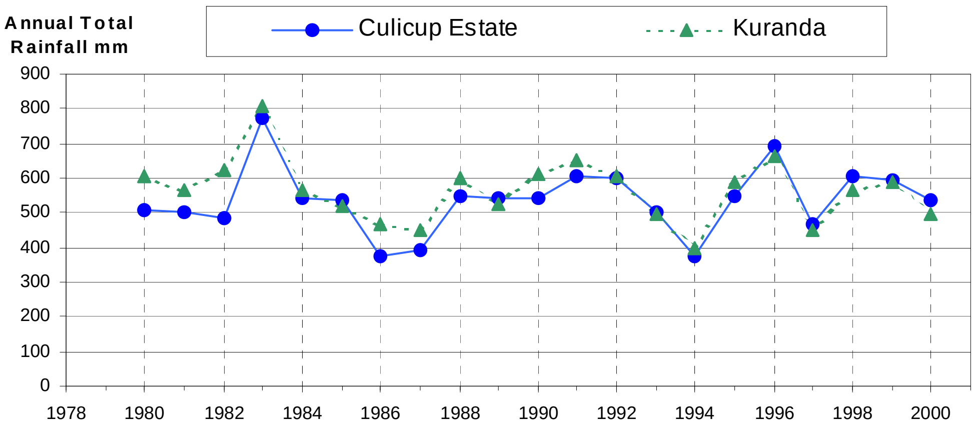


Salinity Trends
SEP ONLY Not signif. p = 0.4825
NOV ONLY **Decreasing** p = 0.0280
SEP & NOV Not signif. p = 0.0522

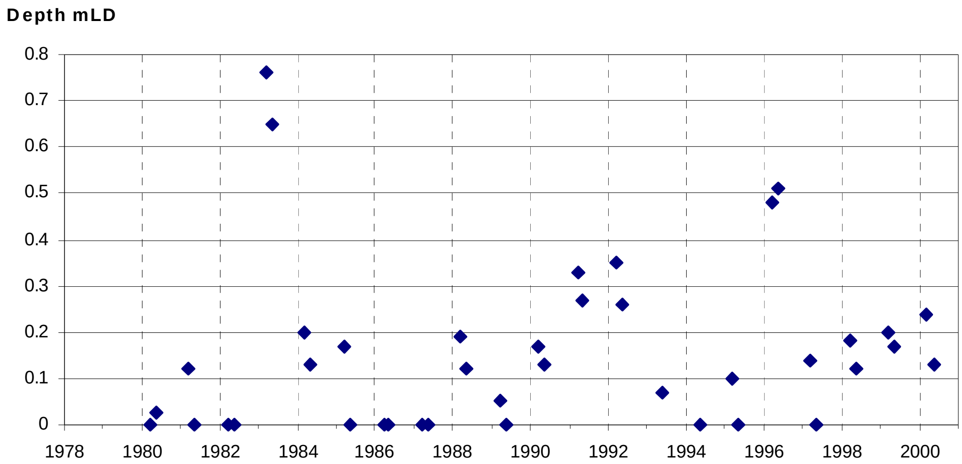
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

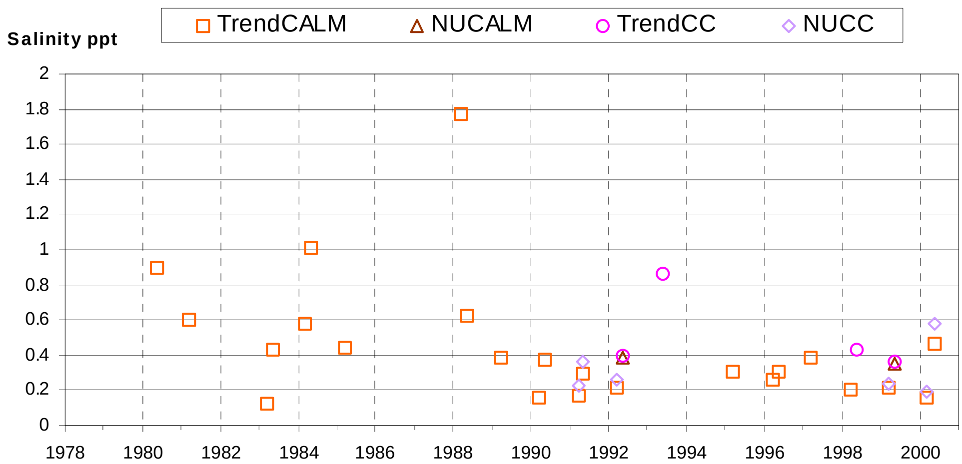
Figure 10: BOYUP BROOK 18239 (KULICUP)



Rainfall Trend
Not signif. p = 0.61



Depth Trends
SEP ONLY Insuff. data
NOV ONLY Not signif. p = 0.366
SEP & NOV Not signif. p = 0.109

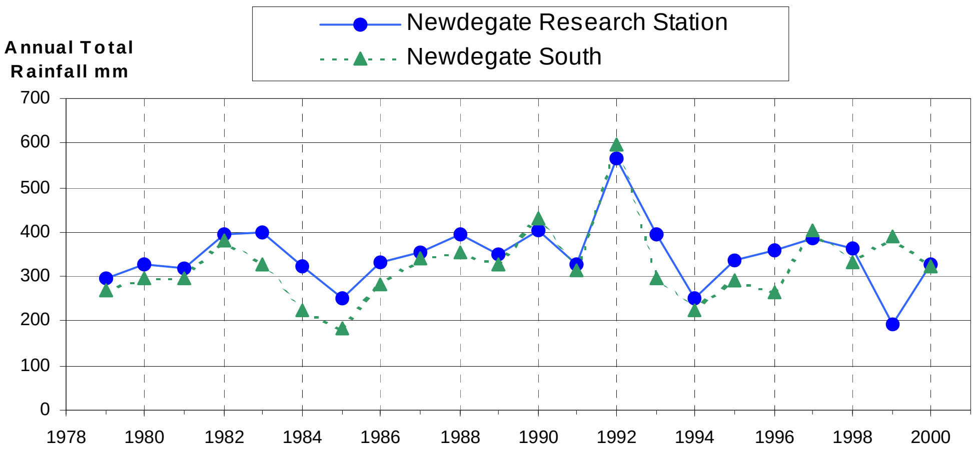


Salinity Trends
SEP ONLY Insuff. data
NOV ONLY Not signif. p = 0.0757
SEP & NOV Not signif. p = 0.0523

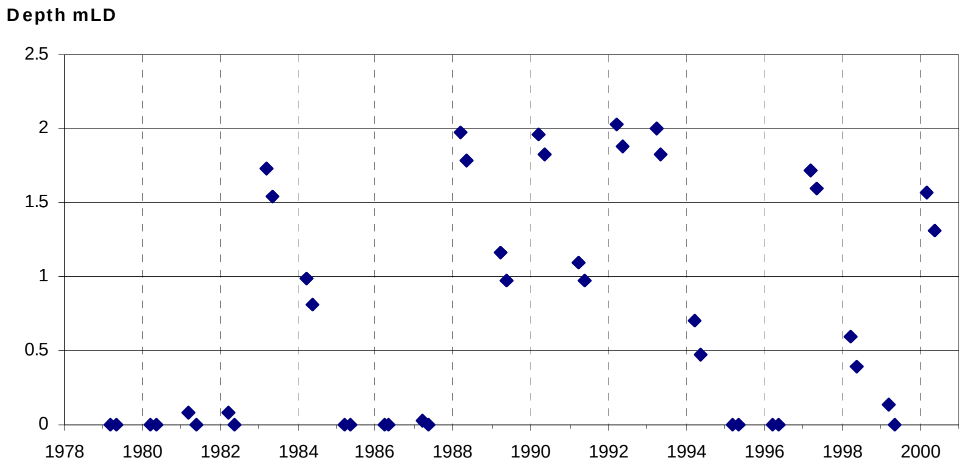
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).
6. For number of records considered sufficient for trend analysis refer to section 4.7.

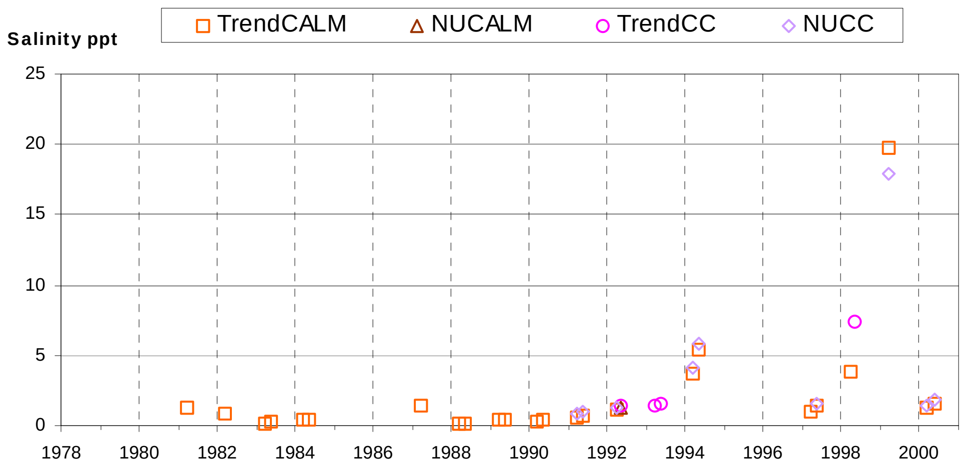
Figure 11: BRYDE



Rainfall Trend
Not signif. p = 0.96



Depth Trends
SEP ONLY Not signif. p = 0.138
NOV ONLY Not signif. p = 0.168
SEP & NOV **Increasing** p = 0.038

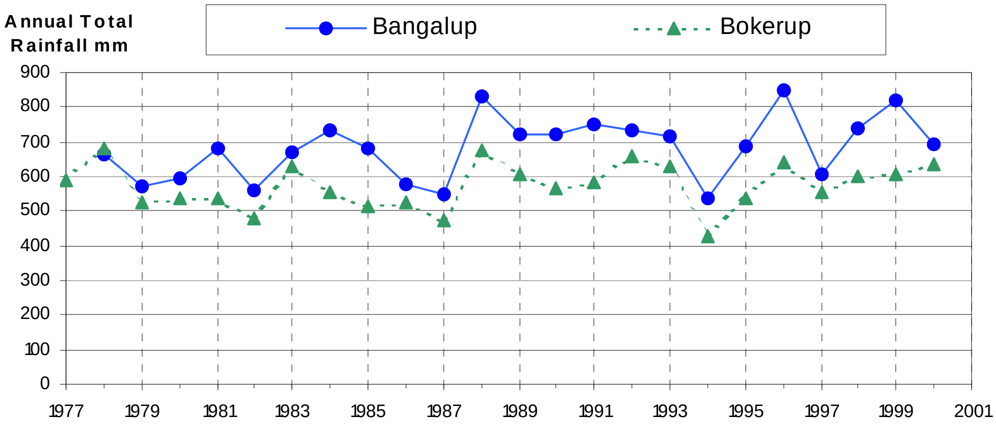


Salinity Trends
SEP ONLY **Increasing** p = 0.0131
NOV ONLY **Increasing** p = 0.0030
SEP & NOV **Increasing** p = 0.0001

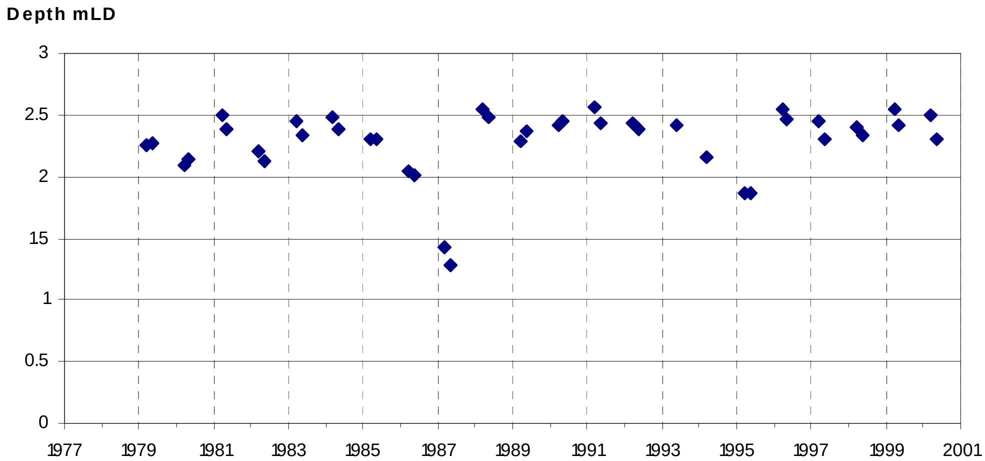
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

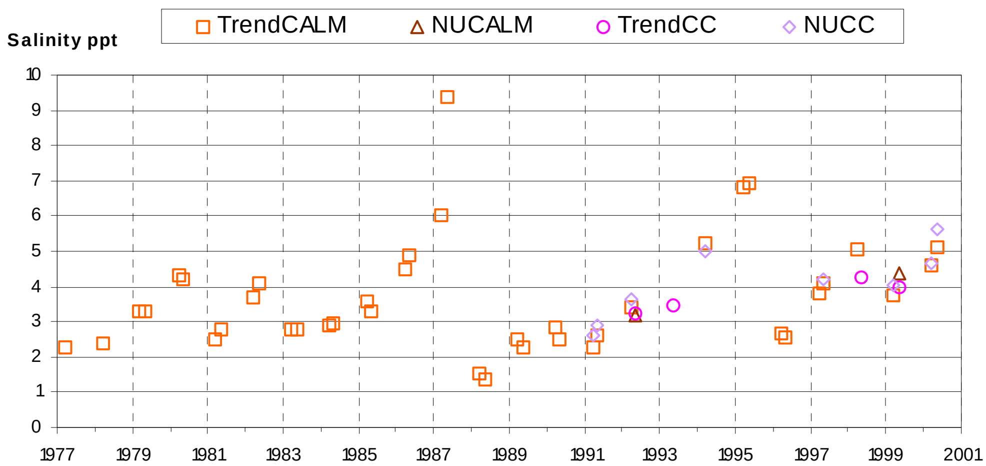
Figure 12: BYENUP



Rainfall Trend
Increasing p = 0.048



Depth Trends
SEP ONLY Not signif. p = 0.358
NOV ONLY Not signif. p = 0.485
SEP & NOV Not signif. p = 0.242

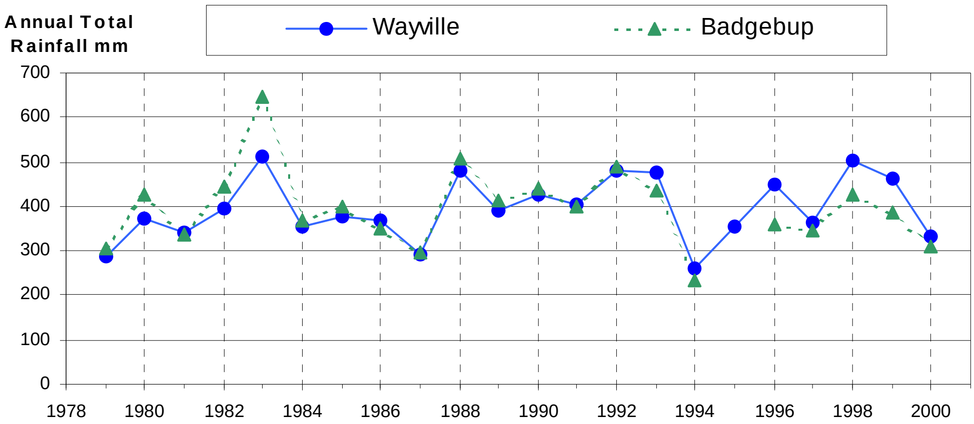


Salinity Trends
SEP ONLY Not signif. p = 0.0718
NOV ONLY Not signif. p = 0.4458
SEP & NOV Not signif. p = 0.0622

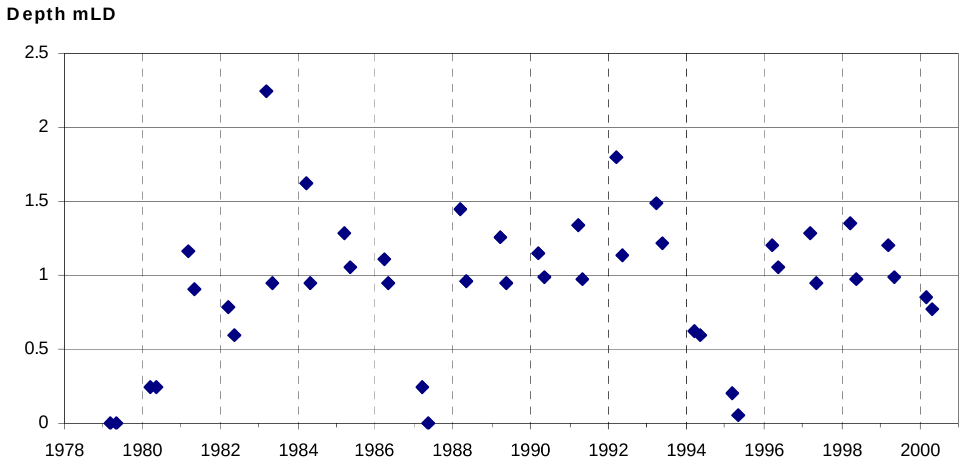
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

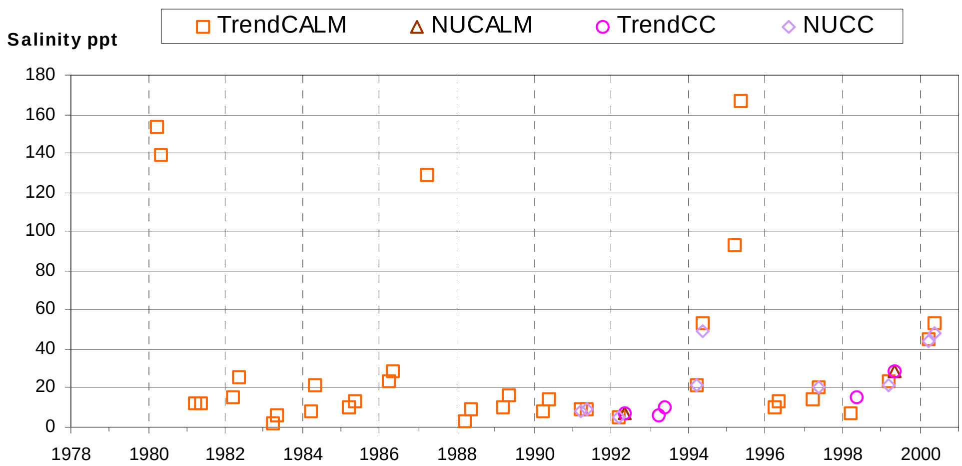
Figure 13: CASUARINA



Rainfall Trend
Not signif. p = 0.29



Depth Trends
SEP ONLY Not signif. p = 0.262
NOV ONLY Not signif. p = 0.156
SEP & NOV Not signif. p = 0.077

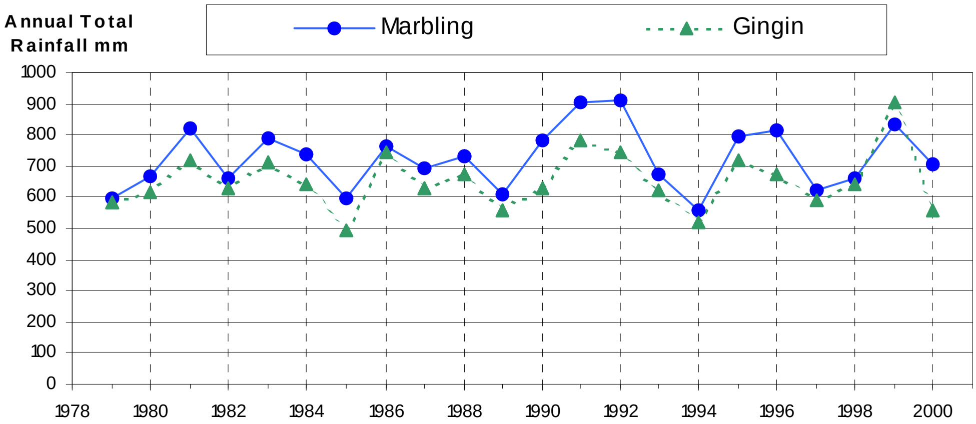


Salinity Trends
SEP ONLY Not signif. p = 0.8522
NOV ONLY Not signif. p = 0.6582
SEP & NOV Not signif. p = 0.6494

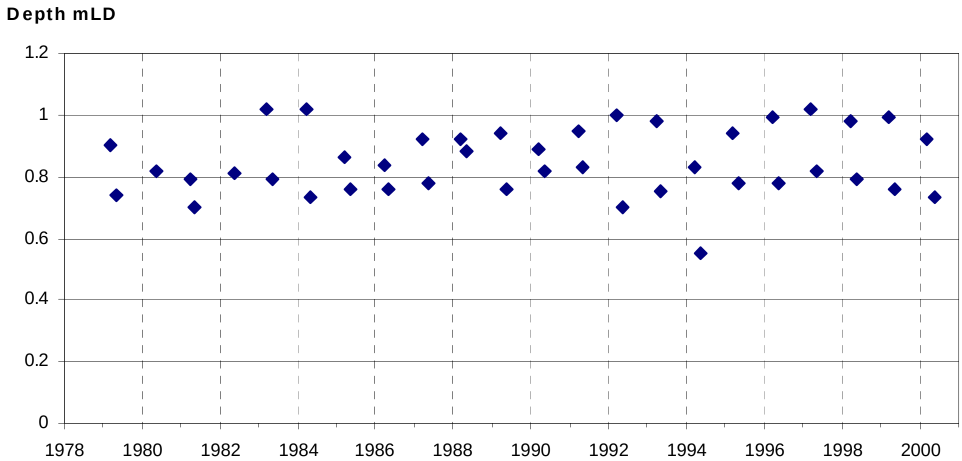
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

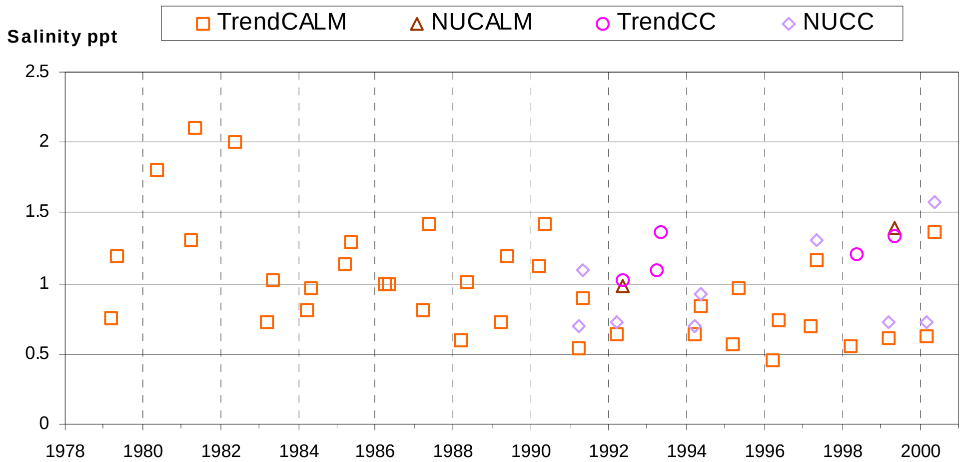
Figure 14: CHANDALA



Rainfall Trend
Not signif. p = 0.53



Depth Trends
SEP ONLY Not signif. p = 0.106
NOV ONLY Not signif. p = 0.671
SEP & NOV Not signif. p = 0.486

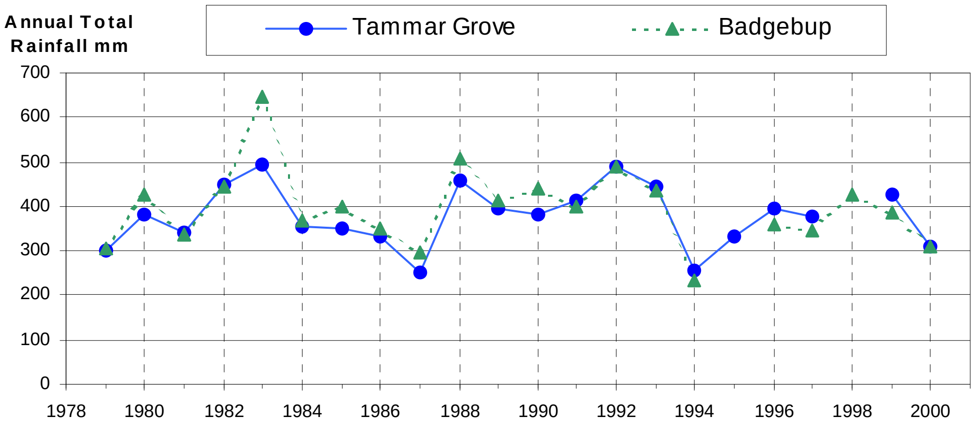


Salinity Trends
SEP ONLY **Decreasing** p = 0.0095
NOV ONLY Not signif. p = 0.0760
SEP & NOV **Decreasing** p = 0.0114

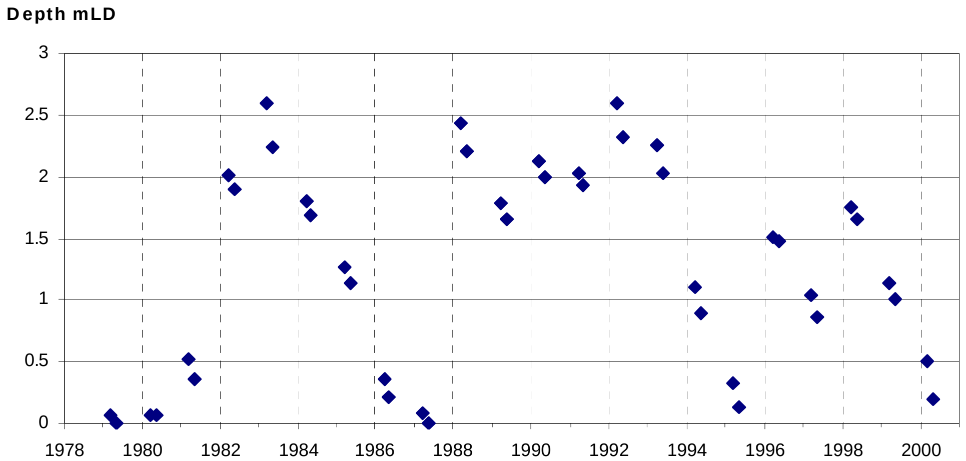
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

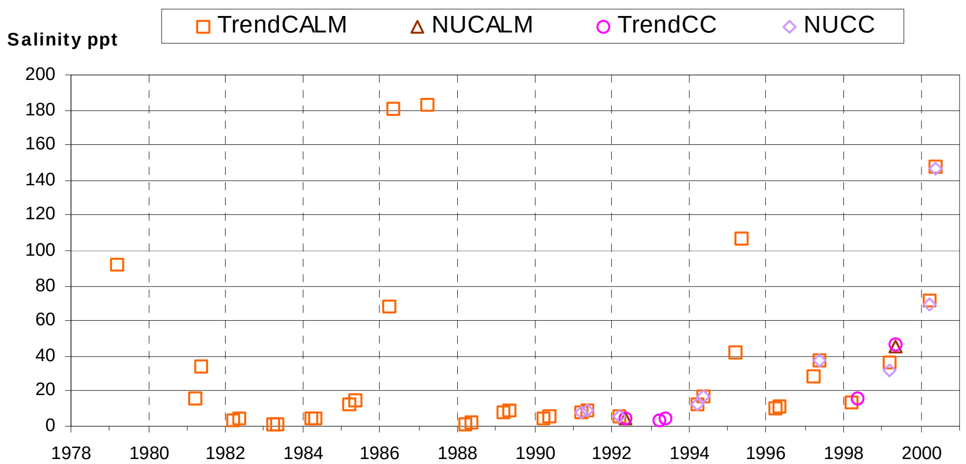
Figure 15: COYRECUP



Rainfall Trend
Not signif. p = 0.98



Depth Trends
SEP ONLY Not signif. p = 0.315
NOV ONLY Not signif. p = 0.368
SEP & NOV Not signif. p = 0.172

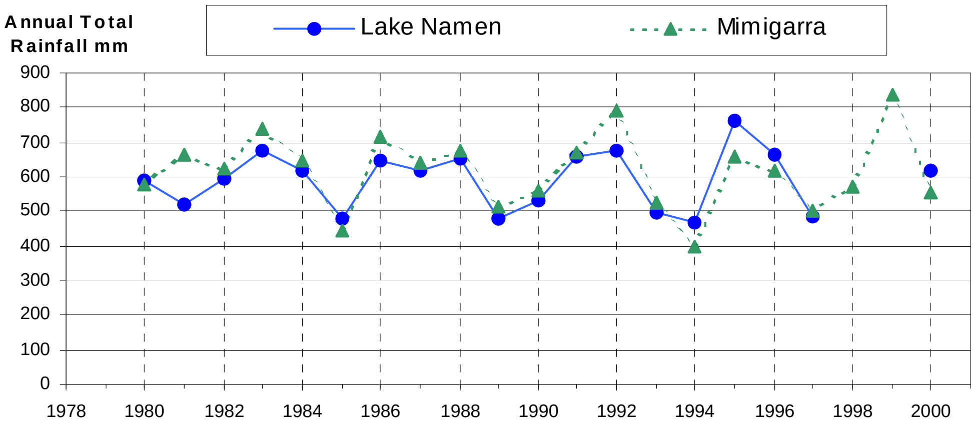


Salinity Trends
SEP ONLY Not signif. p = 0.4189
NOV ONLY Not signif. p = 0.0737
SEP & NOV Not signif. p = 0.0639

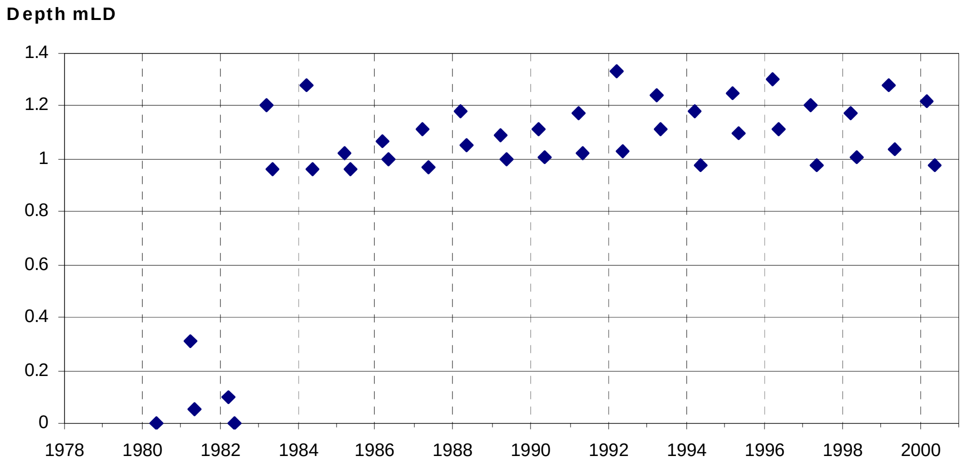
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

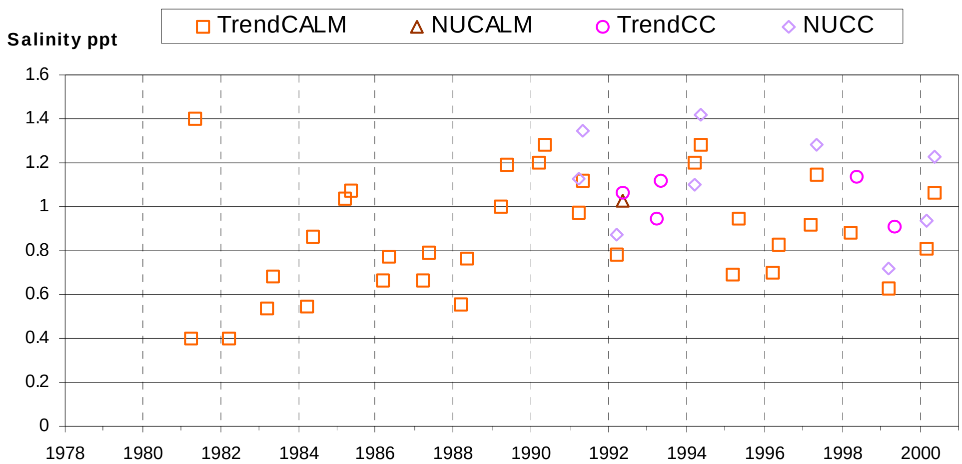
Figure 16: CRACKERS



Rainfall Trend
Not signif. p = 0.83



Depth Trends
SEP ONLY **Increasing** p = 0.009
NOV ONLY **Increasing** p = 0.002
SEP & NOV **Increasing** p = 0.0001

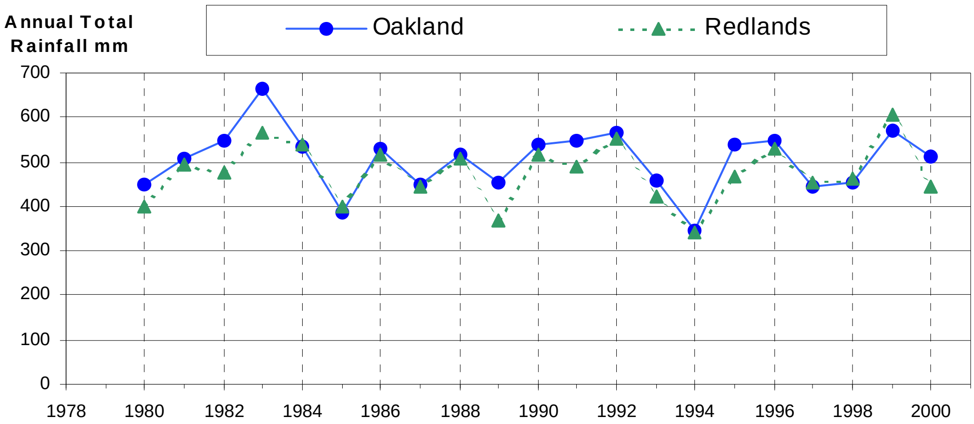


Salinity Trends
SEP ONLY **Increasing** p = 0.0210
NOV ONLY Not signif. p = 0.4232
SEP & NOV **Increasing** p = 0.0232

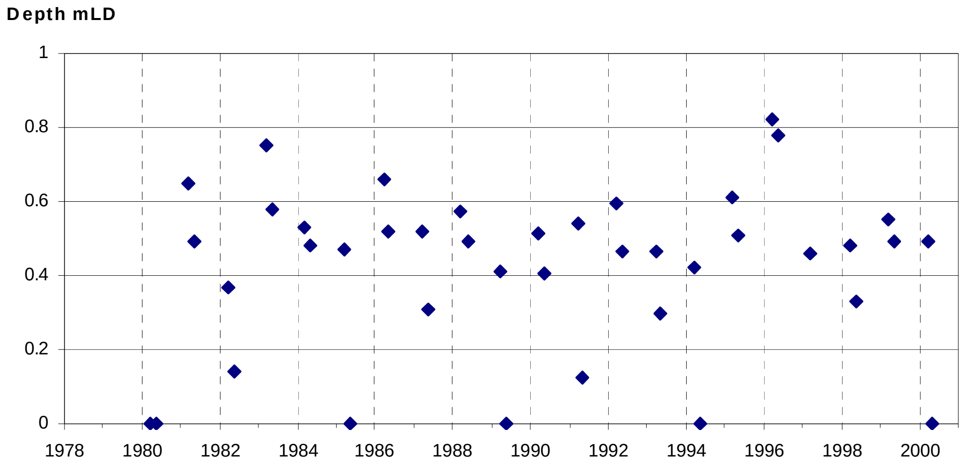
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

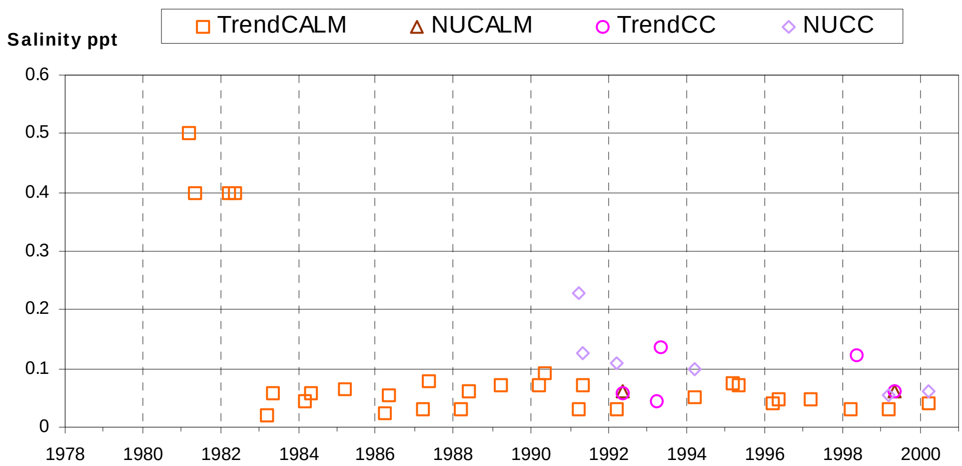
Figure 17: DOBADERRY



Rainfall Trend
Not signif. p = 0.68



Depth Trends
SEP ONLY Not signif. p = 0.178
NOV ONLY Not signif. p = 0.84
SEP & NOV Not signif. p = 0.404

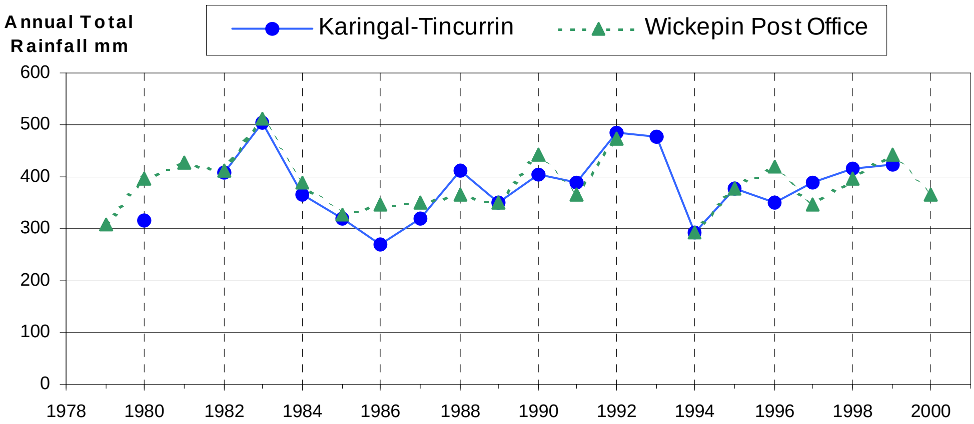


Salinity Trends
SEP ONLY Not signif. p = 0.0717
NOV ONLY Not signif. p = 0.1266
SEP & NOV **Decreasing** p = 0.0164

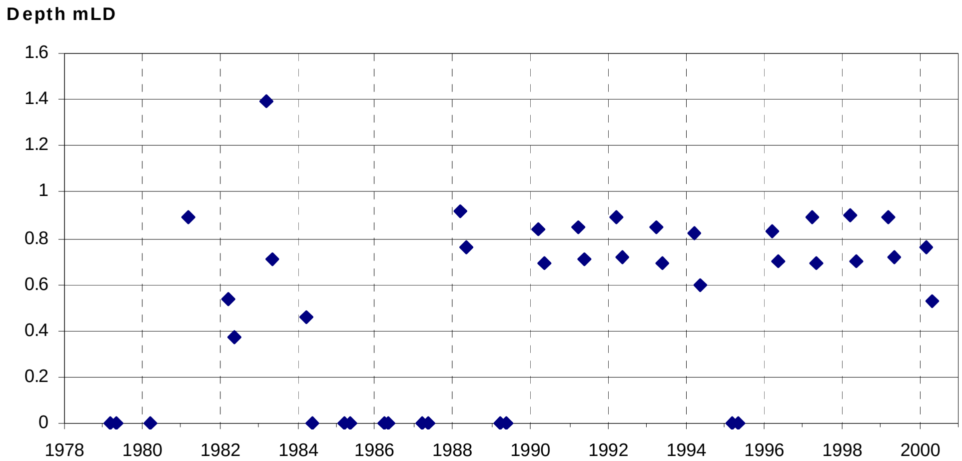
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1^{st} July).

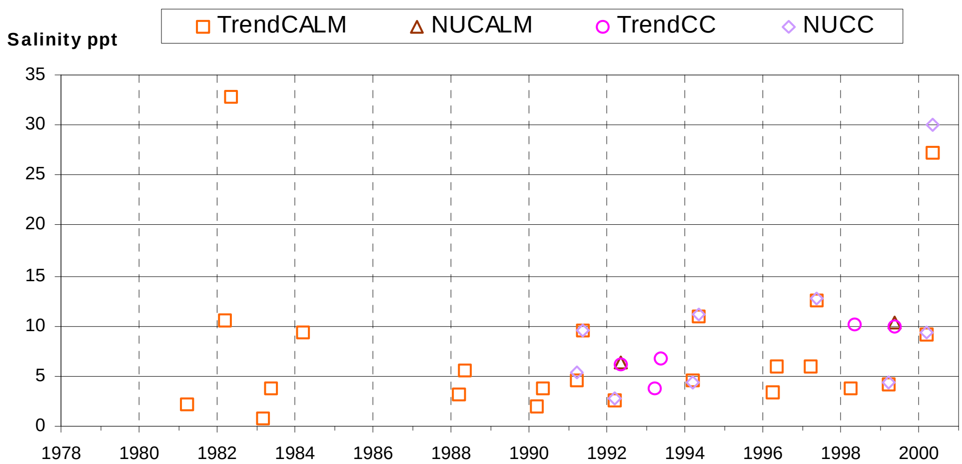
Figure 18: DULBINNING



Rainfall Trend
Not signif. p = 0.44



Depth Trends
SEP ONLY Not signif. p = 0.065
NOV ONLY **Increasing** p = 0.02
SEP & NOV **Increasing** p = 0.004

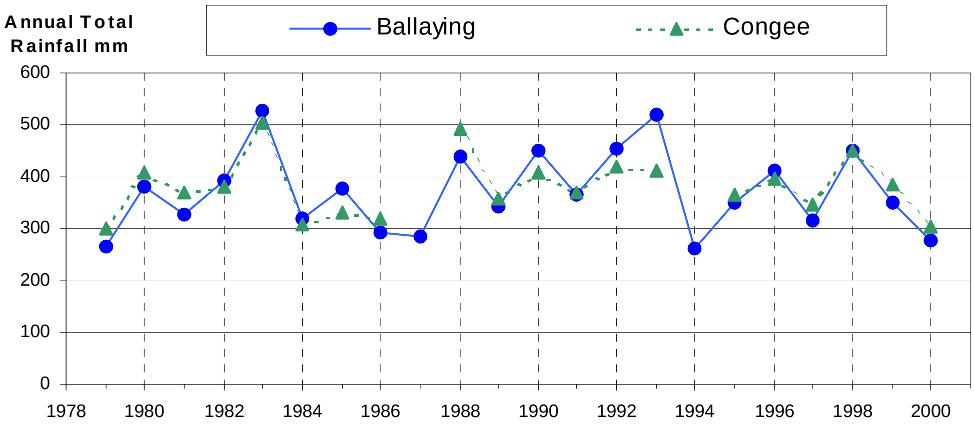


Salinity Trends
SEP ONLY Not signif. p = 0.3833
NOV ONLY Not signif. p = 0.5185
SEP & NOV Not signif. p = 0.1915

Notes:

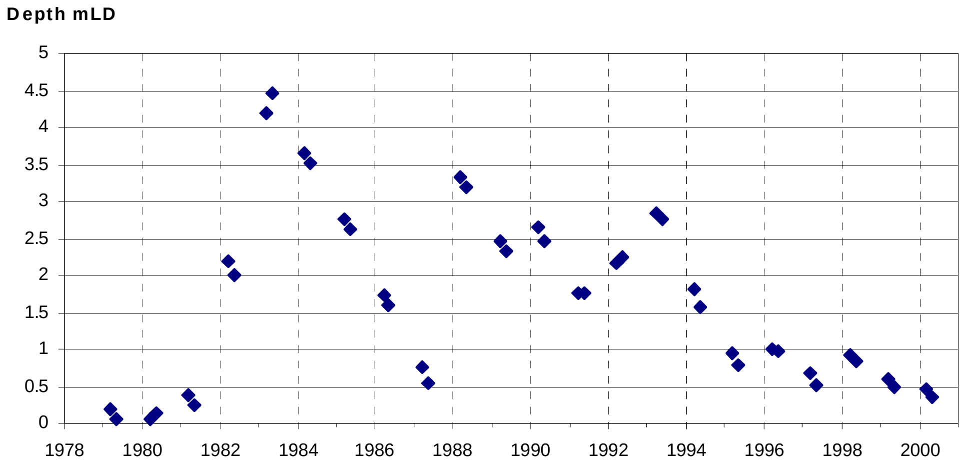
1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

Figure 19: DUMBLEYUNG



Rainfall Trend

Not signif.
p = 0.86

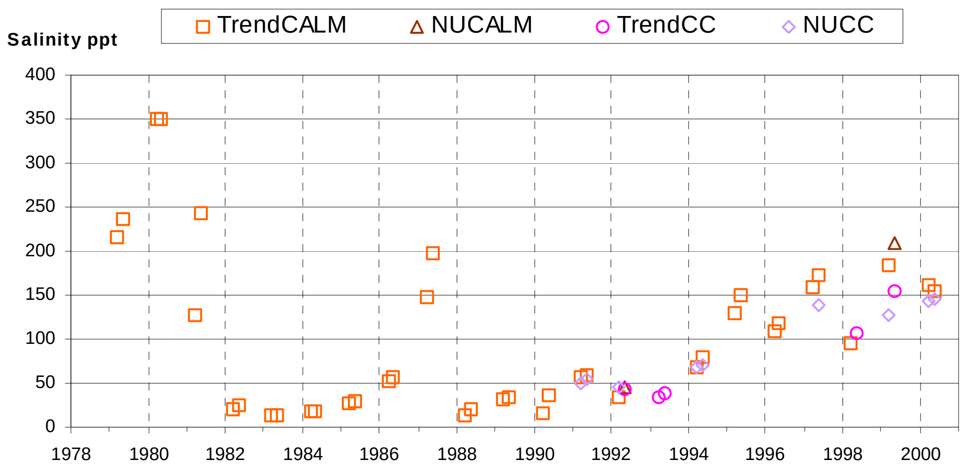


Depth Trends

SEP ONLY
Not signif.
p = 0.728

NOV ONLY
Not signif.
p = 0.676

SEP & NOV
Not signif.
p = 0.574



Salinity Trends

SEP ONLY
Not signif.
p = 0.3389

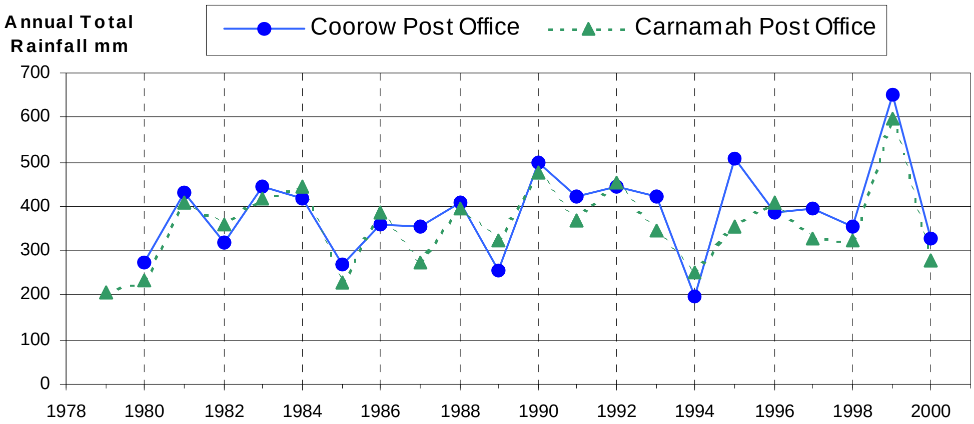
NOV ONLY
Not signif.
p = 0.4553

SEP & NOV
Not signif.
p = 0.2123

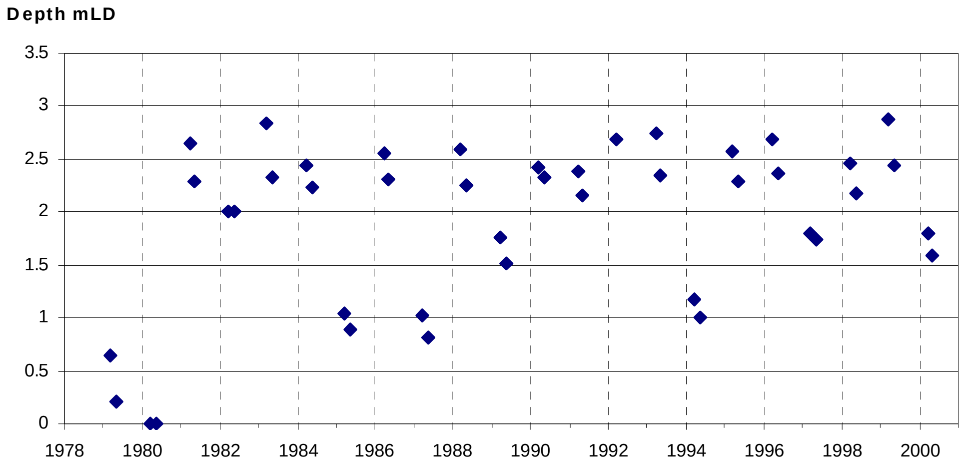
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

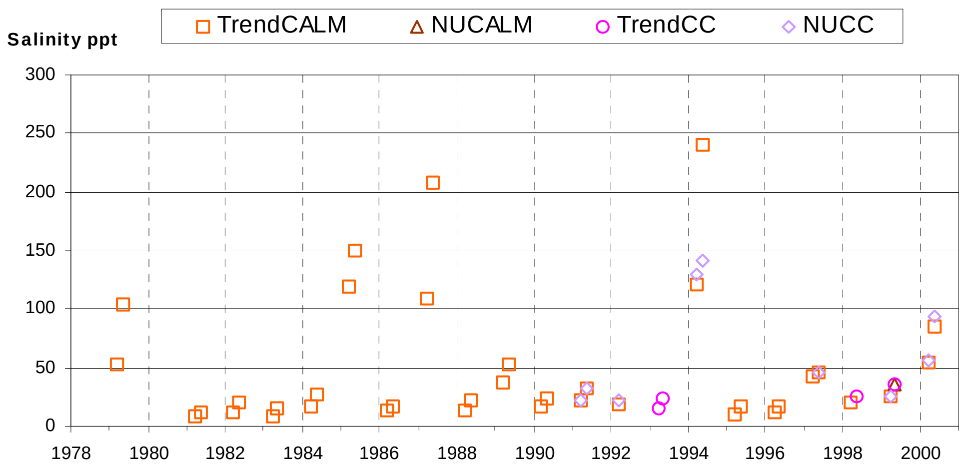
Figure 20: EGANU



Rainfall Trend
Not signif. p = 0.24



Depth Trends
SEP ONLY Not signif. p = 0.054
NOV ONLY **Increasing** p = 0.046
SEP & NOV **Increasing** p = 0.005

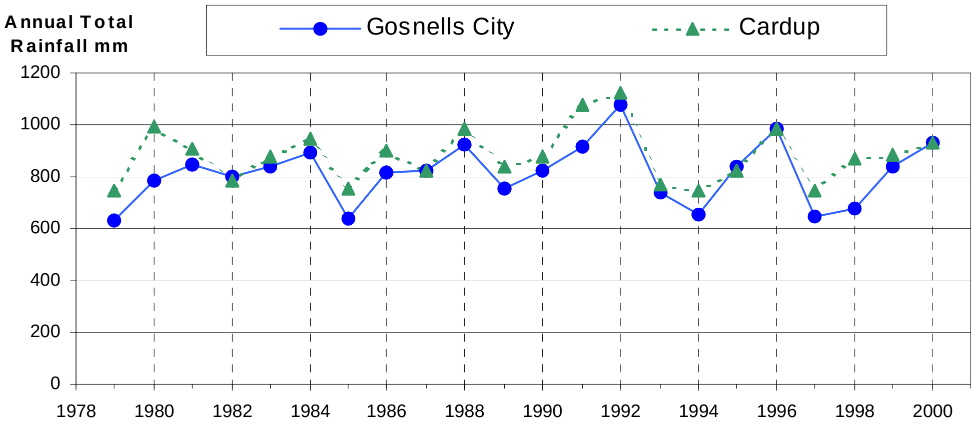


Salinity Trends
SEP ONLY Not signif. p = 0.6225
NOV ONLY Not signif. p = 0.7822
SEP & NOV Not signif. p = 0.5840

Notes:

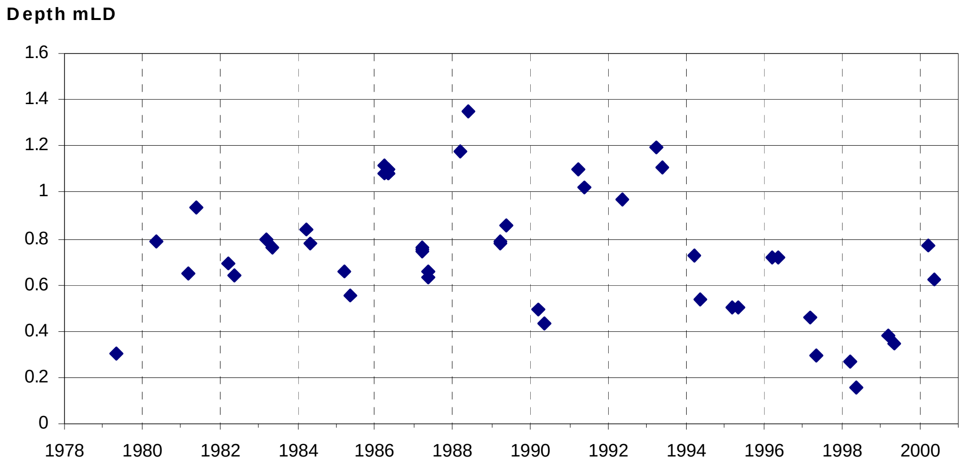
1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

Figure 21: FORRESTDALE



Rainfall Trend

Not signif.
p = 0.54

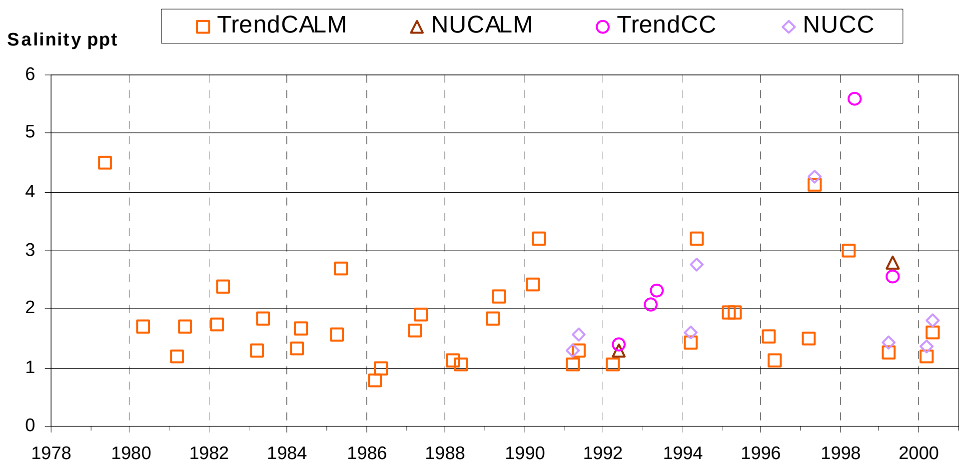


Depth Trends

SEP ONLY
Decreasing
p = 0.047

NOV ONLY
Not signif.
p = 0.098

SEP & NOV
Decreasing
p = 0.011



Salinity Trends

SEP ONLY
Not signif.
p = 0.3523

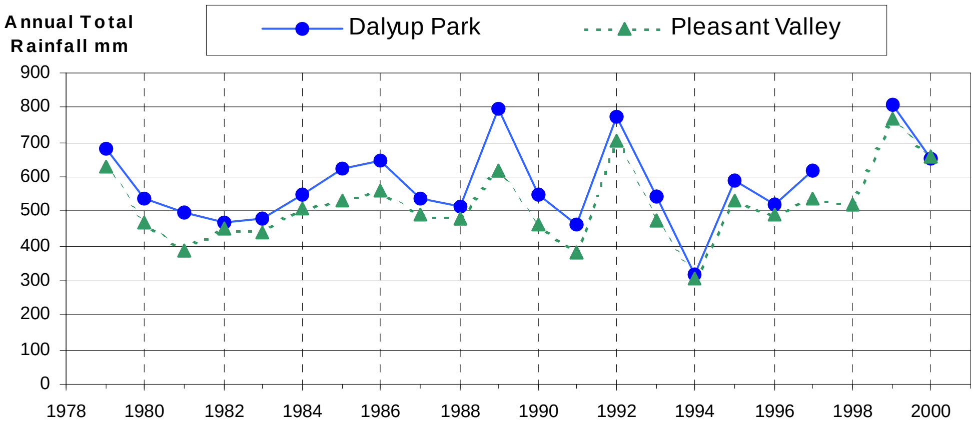
NOV ONLY
Not signif.
p = 0.5633

SEP & NOV
Not signif.
p = 0.4517

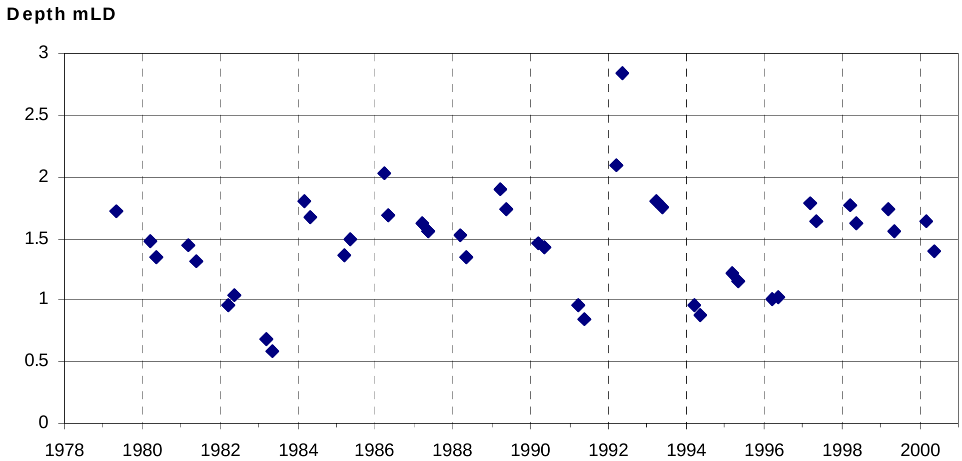
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

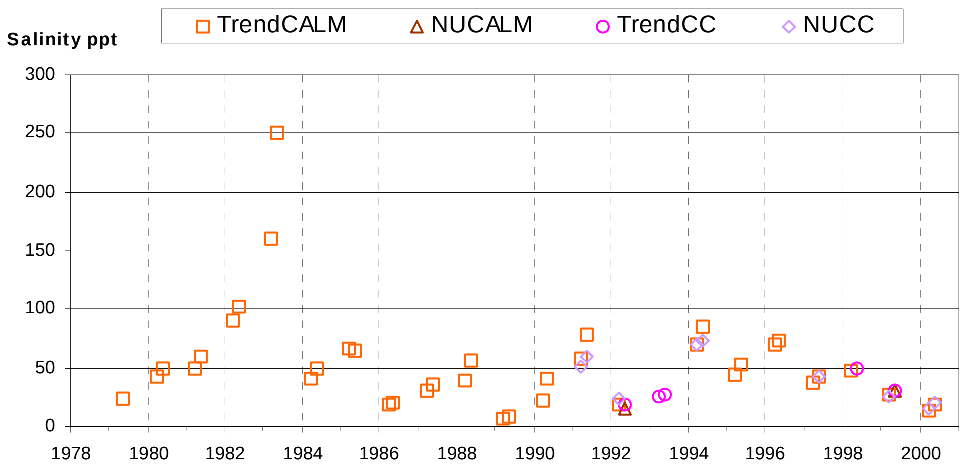
Figure 22: GORE



Rainfall Trend
Not signif. p = 0.36



Depth Trends
SEP ONLY Not signif. p = 0.39
NOV ONLY Not signif. p = 0.688
SEP & NOV Not signif. p = 0.368

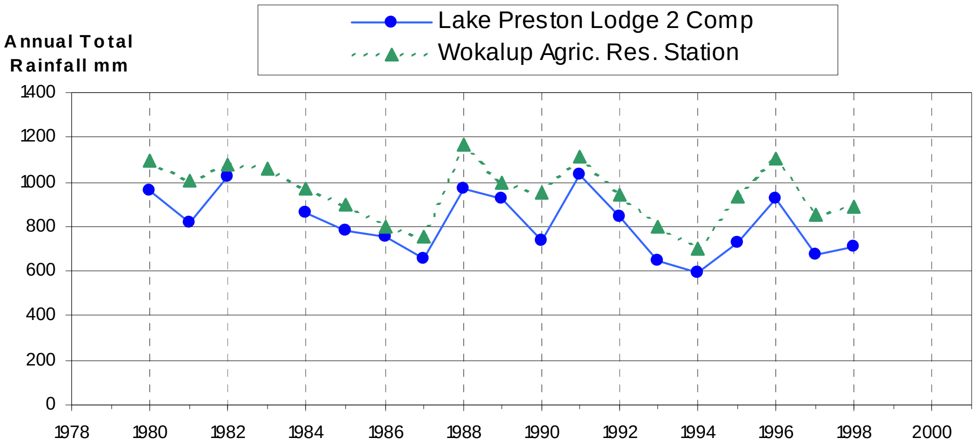


Salinity Trends
SEP ONLY Not signif. p = 0.2105
NOV ONLY Not signif. p = 0.3218
SEP & NOV Not signif. p = 0.1019

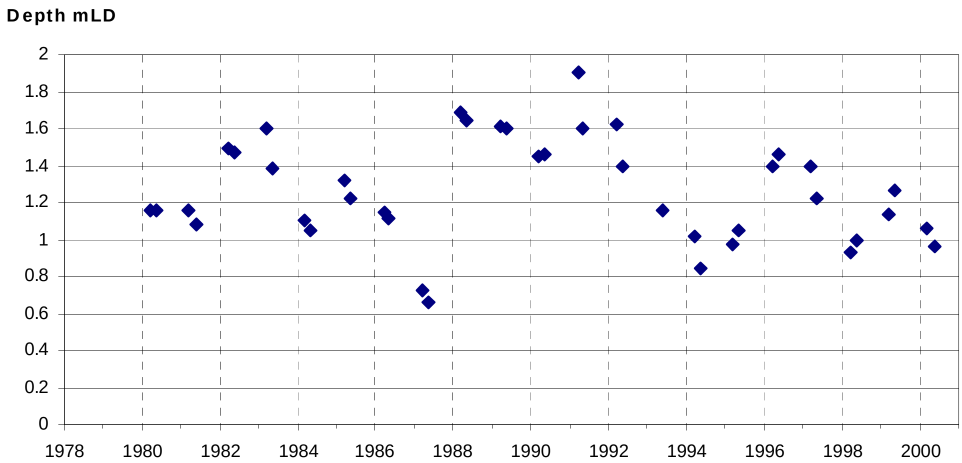
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
4. Year labels are positioned mid-year (1st July).

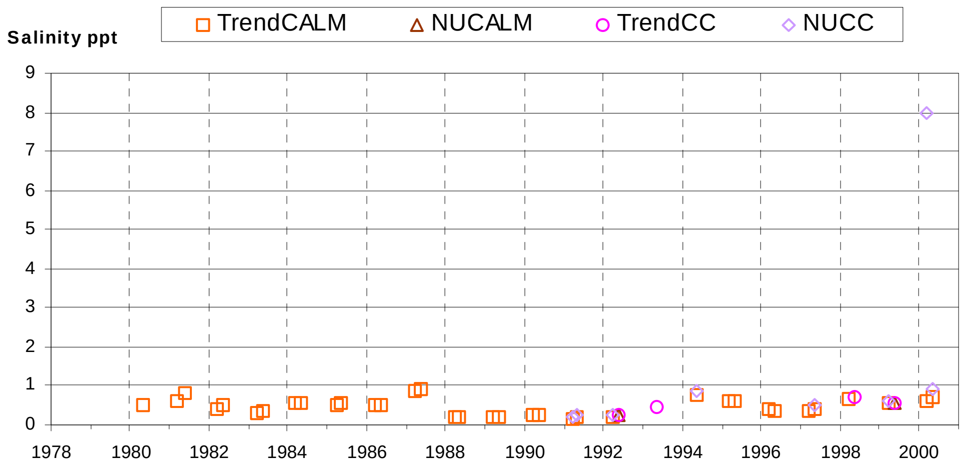
Figure 23: HARVEY 12632



Rainfall Trend
Not signif. p = 0.07



Depth Trends
SEP ONLY Not signif. p = 0.498
NOV ONLY Not signif. p = 0.627
SEP & NOV Not signif. p = 0.385

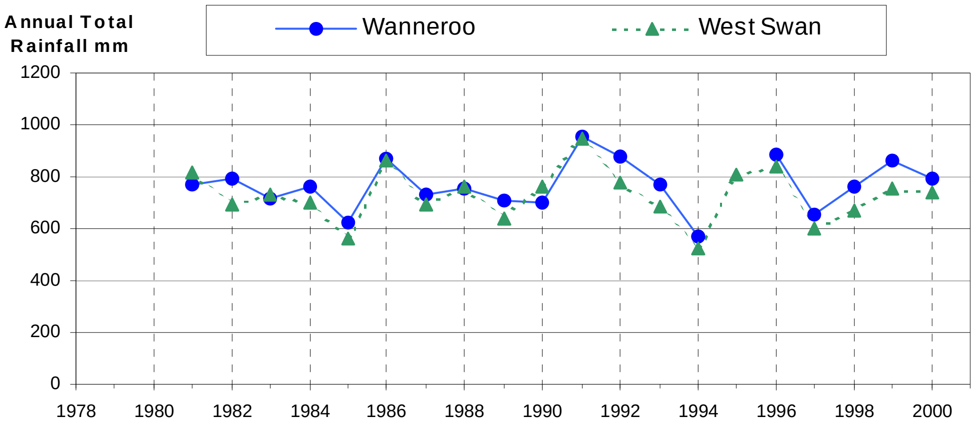


Salinity Trends
SEP ONLY Not signif. p = 0.7235
NOV ONLY Not signif. p = 0.8179
SEP & NOV Not signif. p = 0.6742

Notes:

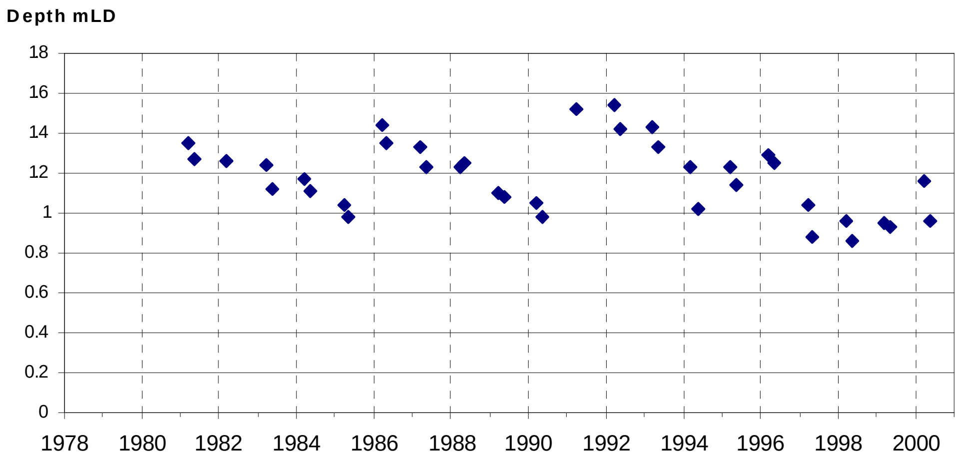
1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

Figure 24: JANDABUP



Rainfall Trend

Not signif.
p = 0.61

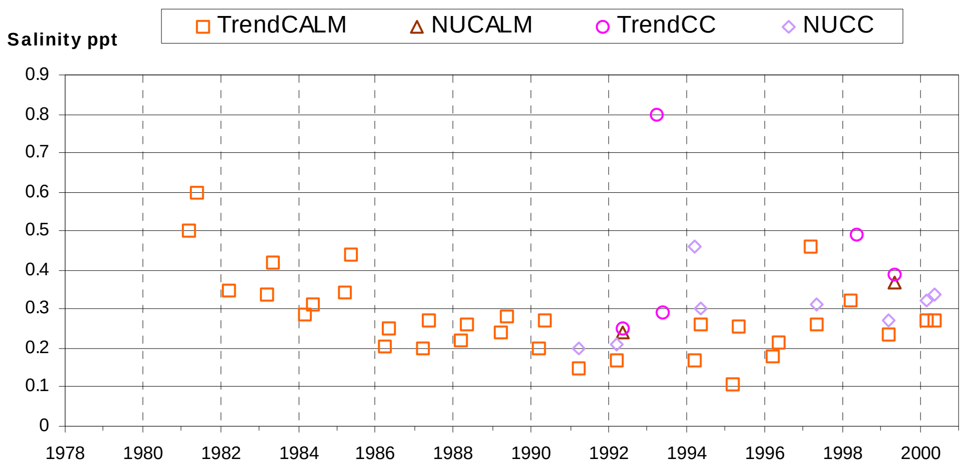


Depth Trends

SEP ONLY
Not signif.
p = 0.177

NOV ONLY
Insuff. data

SEP & NOV
Decreasing
p = 0.020



Salinity Trends

SEP ONLY
Not signif.
p = 0.3752

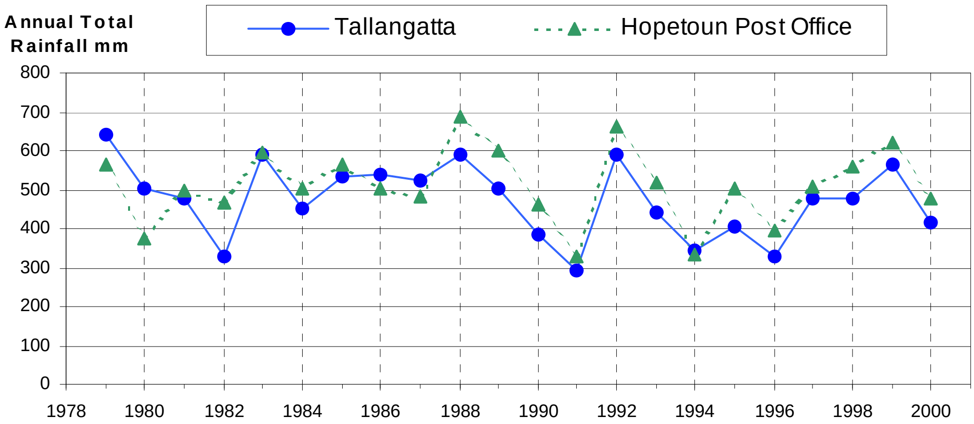
NOV ONLY
Insuff. data

SEP & NOV
Not signif.
p = 0.1688

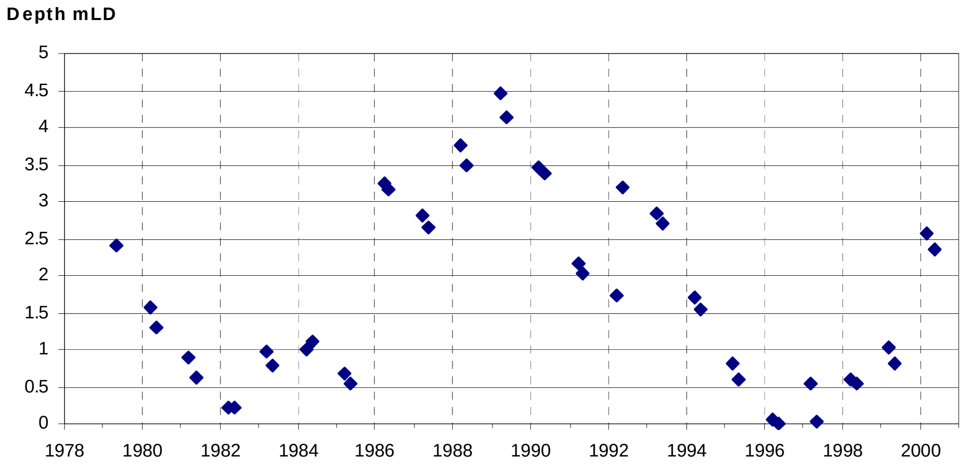
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1^{st} July).
6. For number of records considered sufficient for trend analysis refer to section 4.7.

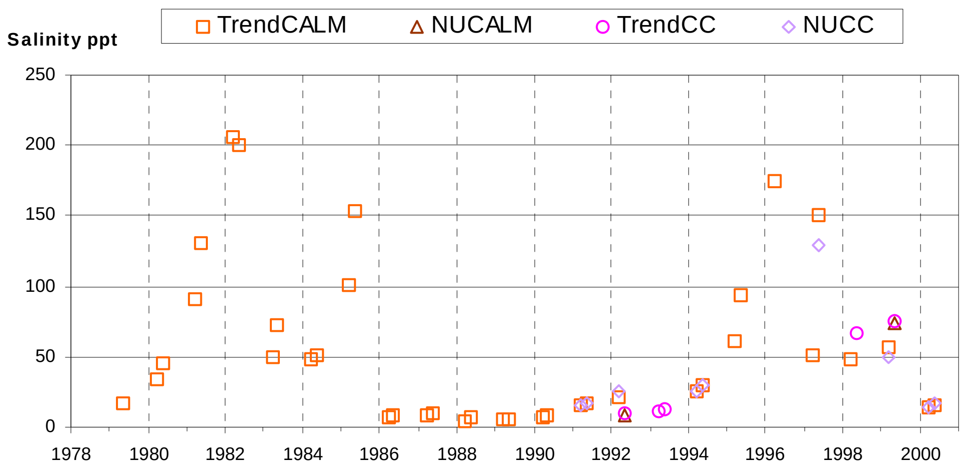
Figure 25: JERDACUTTUP



Rainfall Trend
Not signif. p = 0.15



Depth Trends
SEP ONLY Not signif. p = 0.814
NOV ONLY Not signif. p= 0.527
SEP & NOV Not signif. p = 0.516

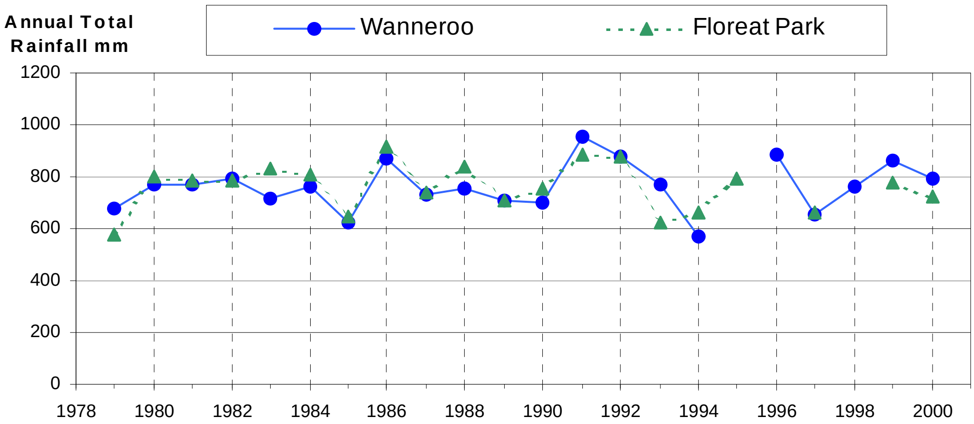


Salinity Trends
SEP ONLY Not signif. p = 0.7765
NOV ONLY Not signif. p= 0.7666
SEP & NOV Not signif. p = 0.6618

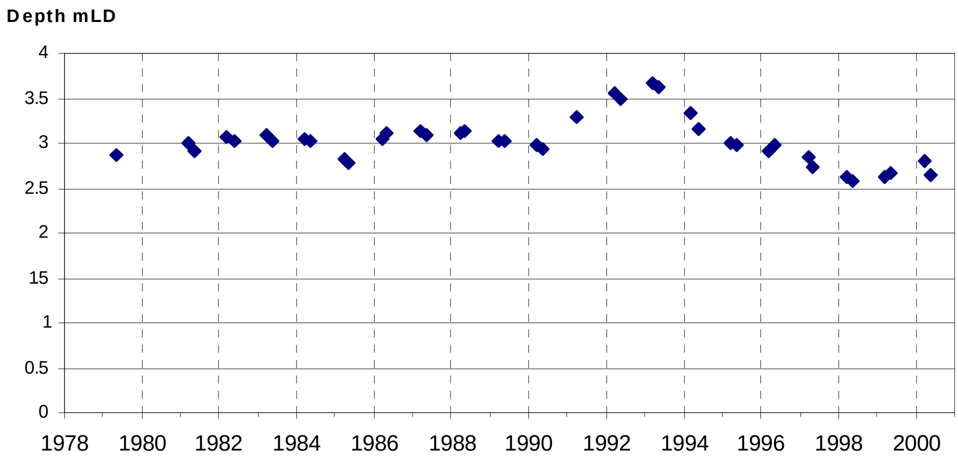
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

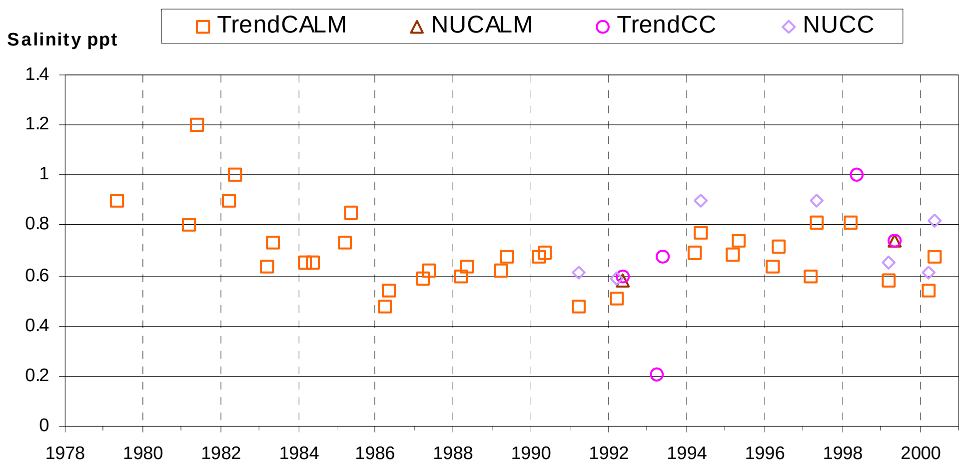
Figure 26: JOONDALUP



Rainfall Trend
Not signif. p = 0.44



Depth Trends
SEP ONLY Not signif. p = 0.276
NOV ONLY Not signif. p= 0.308
SEP & NOV Not signif. p = 0.134

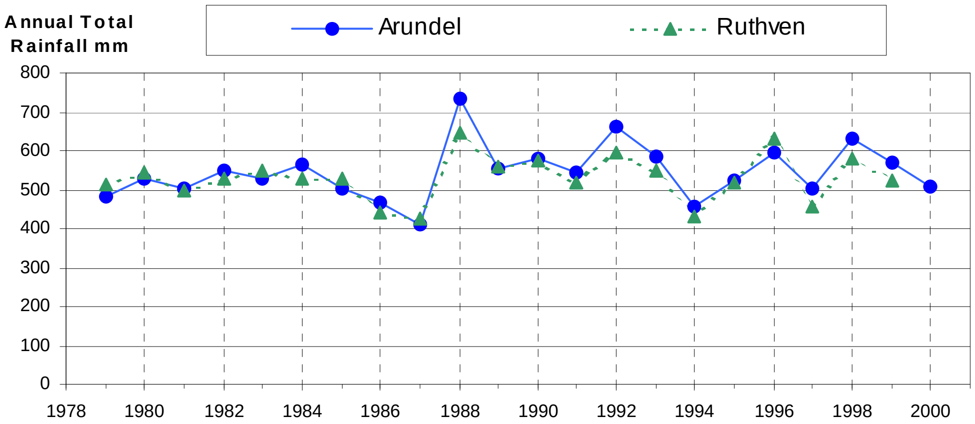


Salinity Trends
SEP ONLY Not signif. p = 0.3197
NOV ONLY Not signif. p= 0.3637
SEP & NOV Not signif. p = 0.1836

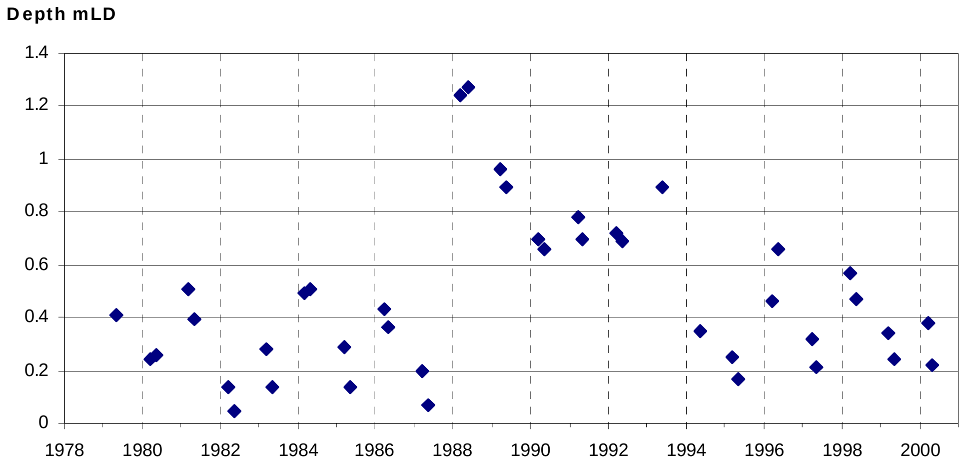
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

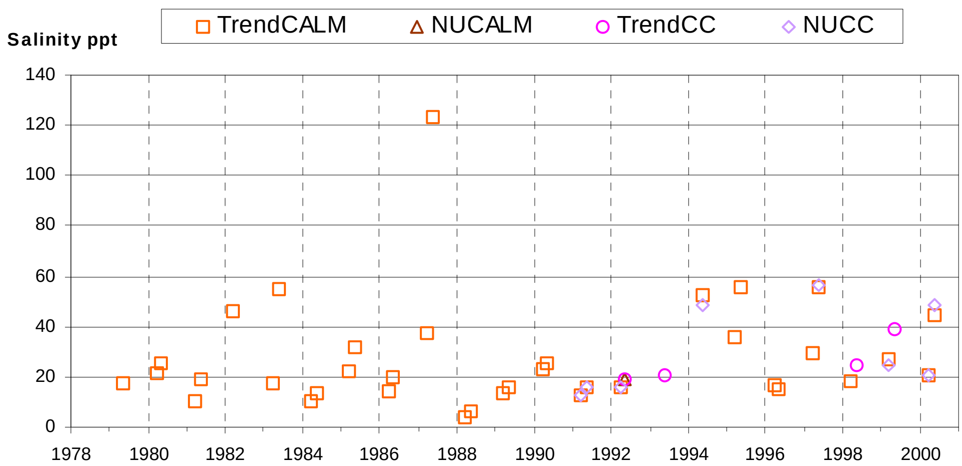
Figure 27: KWORNICUP



Rainfall Trend
Not signif. p = 0.32



Depth Trends
SEP ONLY Insuff. data
NOV ONLY Not signif. p= 0.522
SEP & NOV Not signif. p = 0.376

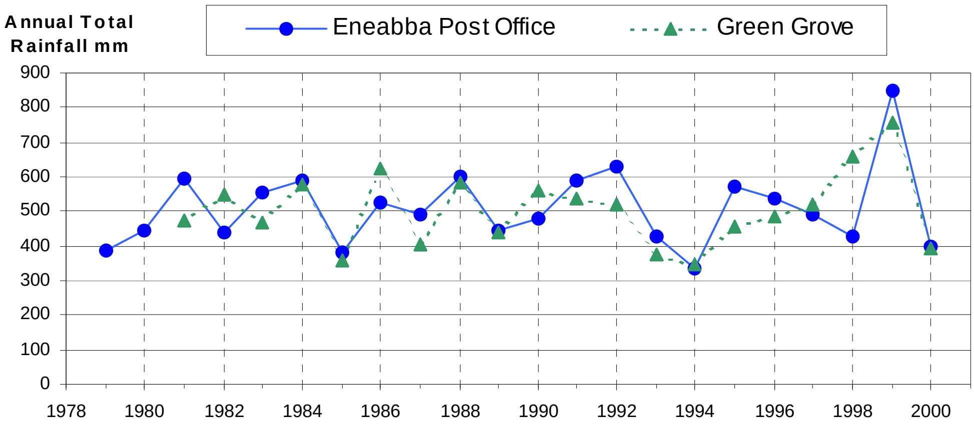


Salinity Trends
SEP ONLY Insuff. data
NOV ONLY Not signif. p= 0.3035
SEP & NOV Not signif. p = 0.1993

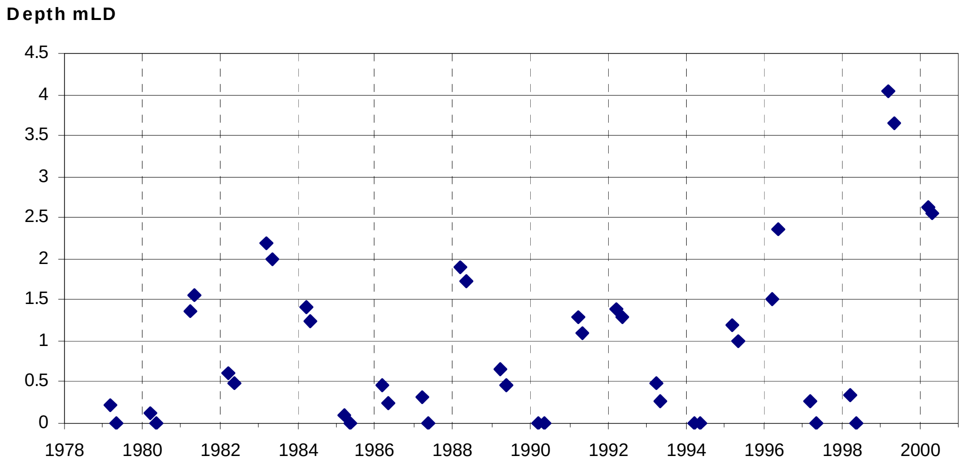
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).
6. For number of records considered sufficient for trend analysis refer to section 4.7.

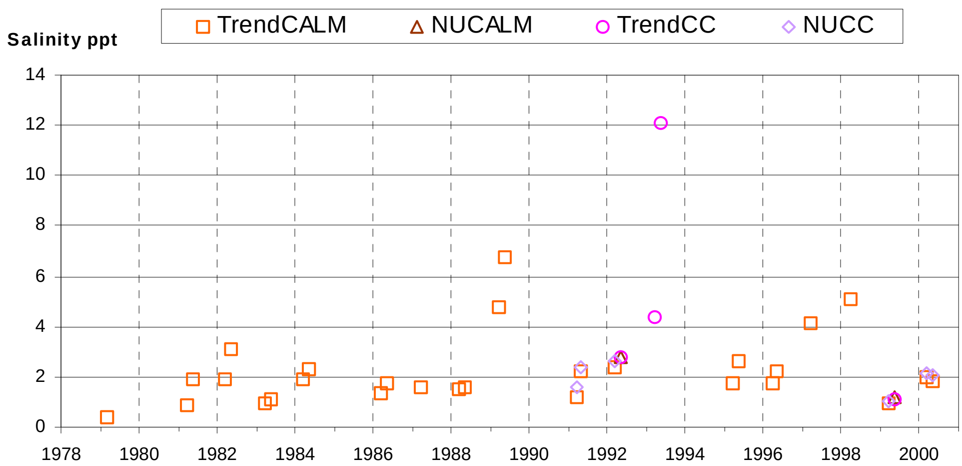
Figure 28: LOGUE



Rainfall Trend
Not signif. p = 0.47



Depth Trends
SEP ONLY Not signif. p = 0.252
NOV ONLY Not signif. p= 0.27
SEP & NOV Not signif. p = 0.111

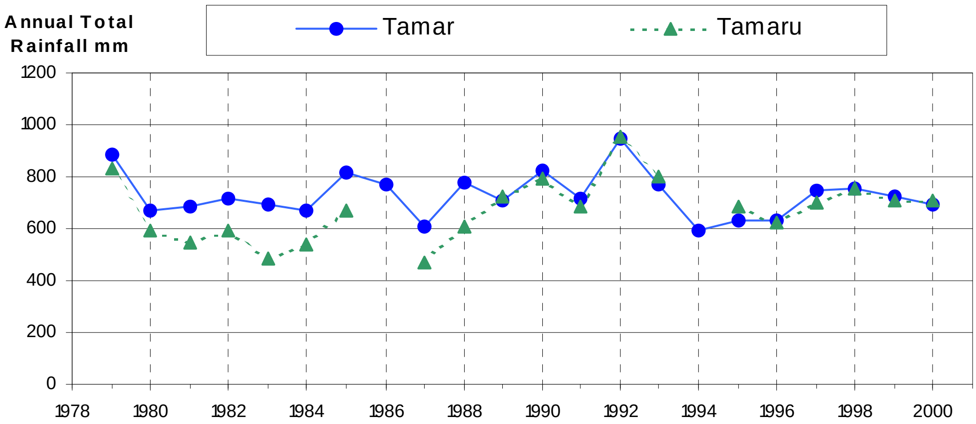


Salinity Trends
SEP ONLY **Increasing** p = 0.0242
NOV ONLY Not signif. p= 0.8889
SEP & NOV Not signif. p = 0.0738

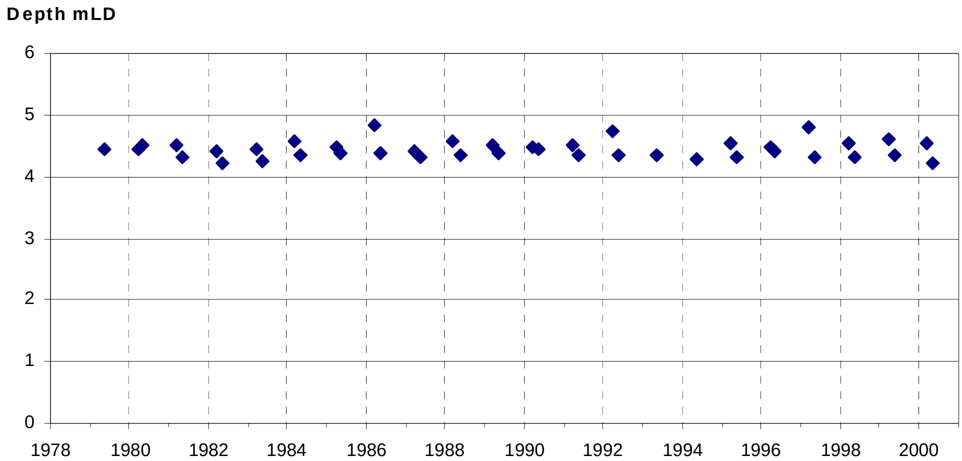
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1^{st} July).

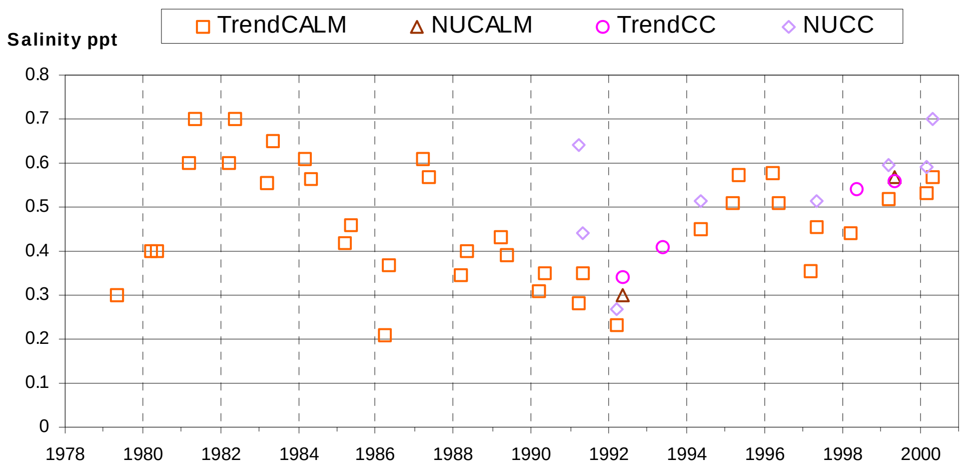
Figure 29: MOATES



Rainfall Trend
Not signif. p = 0.59



Depth Trends
SEP ONLY Insuff. data
NOV ONLY Not signif. p= 0.134
SEP & NOV Not signif. p = 0.812

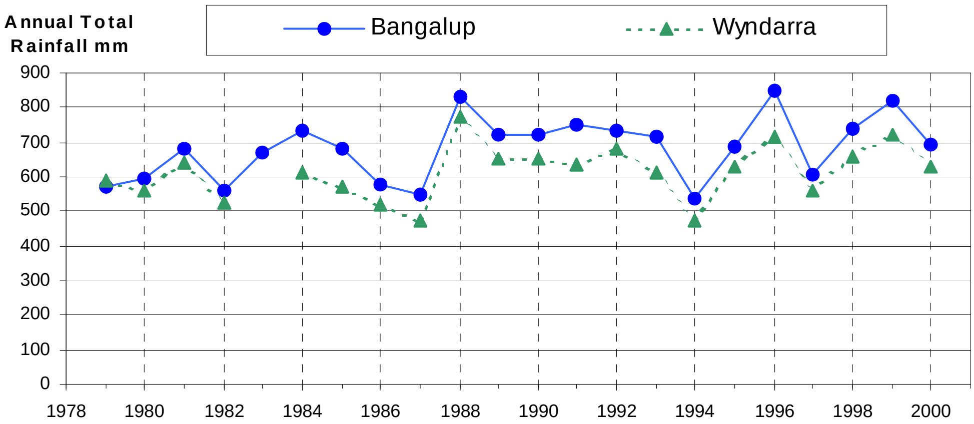


Salinity Trends
SEP ONLY Insuff. data
NOV ONLY Not signif. p= 0.8254
SEP & NOV Not signif. p = 0.9232

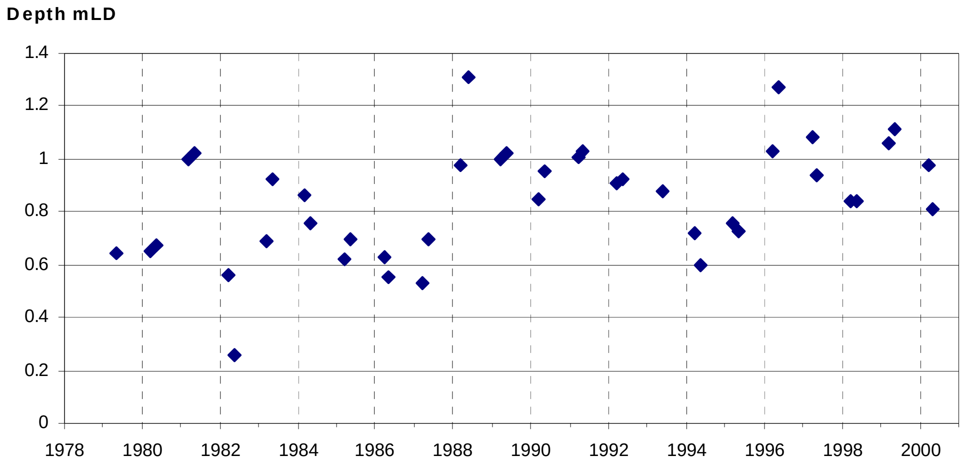
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).
6. For number of records considered sufficient for trend analysis refer to section 4.7.

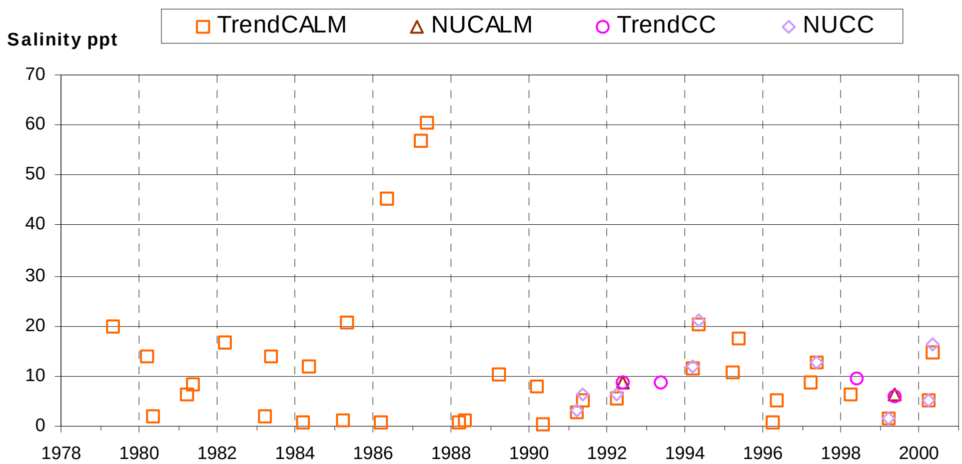
Figure 30: MUIR



Rainfall Trend
Increasing p = 0.047



Depth Trends
SEP ONLY **Increasing** p = 0.014
NOV ONLY Not signif. p= 0.073
SEP & NOV **Increasing** p = 0.003

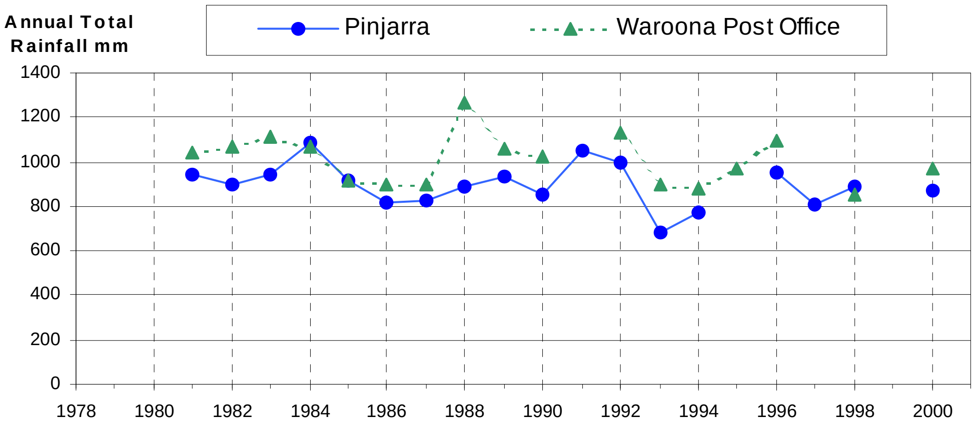


Salinity Trends
SEP ONLY Not signif. p = 0.9576
NOV ONLY Not signif. p= 0.9136
SEP & NOV Not signif. p = 0.9371

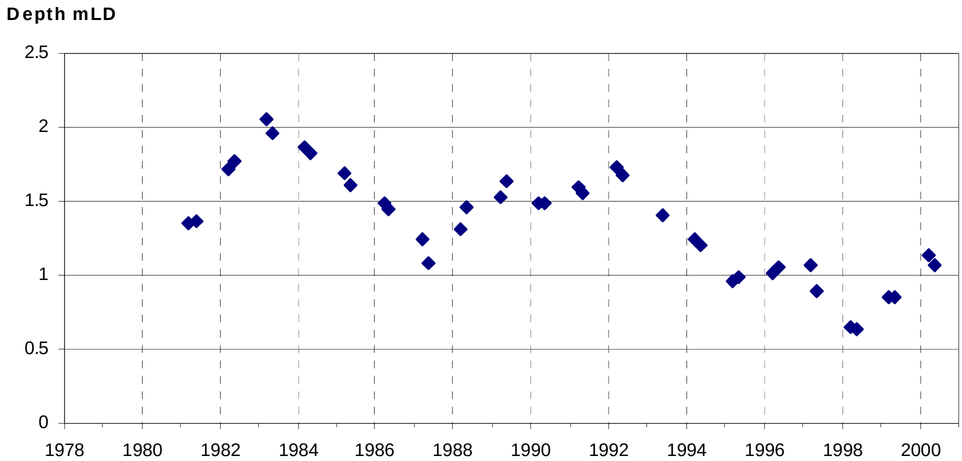
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

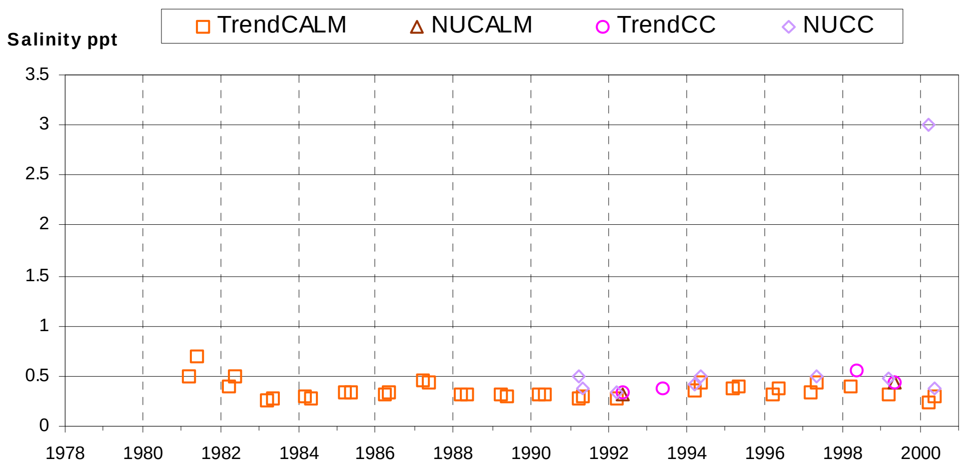
Figure 31: NINE MILE



Rainfall Trend
Not signif. p = 0.25



Depth Trends
SEP ONLY Insuff. data
NOV ONLY **Decreasing** p= 0.0001
SEP & NOV **Decreasing** p = 0.0001

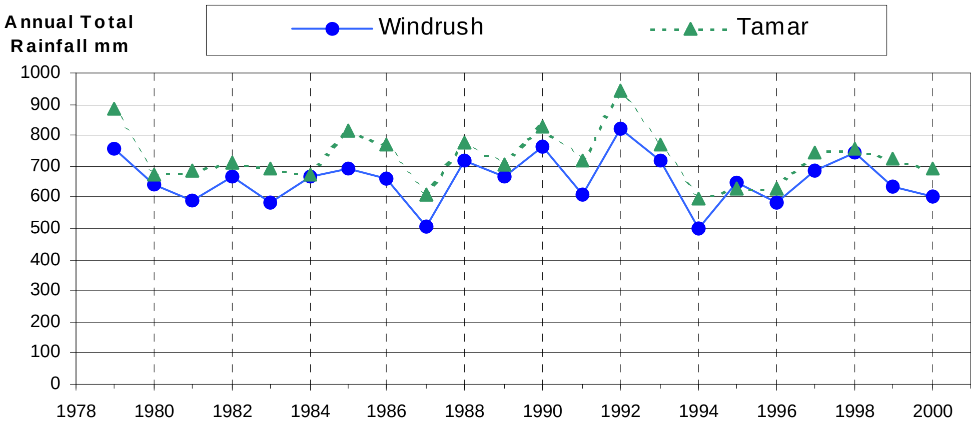


Salinity Trends
SEP ONLY Insuff. data
NOV ONLY Not signif. p= 0.9749
SEP & NOV Not signif. p = 0.6068

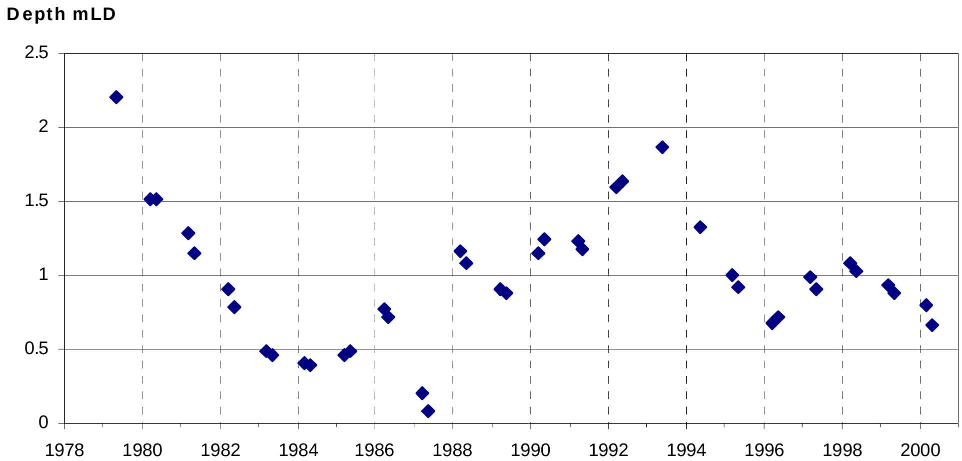
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).
6. For number of records considered sufficient for trend analysis refer to section 4.7.

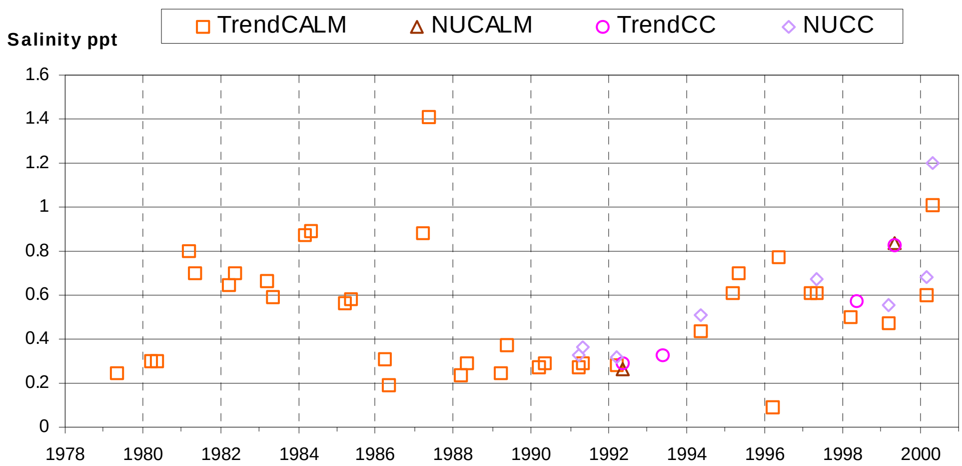
Figure 32: PLEASANT VIEW



Rainfall Trend
Not signif. p = 0.91



Depth Trends
SEP ONLY Insuff. data
NOV ONLY Not signif. p= 0.961
SEP & NOV Not signif. p = 0.806

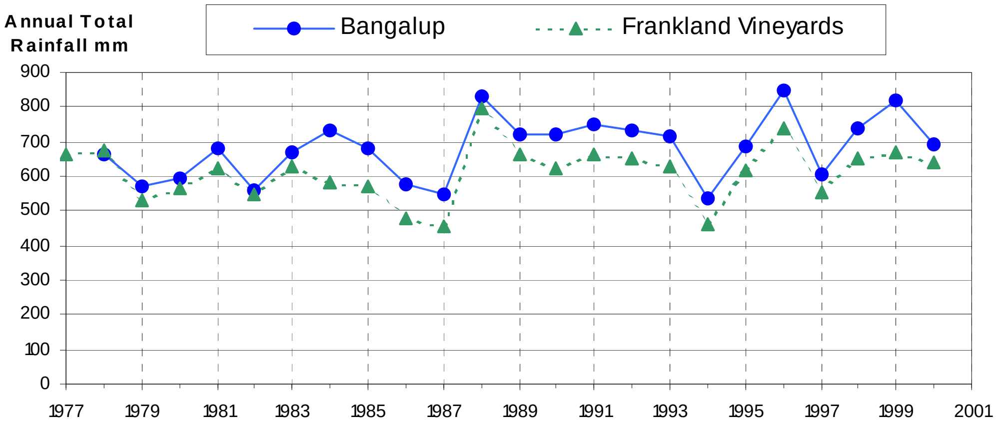


Salinity Trends
SEP ONLY Insuff. data
NOV ONLY Not signif. p= 0.2491
SEP & NOV Not signif. p = 0.8437

Notes:

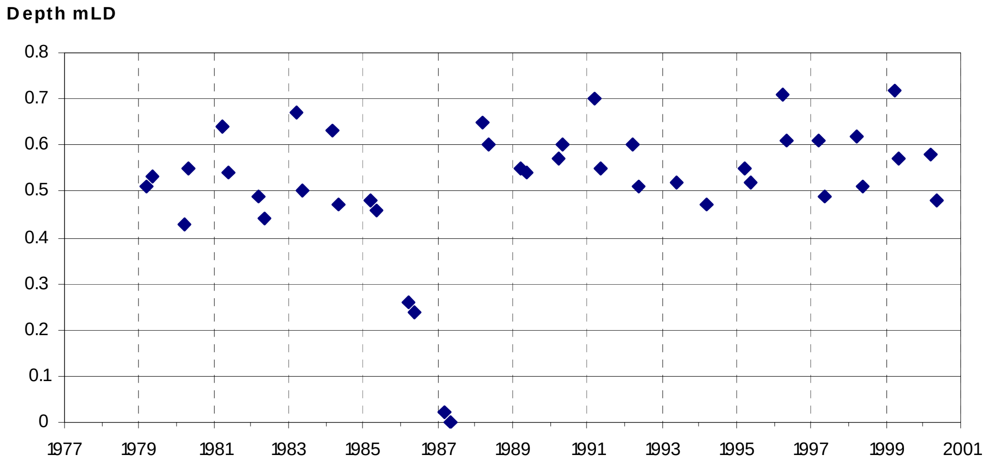
1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).
6. For number of records considered sufficient for trend analysis refer to section 4.7.

Figure 33: POORGINUP



Rainfall Trend

Increasing
p = 0.048

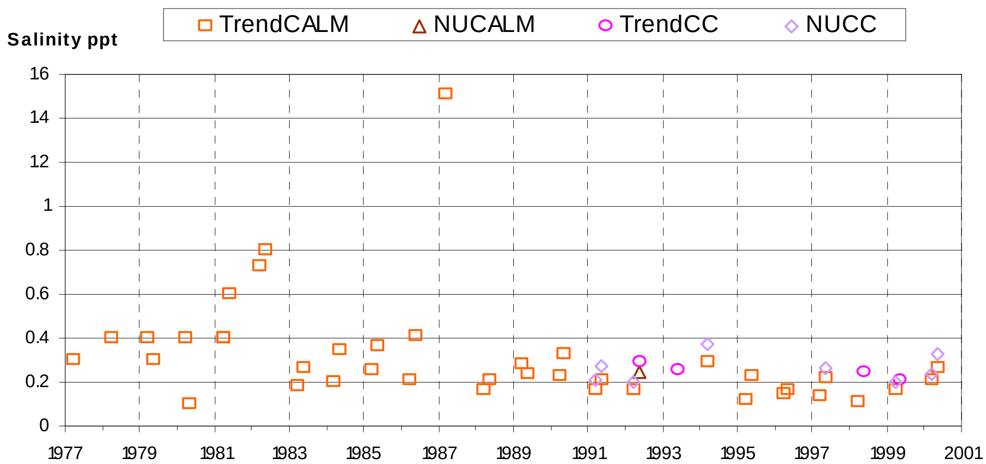


Depth Trends

SEP ONLY
Not signif.
p = 0.350

NOV ONLY
Not signif.
p= 0.54

SEP & NOV
Not signif.
p = 0.286



Salinity Trends

SEP ONLY
Decreasing
p = 0.0023

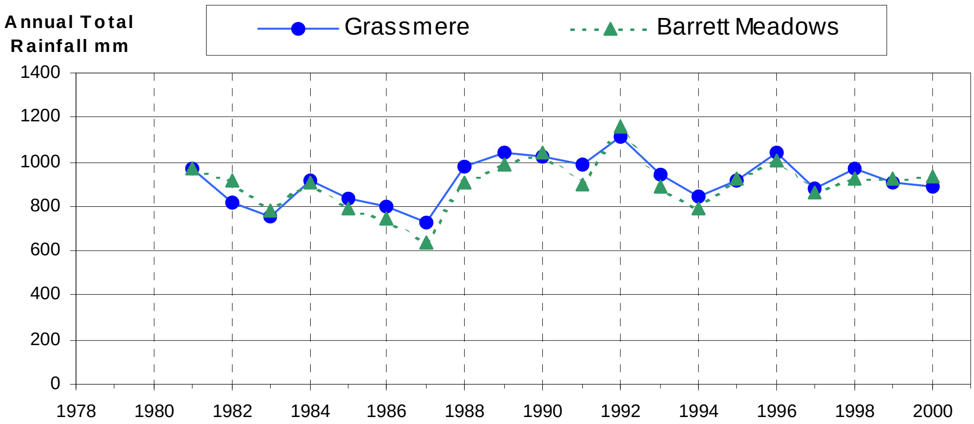
NOV ONLY
Not signif.
p= 0.1359

SEP & NOV
Decreasing
p = 0.0008

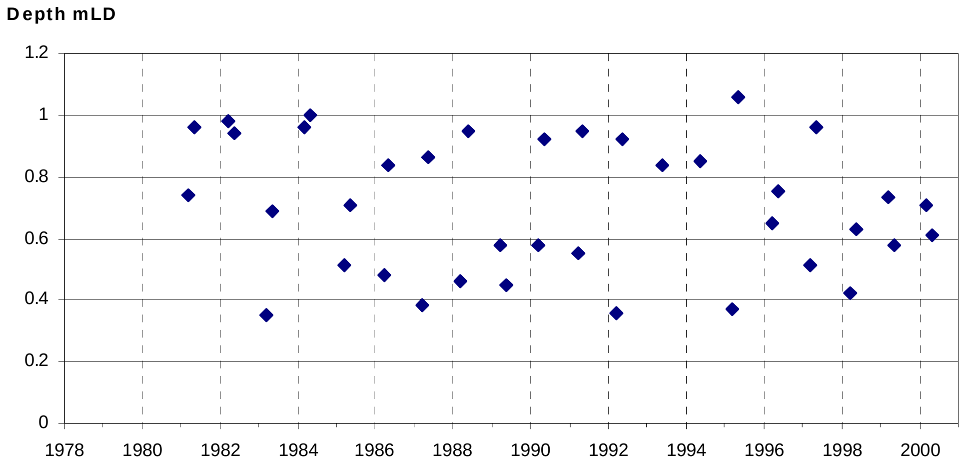
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

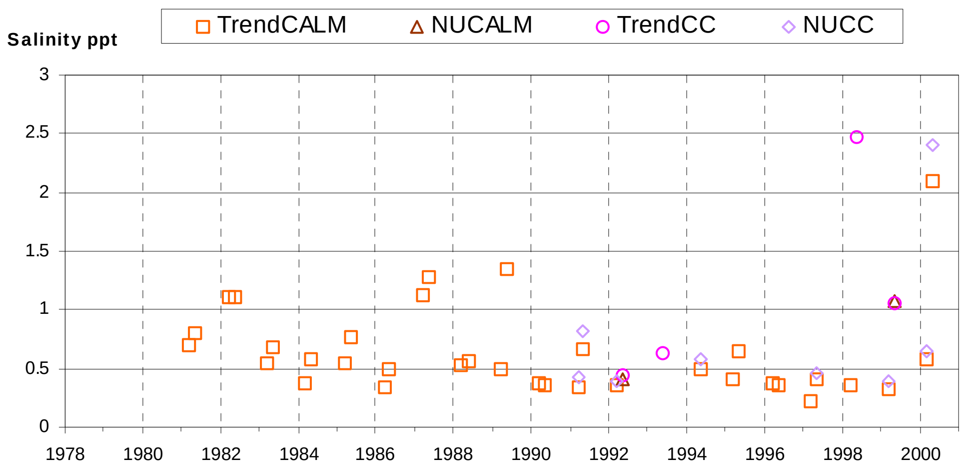
Figure 34: POWELL



Rainfall Trend
Not signif. p = 0.19



Depth Trends
SEP ONLY Insuff. data
NOV ONLY Not signif. p= 0.205
SEP & NOV Not signif. p = 0.352

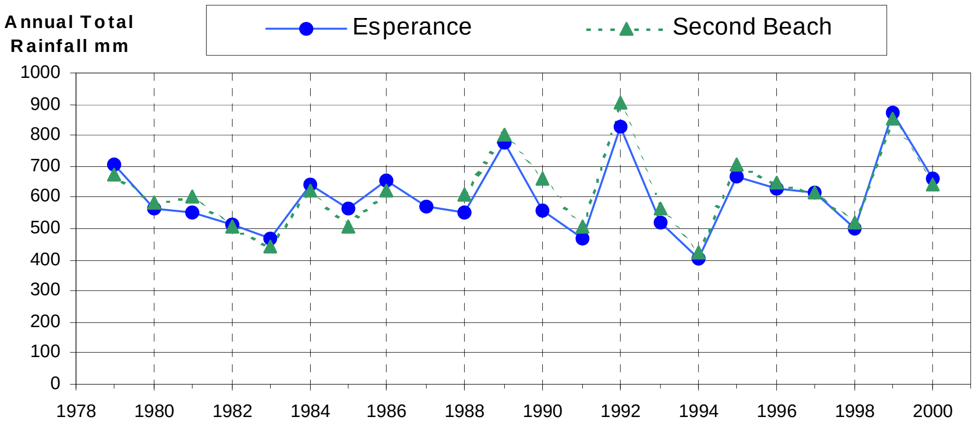


Salinity Trends
SEP ONLY Insuff. data
NOV ONLY Not signif. p= 0.5462
SEP & NOV Not signif. p = 0.5256

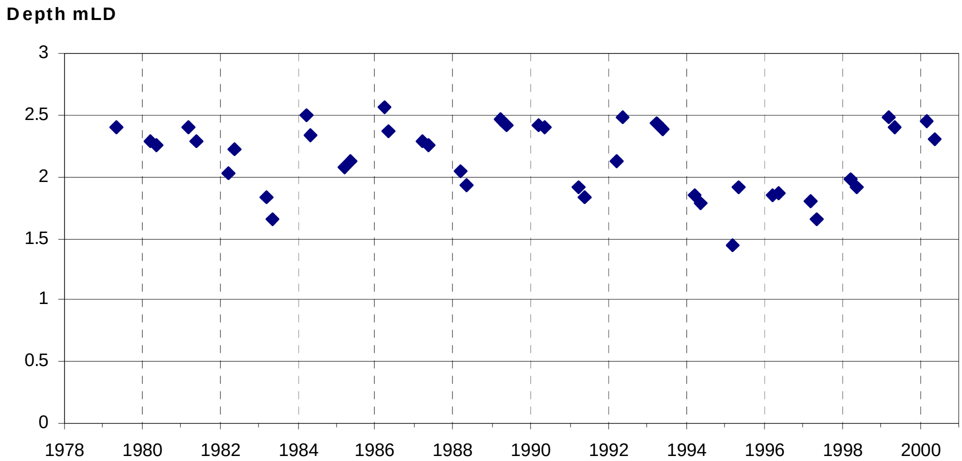
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).
6. For number of records considered sufficient for trend analysis refer to section 4.7.

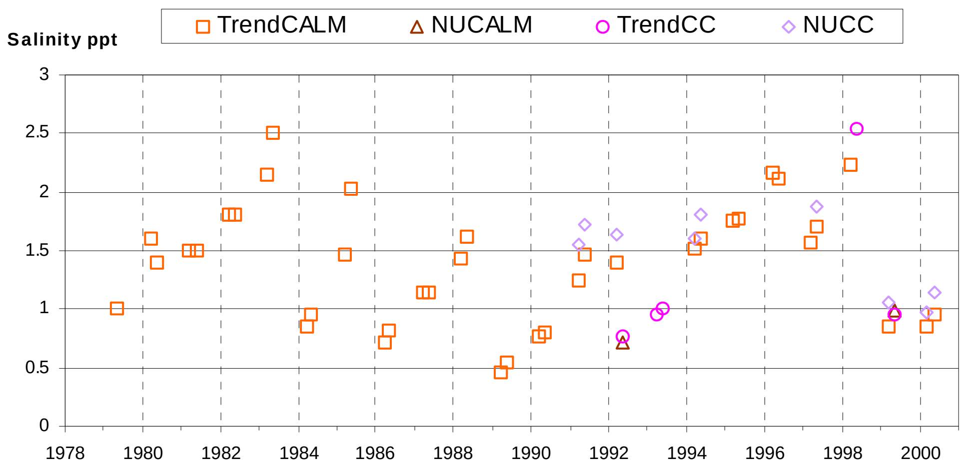
Figure 35: SHARK



Rainfall Trend
Not signif. p = 0.37



Depth Trends
SEP ONLY Not signif. p = 0.340
NOV ONLY Not signif. p= 0.274
SEP & NOV Not signif. p = 0.139

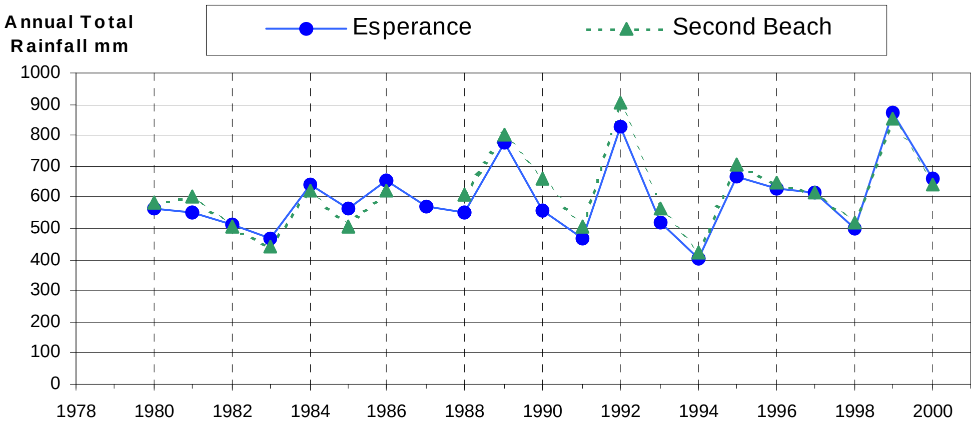


Salinity Trends
SEP ONLY Not signif. p = 0.8595
NOV ONLY Not signif. p= 0.9322
SEP & NOV Not signif. p = 0.9450

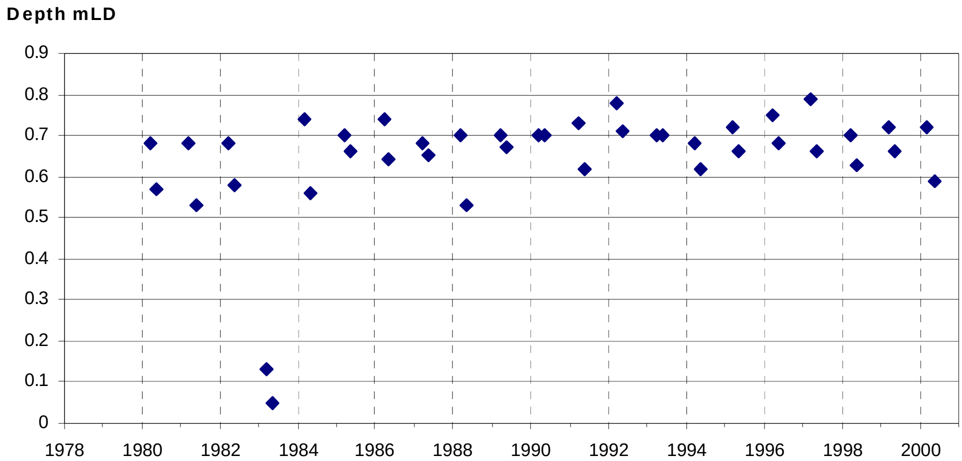
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

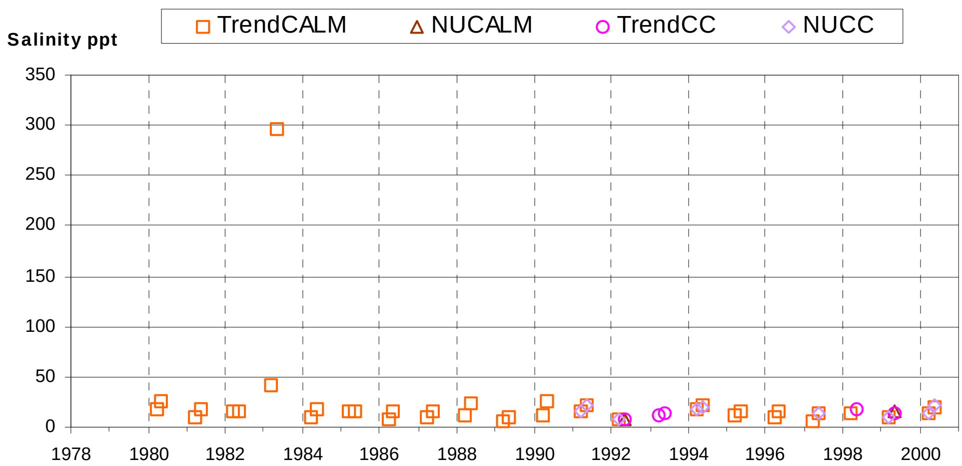
Figure 36: STATION



Rainfall Trend
Not signif. p = 0.19



Depth Trends
SEP ONLY Not signif. p = 0.149
NOV ONLY Not signif. p= 0.096
SEP & NOV **Increasing** p = 0.029

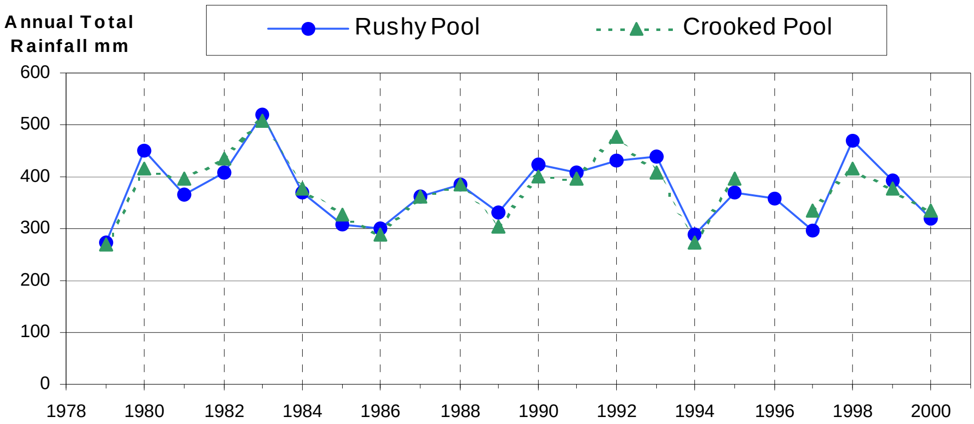


Salinity Trends
SEP ONLY Not signif. p = 0.2180
NOV ONLY Not signif. p= 0.1759
SEP & NOV Not signif. p = 0.0927

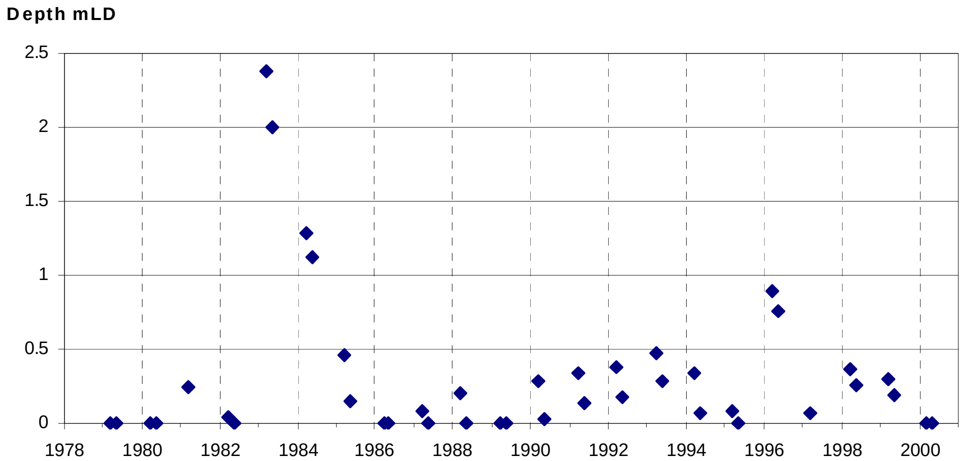
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

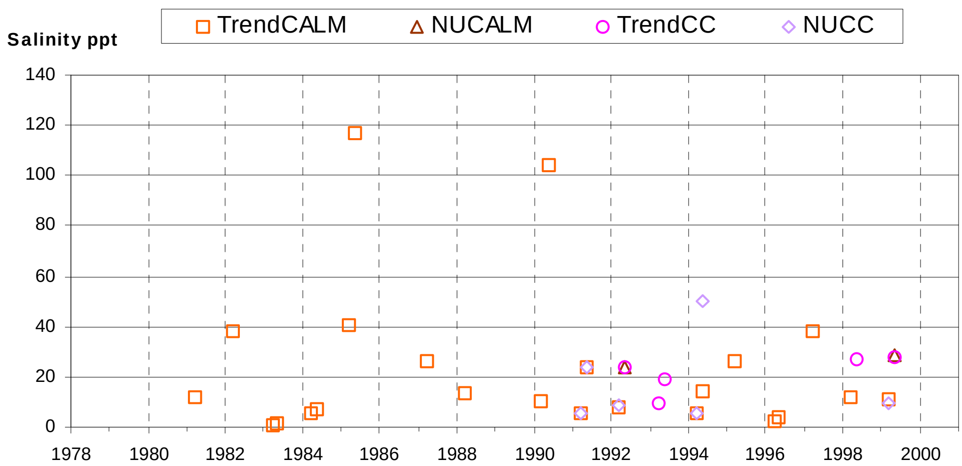
Figure 37: TAARBLIN



Rainfall Trend
Not signif. p = 0.81



Depth Trends
SEP ONLY Not signif. p = 0.920
NOV ONLY Not signif. p= 0.87
SEP & NOV Not signif. p = 0.869

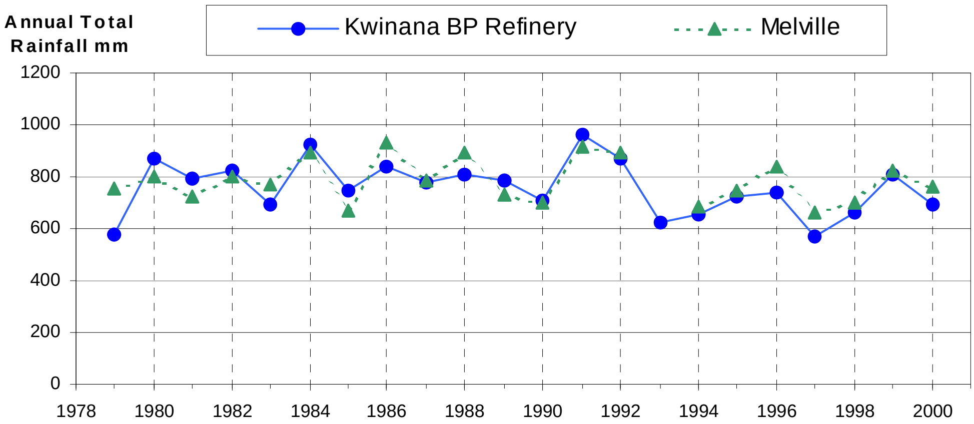


Salinity Trends
SEP ONLY Not signif. p = 0.9551
NOV ONLY Not signif. p= 0.6194
SEP & NOV Not signif. p = 0.6045

Notes:

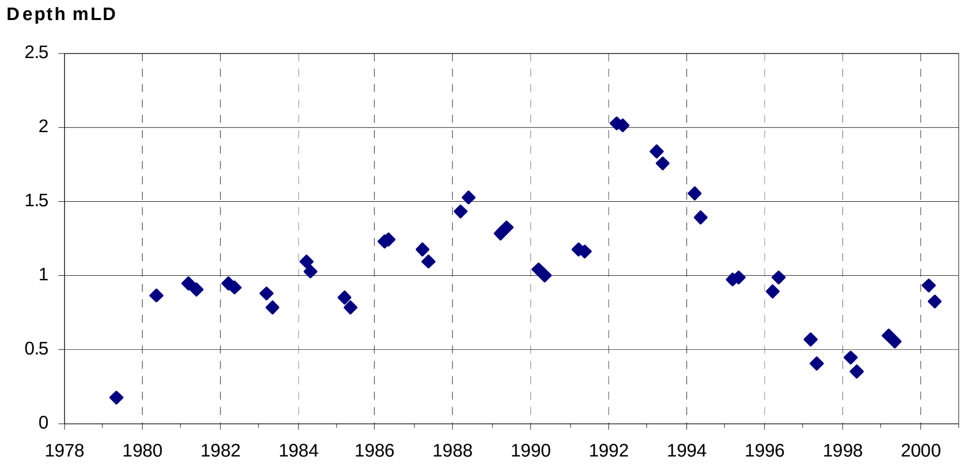
1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

Figure 38: THOMSONS



Rainfall Trend

Not signif.
p = 0.21

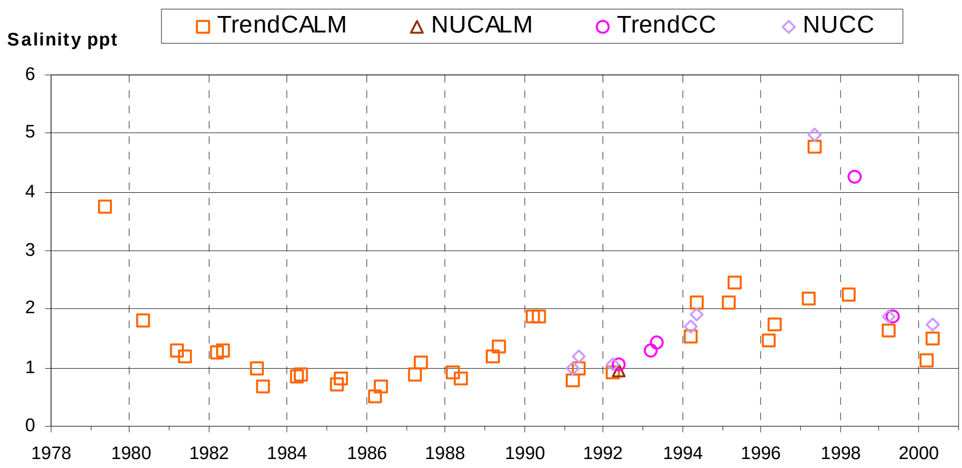


Depth Trends

SEP ONLY
Not signif.
p = 0.350

NOV ONLY
Not signif.
p= 0.864

SEP & NOV
Not signif.
p = 0.732



Salinity Trends

SEP ONLY
Increasing
p = 0.0092

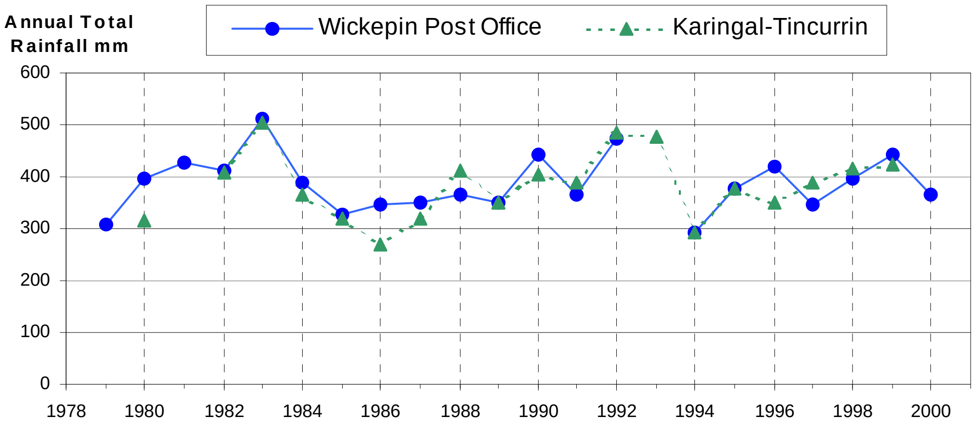
NOV ONLY
Not signif.
p= 0.0670

SEP & NOV
Increasing
p = 0.0045

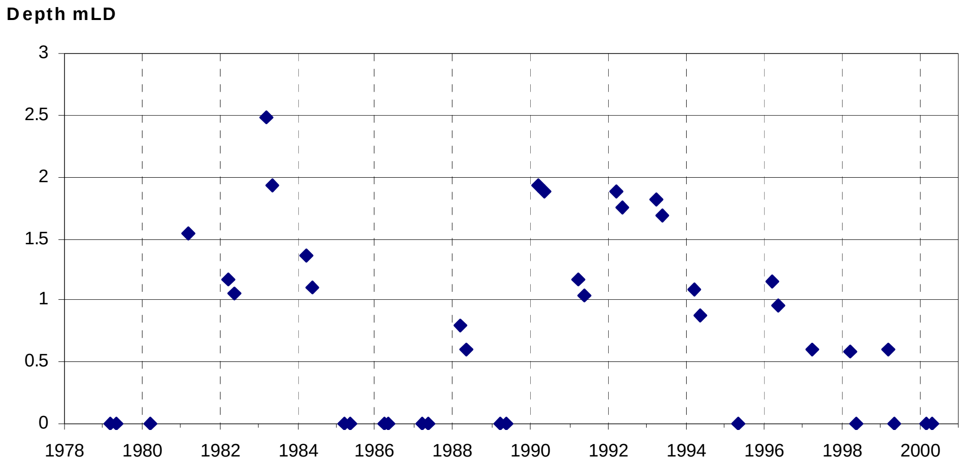
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

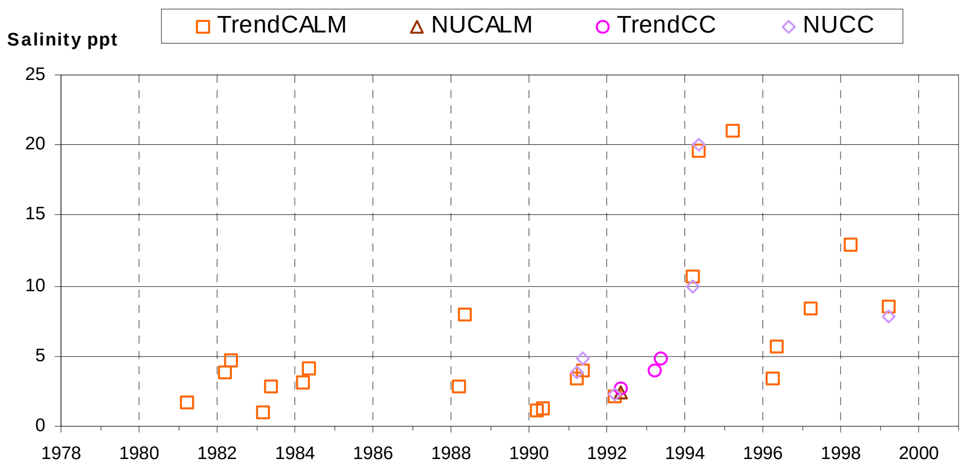
Figure 39: TOOLIBIN



Rainfall Trend
Not signif. p = 0.99



Depth Trends
SEP ONLY Not signif. p = 0.596
NOV ONLY Insuff. data
SEP & NOV Not signif. p = 0.949

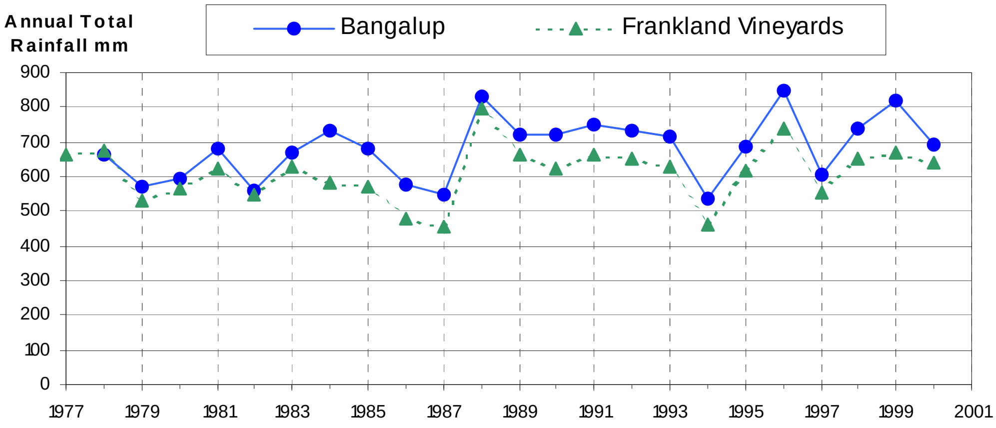


Salinity Trends
SEP ONLY **Increasing** p = 0.0055
NOV ONLY Insuff. data
SEP & NOV **Increasing** p = 0.0046

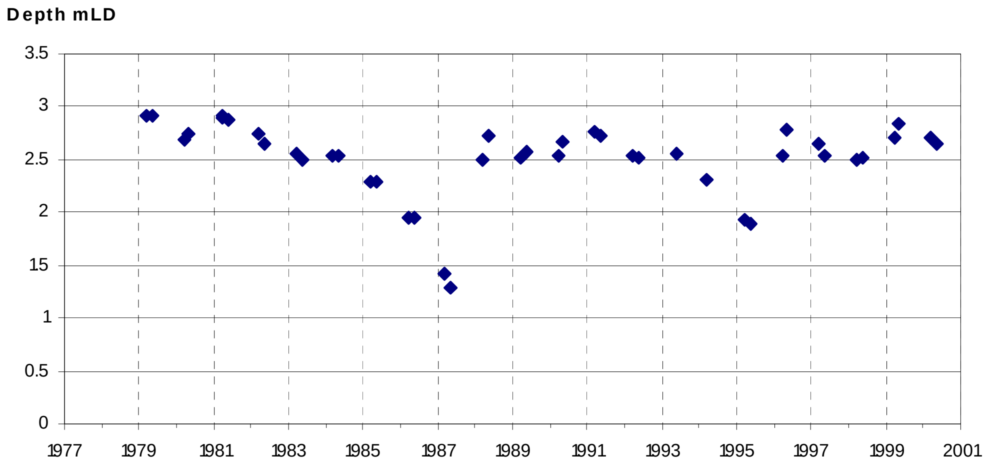
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).
6. For number of records considered sufficient for trend analysis refer to section 4.7.

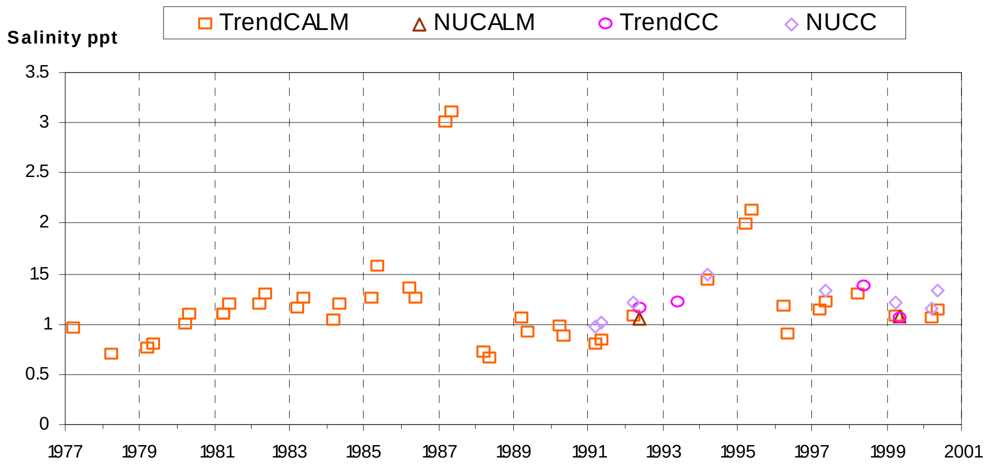
Figure 40: TORDIT-GURRUP



Rainfall Trend
Increasing p = 0.048



Depth Trends
SEP ONLY Not signif. p = 0.527
NOV ONLY Not signif. p= 0.95
SEP & NOV Not signif. p = 0.623

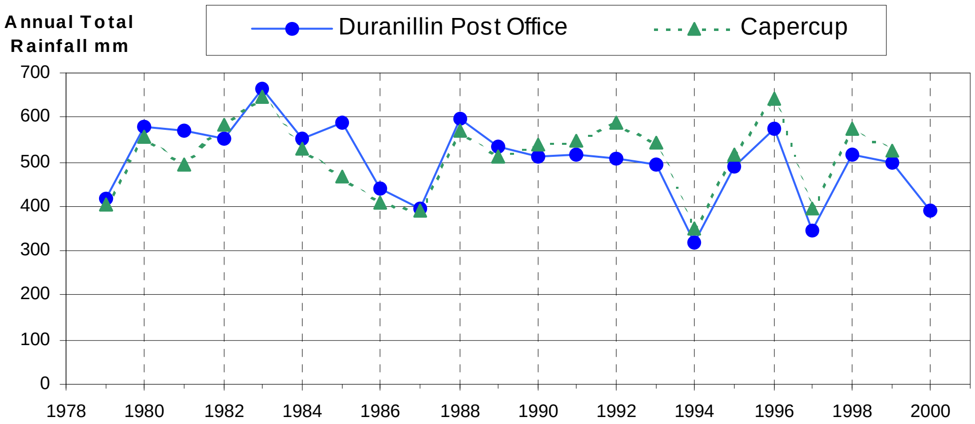


Salinity Trends
SEP ONLY Not signif. p = 0.1955
NOV ONLY Not signif. p = 0.9024
SEP & NOV Not signif. p = 0.2762

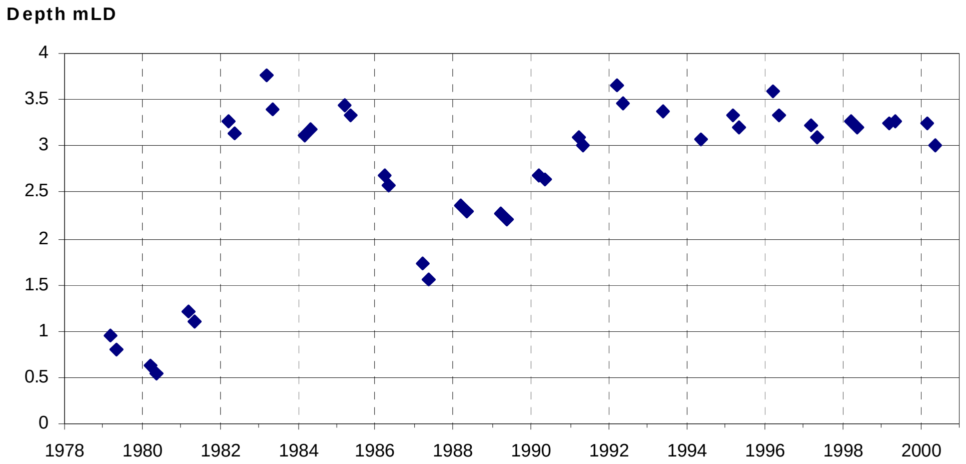
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

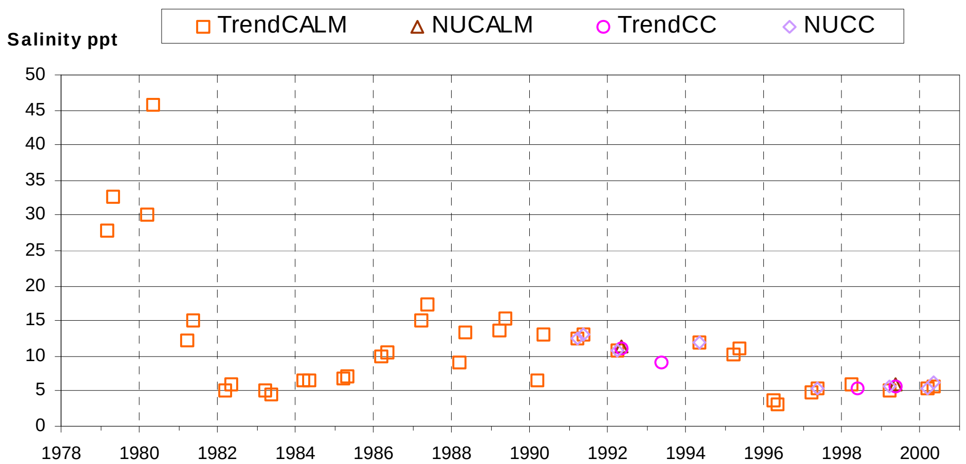
Figure 41: TOWERRINNING



Rainfall Trend
Not signif. p = 0.056



Depth Trends
SEP ONLY **Increasing** p = 0.005
NOV ONLY **Increasing** p= 0.002
SEP & NOV **Increasing** p = 0.0001

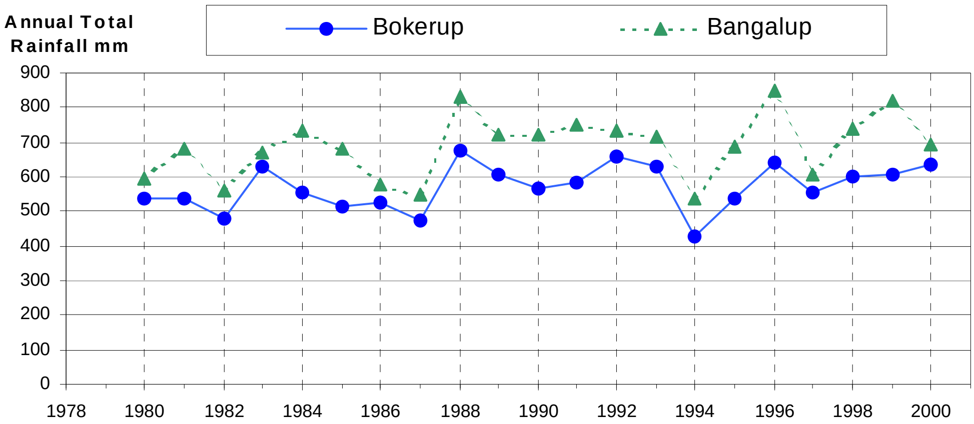


Salinity Trends
SEP ONLY **Decreasing** p = 0.0123
NOV ONLY **Decreasing** p = 0.0106
SEP & NOV **Decreasing** p = 0.0003

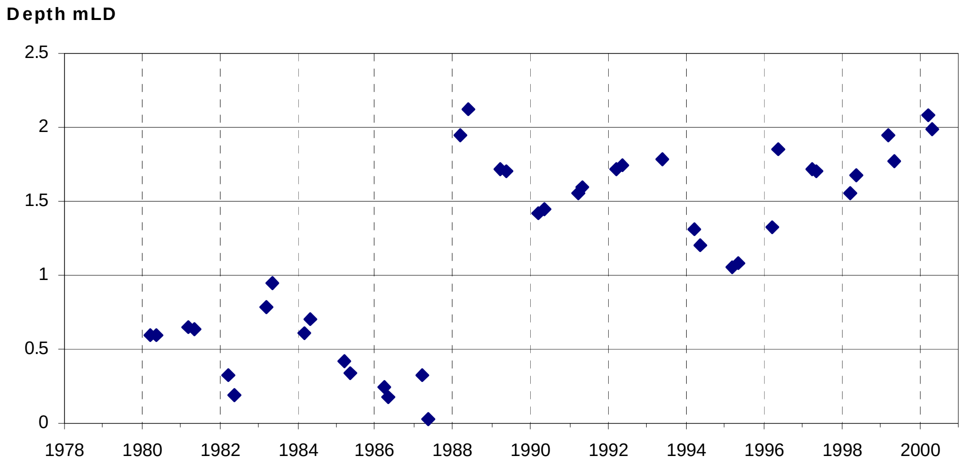
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

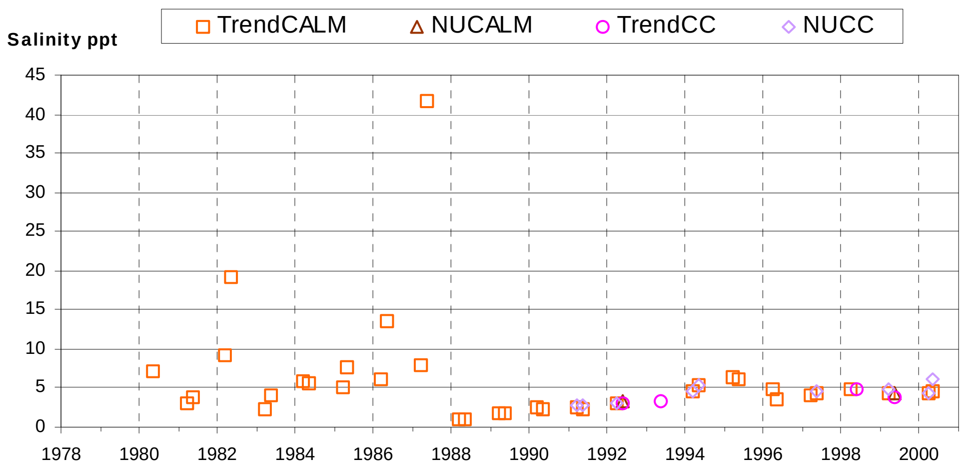
Figure 42: UNICUP



Rainfall Trend
Not signif. p = 0.14



Depth Trends
SEP ONLY **Increasing** p = 0.0001
NOV ONLY **Increasing** p= 0.0007
SEP & NOV **Increasing** p = 0.0001

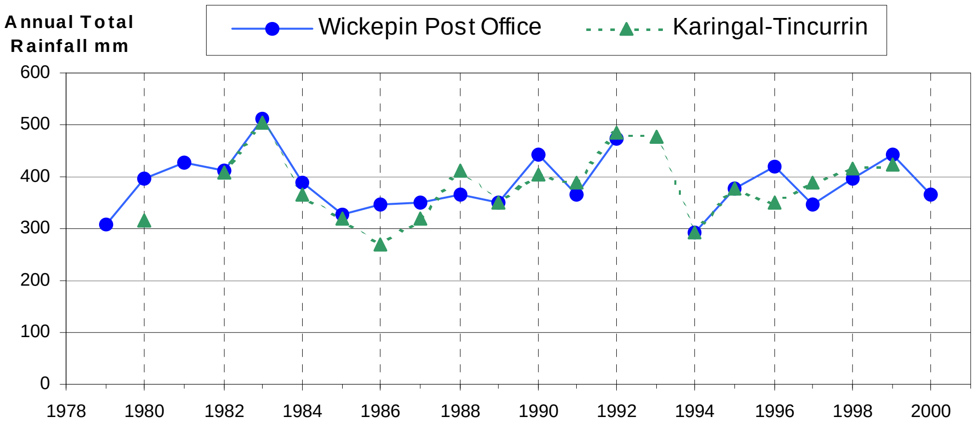


Salinity Trends
SEP ONLY Not signif. p = 0.8674
NOV ONLY Not signif. p = 0.2209
SEP & NOV Not signif. p = 0.3280

Notes:

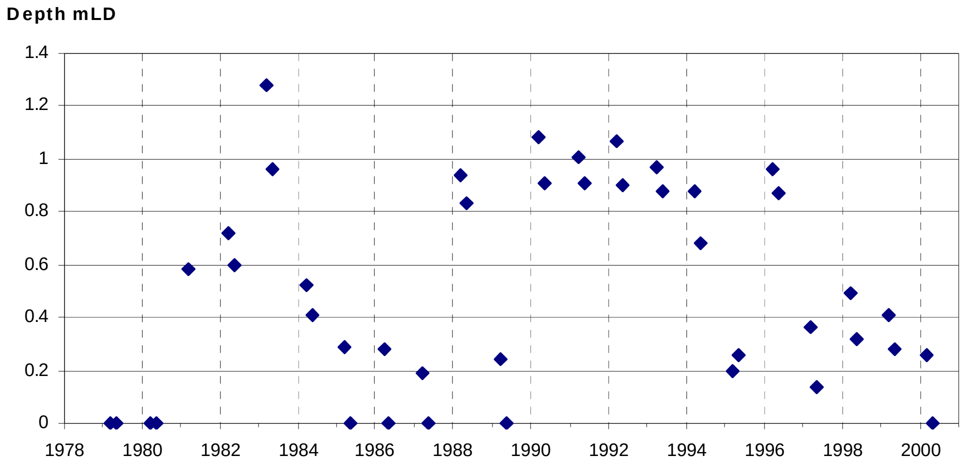
1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

Figure 43: WALBYRING



Rainfall Trend

Not signif.
p = 0.99

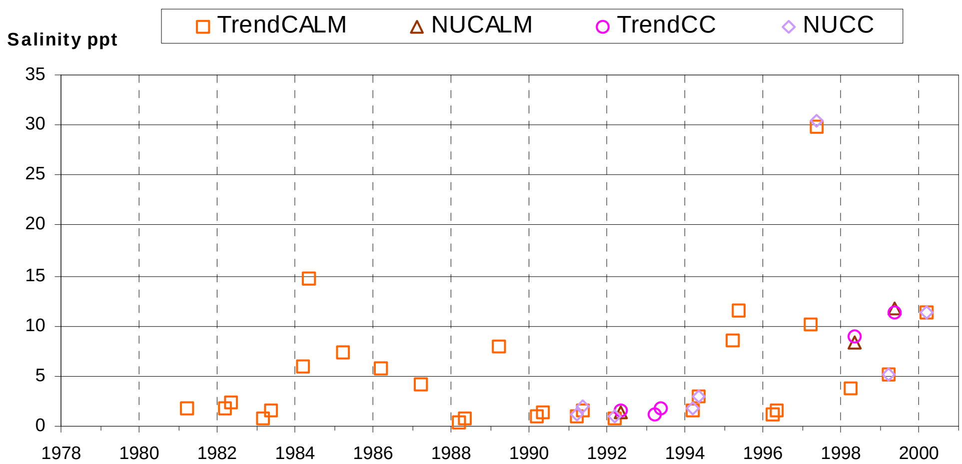


Depth Trends

SEP ONLY
Not signif.
p = 0.217

NOV ONLY
Not signif.
p= 0.34

SEP & NOV
Not signif.
p = 0.153



Salinity Trends

SEP ONLY
Not signif.
p = 0.2531

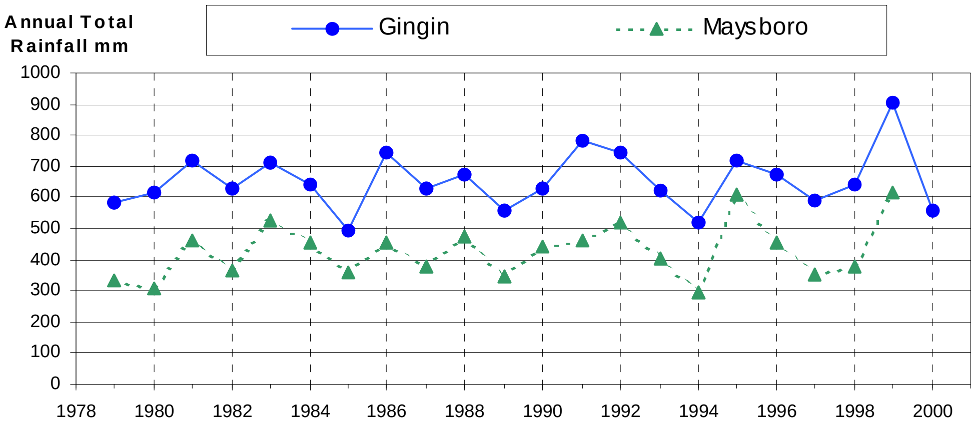
NOV ONLY
Not signif.
p = 0.1551

SEP & NOV
Not signif.
p = 0.0551

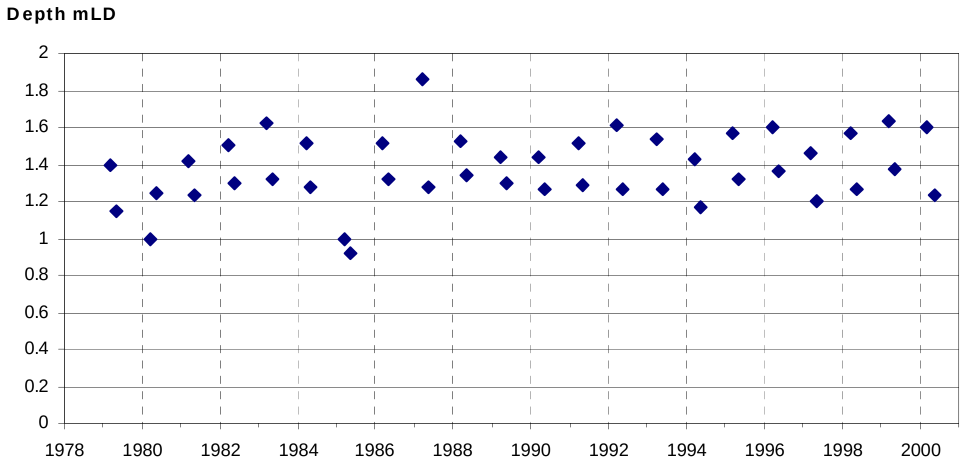
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

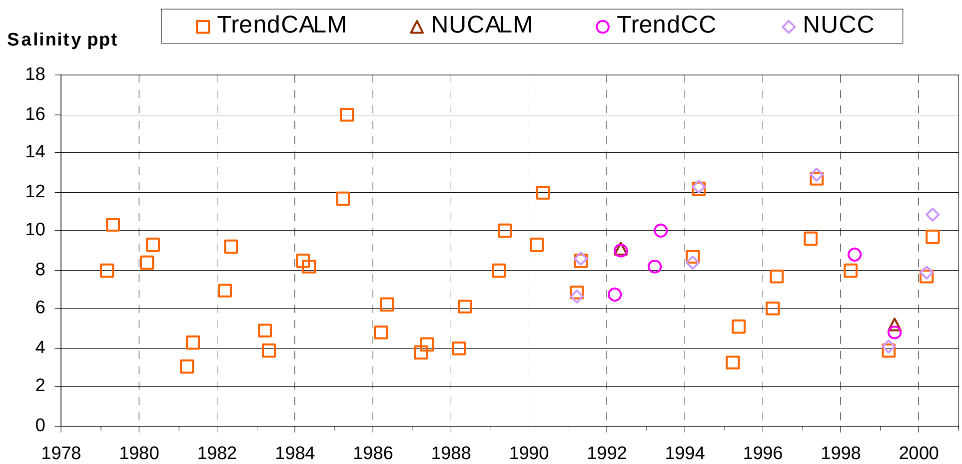
Figure 44: WANNAMAL



Rainfall Trend
Not signif. p = 0.52



Depth Trends
SEP ONLY **Increasing** p = 0.049
NOV ONLY Not signif. p= 0.314
SEP & NOV Not signif. p = 0.084

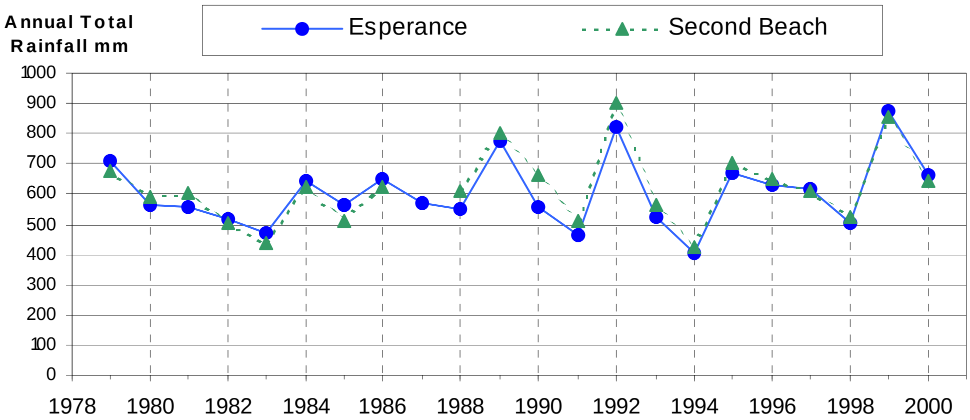


Salinity Trends
SEP ONLY Not signif. p = 0.8754
NOV ONLY Not signif. p = 0.5962
SEP & NOV Not signif. p = 0.6112

Notes:

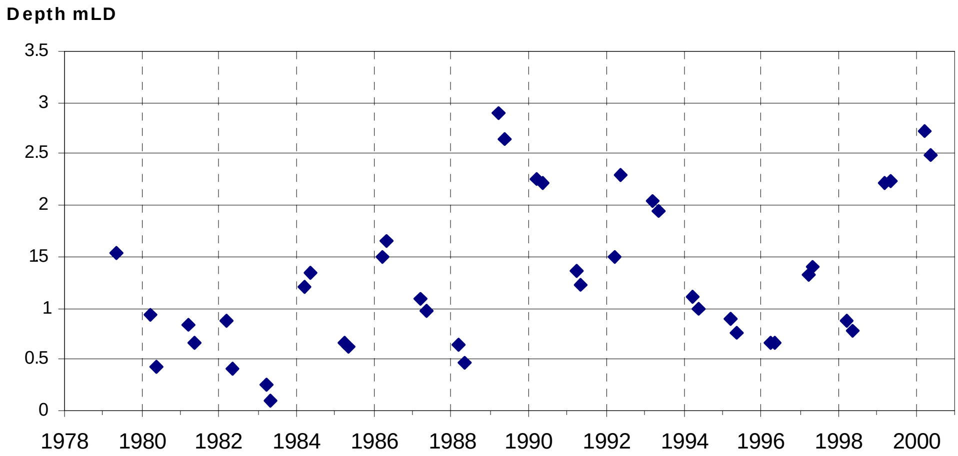
1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels indicate 1st July each year.

Figure 45: WARDEN



Rainfall Trend

Not signif.
p = 0.37

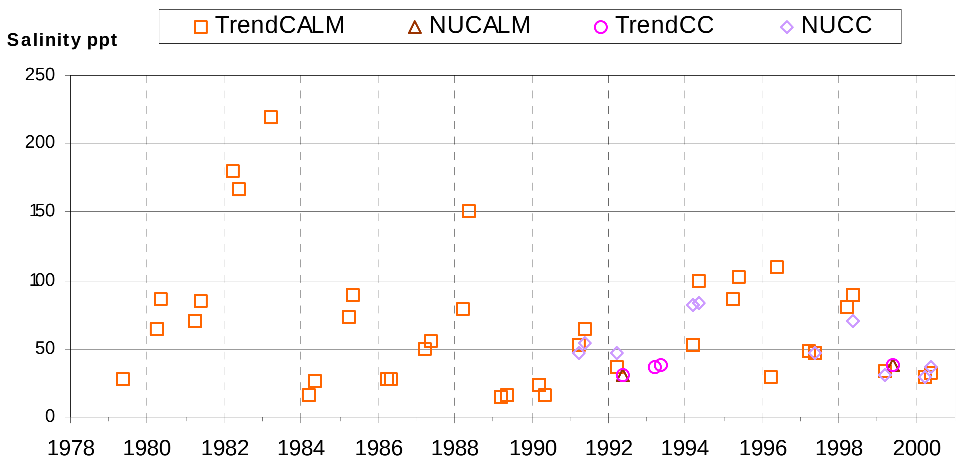


Depth Trends

SEP ONLY
Not signif.
p = 0.053

NOV ONLY
Increasing
p= 0.045

SEP & NOV
Increasing
p = 0.004



Salinity Trends

SEP ONLY
Not signif.
p = 0.1839

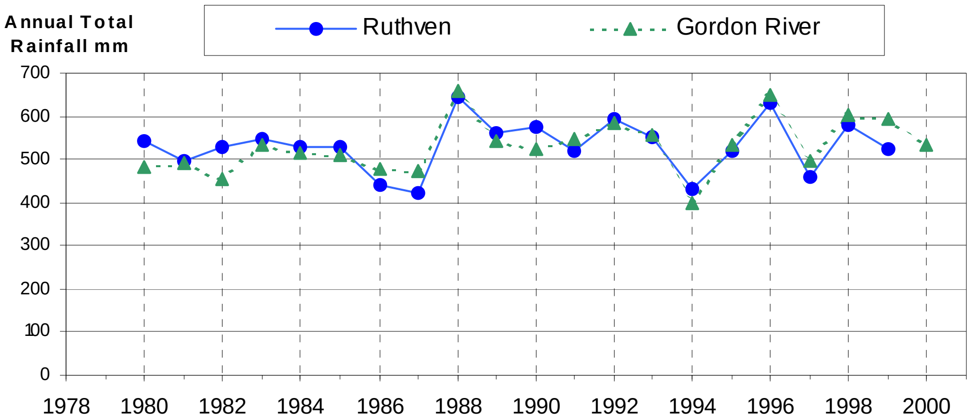
NOV ONLY
Not signif.
p = 0.8528

SEP & NOV
Not signif.
p = 0.2859

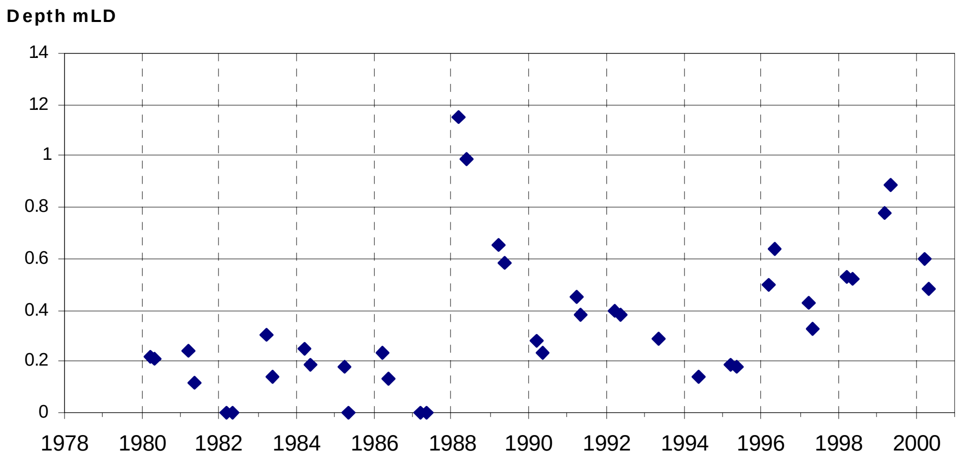
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

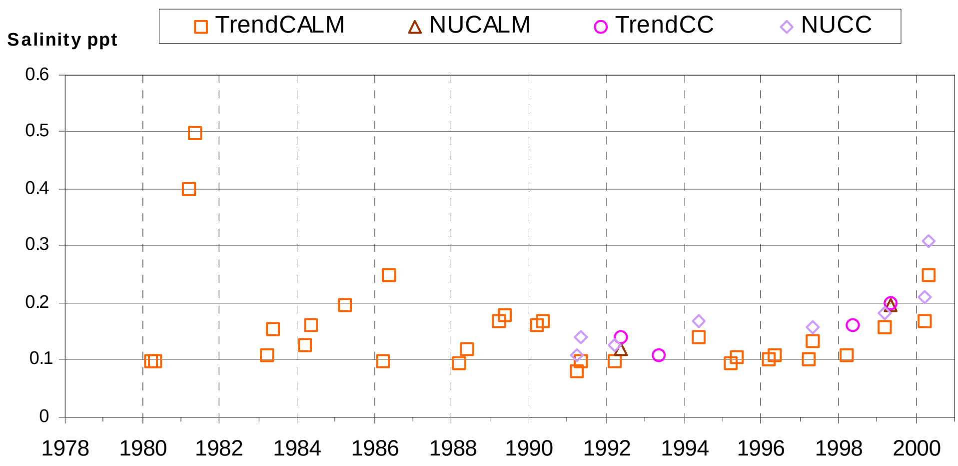
Figure 46: WARRINUP



Rainfall Trend
Not signif. p = 0.67



Depth Trends
SEP ONLY Insuff. data
NOV ONLY **Increasing** p= 0.006
SEP & NOV **Increasing** p = 0.0004

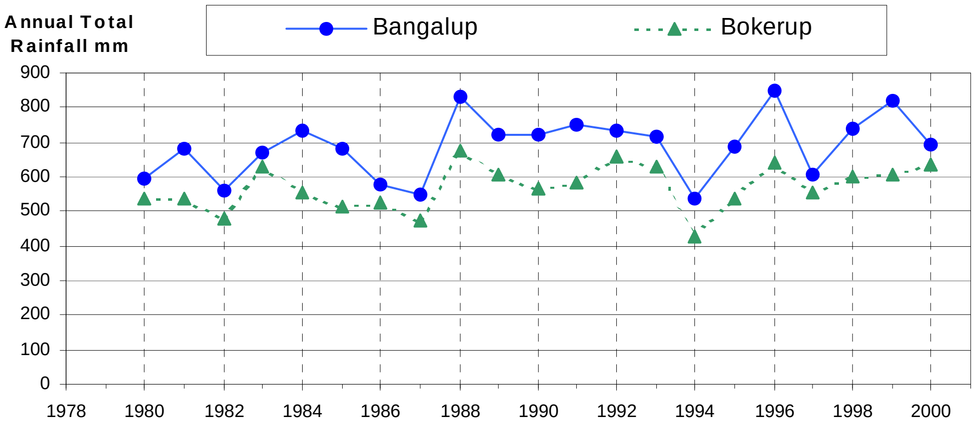


Salinity Trends
SEP ONLY Insuff. data
NOV ONLY Not signif. p = 0.4646
SEP & NOV Not signif. p = 0.2921

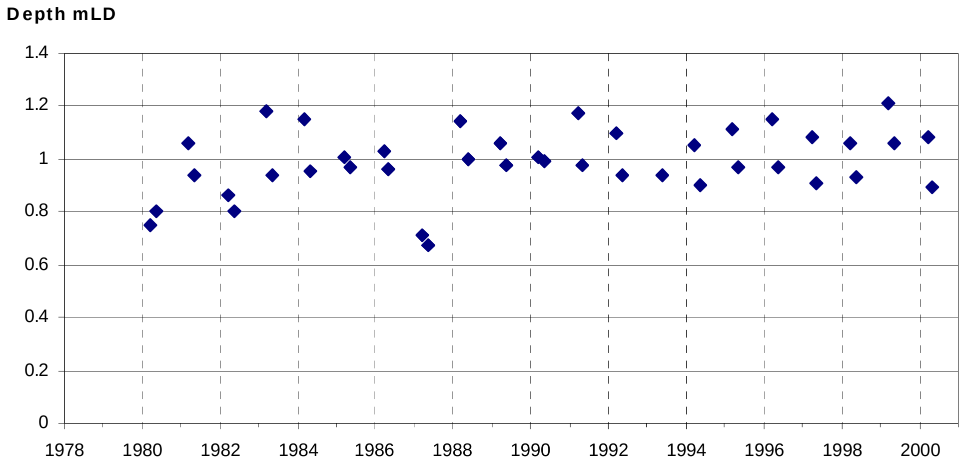
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. ‘routine monitoring periods’ described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1^{st} July).
6. For number of records considered sufficient for trend analysis refer to section 4.7.

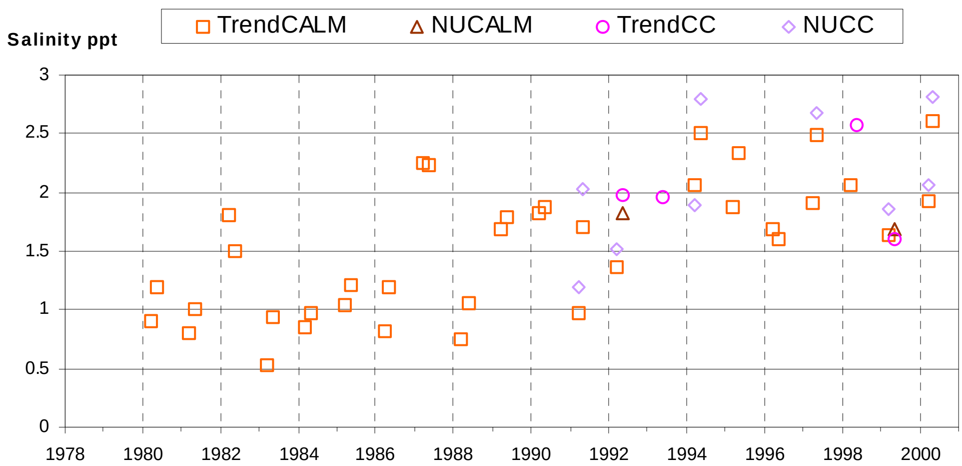
Figure 47: YARNUP



Rainfall Trend
Not signif. p = 0.10



Depth Trends
SEP ONLY **Increasing** p = 0.048
NOV ONLY Not signif. p= 0.156
SEP & NOV **Increasing** p = 0.034

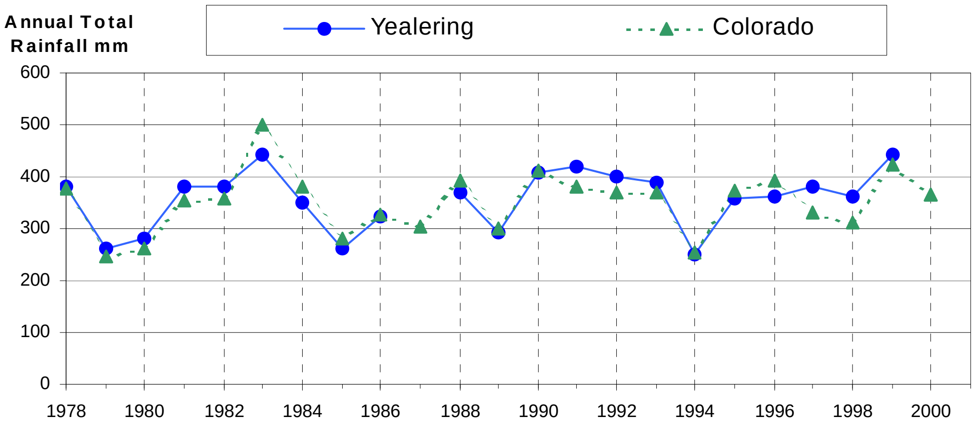


Salinity Trends
SEP ONLY **Increasing** p = 0.0019
NOV ONLY **Increasing** p = 0.0001
SEP & NOV **Increasing** p = 0.0001

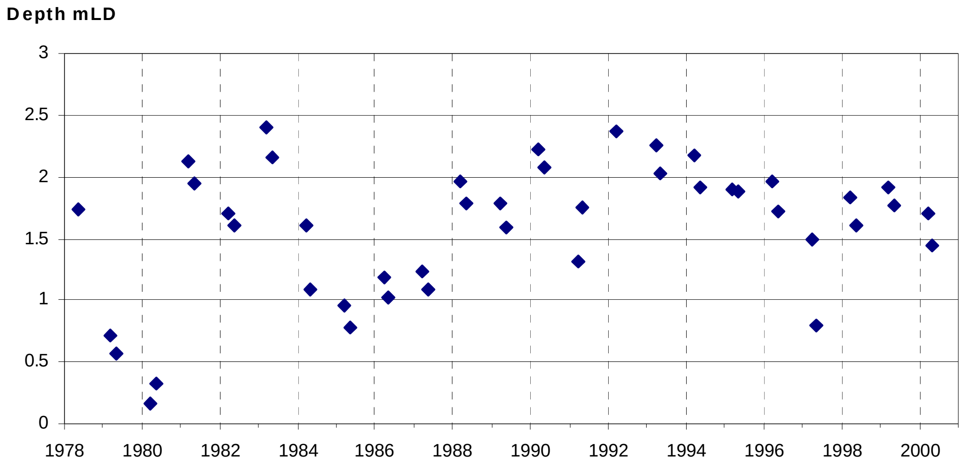
Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

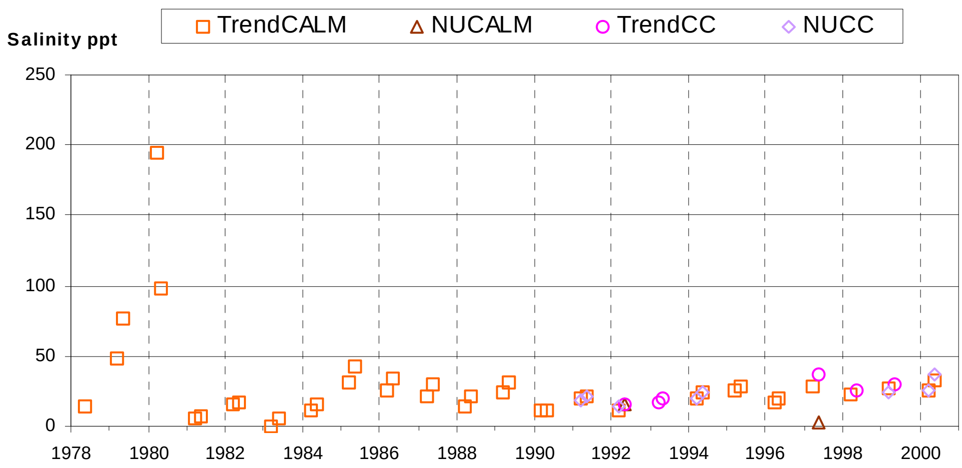
Figure 48: YEALERING



Rainfall Trend
Not signif. p = 0.25



Depth Trends
SEP ONLY **Increasing** p = 0.031
NOV ONLY Not signif. p= 0.136
SEP & NOV **Increasing** p = 0.008



Salinity Trends
SEP ONLY Not signif. p = 0.6780
NOV ONLY Not signif. p = 0.5982
SEP & NOV Not signif. p = 0.9980

Notes:

1. Rainfall data are from two nearest Meteorological Stations, unbroken line indicates nearest. Only nearest Station was used in trend analysis.
2. All depth and salinity data are from Sep. and Nov. 'routine monitoring periods' described in section 4.3.
3. mLD = metres Local Datum = depth in metres at deepest point in wetland.
4. Salinities were determined by Dept. CALM (DCALM) and/or WA Chemistry Centre (WACC). NU values were Not Used in trend analysis; see section 4.7 for explanation.
5. Year labels are positioned mid-year (1st July).

Appendix 1: Monitored wetlands' names, codes, coordinates, Local Government Authorities, monitoring periods and monitoring status.

Wetland Name	Code	Easting	Northing	Datum	Zone	Local Authority	Period monitored	100 SSS Wetlands	25 SSS Biological Wetlands
Ace	ACE	757860	6344590	AGD84	50	Lake Grace	7/80 - 5/85		
Albany 26385	ALB1	605900	6148430	AGD84	50	Albany	5/81 - 5/85, 9/98 onwards	Y	
Albany 27157	ALB2	618770	6147330	AGD84	50	Albany	3/80 - 5/85		
Altham	ALTH	634420	6302400	AGD84	50	Kent	7/80 - 11/91, 9/00 onwards	Y	Y
Anderson	ANDE	588673	6217155	AGD84	50	Tambellup	5/81 - 3/92, 9/00 onwards	Y	
Angove	ANGO	605684	6132427	AGD84	50	Albany	11/79 - 5/85, 9/90		
Ardath	ARDA	609070	6448375	GDA94	50	Bruce Rock	9/99 onwards	Y	Y
Atkins Yate	ATKI	749930	6330350	AGD84	50	Lake Grace	9/00 onwards	Y	
Bambun	BAMB	394750	6522680	AGD84	50	Gingin	5/79 onwards	Y	
Bennetts	BENN	742432	6314505	AGD84	50	Lake Grace	9/92 onwards	Y	Y
Beverley	BEVE	514296	6432611	GDA94	50	Bev./Brook./Quairad.	6/78 onwards	Y	
Biddy	BIDD	681980	6344720	AGD84	50	Lake Grace	7/82 - 5/85, 9/91 - 1/93		
Blue Gum	BLUE	401230	6615180	GDA94	50	Moora	9/00 onwards	Y	Y
Boat Harbour	BOA1	508103	6124812	AGD84	50	Denmark	8/91 onwards	Y	
Bokan	BOKA	549226	6349850	AGD84	50	Narrogin	7/79 - 5/85		
Boyup Brook 18239	BOYU	469722	6257246	AGD84	50	Boyup Brook	9/80 onwards	Y	Y
Broadwater	BROA	341050	6273280	AGD84	50	Busselton	11/85 onwards	Y	
Brown	BROW	559583	6397753	AGD84	50	Corrigin	7/79 - 11/91, 9/97 onwards	Y	
Bruce Rock 30969	BRUC	575000	6473785	AGD84	50	Bruce Rock	5/82 - 5/85		
Bryde	BRYD	669607	6308023	AGD84	50	Kent	6/79 onwards	Y	Y
Byenup	BYEN	478382	6182380	AGD84	50	Manjimup	6/77 onwards	Y	
Cairlocup	CAIR	662380	6266660	AGD84	50	Kent	9/80 - 5/85		
Camel	CAME	587900	6204630	AGD84	50	Cranbrook	8/80 - 5/85		
Campion	CAMP	627543	6554062	AGD84	50	Nungarin/Merredin	3/79 - 11/91, 9/99 onwards	Y	Y
Capamaura	CAPA	392970	6691308	AGD84	50	Carnamah	7/80 - 5/85, 3/90		
Casuarina	CASU	569532	6277311	AGD84	50	Katanning	5/78 onwards	Y	
Chandala	CHAN	400390	6514280	AGD84	50	Chittering	5/79 onwards	Y	
Chittering	CHIT	413932	6521142	AGD84	50	Chittering	4/78 - 11/86		
Clifton	CLIF	373900	6375950	AGD84	50	Mandurah	11/85 onwards	Y	
Coblinine	COBL	564428	6306061	AGD84	50	Dumbleyung	6/79 - 11/91		
Coomalbidgup	CMBG	349010	6267744	AGD84	51	Esperance	9/00 onwards	Y	Y
Coomelberrup	COOM	573072	6303109	AGD84	50	Dumbleyung	5/78 - 5/85, 3/93, 9/97 onwards	Y	Y
Corrigin 12900	CORR	603398	6413137	AGD84	50	Corrigin	7/82 onwards	Y	Y
Coyrecup	COYR	577057	6268401	AGD84	50	Katanning	5/78 onwards	Y	Y
Crackers	CRAC	365596	6579497	AGD84	50	Dandaragan	7/80 onwards	Y	
Cranbrook 25812	CRAN	573570	6203270	AGD84	50	Cranbrook	8/80 - 8/85		
Cronin	CRON	760040	6413702	AGD84	50	Kondinin	4/81 - 5/85, 11/95		
Davies	DAVI	318851	6211558	GDA94	50	Augusta-Margaret River	4/91 onwards	Y	
Dobaderry	DOBA	463091	6437231	AGD84	50	Beverley	9/80 onwards	Y	
Dowerin	DOWE	505691	6541492	GDA94	50	Dowerin	6/79 - 5/81, 9/99		
Dulbinning	DULB	557359	6359026	AGD84	50	Wickepin	7/79 onwards	Y	
Dumbleyung	DUMB	560070	6309876	GDA94	50	Dumbleyung/Wagin	6/79 onwards	Y	Y
Dundas 33113	DUND	393150	6358500	AGD84	51	Dundas	11/79 - 11/91		

Appendix 1: Cont.

Wetland Name	Code	Easting	Northing	Datum	Zone	Local Authority	Period monitored	100 SSS Wetlands	25 SSS Biological Wetlands
Eganu	EGAN	391375	6680529	AGD84	50	Coorow	7/78 onwards	Y	Y
Egret	EGRE	379600	6314733	AGD84	50	Harvey	5/85 onwards	Y	
Ellen Brook	ELLE	408600	6486370	AGD84	50	Swan	7/79 - 11/84		
Eneminga	ENEM	358547	6590020	AGD84	50	Dandaragan	7/80 - 11/91		
Esperance 26410	ESP1	304974	6265010	AGD84	51	Esperance	11/81 onwards	Y	
Esperance 27768	ESP2	388650	6319600	AGD84	51	Esperance	6/81 - 5/85		
Esperance 27985	ESP3	385840	6309170	AGD84	51	Esperance	6/81 - 11/91, 9/00 onwards	Y	
Esperance 32128	ESP4	470995	6278360	AGD84	51	Esperance	7/82 - 5/85		
Esperance 32776	ESP5	438140	6294455	AGD84	51	Esperance	6/81 - 5/85		
Flagstaff	FLAG	523590	6291466	AGD84	50	Woodanilling	6/79 - 11/91, 9/97 onwards	Y	
Forrestdale	FORR	399900	6442030	AGD84	50	Armadale	11/77 onwards	Y	
Frasers	FRAS	507238	6542439	GDA94	50	Dowerin	9/00 onwards	Y	Y
Gardner	GARD	605670	6129770	AGD84	50	Albany	5/81 - 5/85, 9/89, 9/90		
Gibb Road	GIBB	397478	6441517	AGD84	50	Armadale	9/92 onwards	Y	
Gingin 31241	GING	387733	6525564	AGD84	50	Gingin	6/79 - 5/85		
Gnowangerup 26264	GNO1	635950	6196160	AGD84	50	Gnowangerup	3/80 - 11/91		
Gnowangerup 26569	GNO2	636690	6257350	AGD84	50	Gnowangerup	7/82 - 5/85		
Goonaping	GOON	461800	6443306	GDA94	50	Beverley	9/00 onwards	Y	Y
Goorly	GOOR	503349	6664800	GDA94	50	Dalwallinu	9/00 onwards	Y	
Gore	GORE	363162	6263531	GDA94	51	Esperance	11/79 onwards	Y	
Gounter	GOUN	672856	6413041	AGD84	50	Kondinin	7/80 - 11/91		
Gundaring	GUND	546967	6315569	AGD84	50	Wagin	5/78 - 11/91		
Guraga	GURA	363480	6585400	AGD84	50	Dandaragan	9/82 onwards	Y	
Harvey 12632	HARV	386426	6348757	AGD84	50	Harvey	8/80 onwards	Y	
Hebitons	HEBI	345827	6806158	GDA94	50	Mullewa	9/00 onwards	Y	
Hinds	HIND	456858	6596855	AGD84	50	Wongan-Ballidu	6/79 - 11/91, 9/97 onwards	Y	
Jandabup	JAND	390790	6486829	AGD84	50	Wanneroo	4/78 onwards	Y	
Jasper	JASP	379595	6190247	AGD84	50	Nannup	11/85 onwards	Y	
Jerdacuttup	JERD	246676	6241845	AGD84	51	Ravensthorpe	11/79 onwards	Y	
Joondalup	JOON	384213	6487296	AGD84	50	Joondalup	4/78 onwards	Y	
Karakin	KARA	354261	6563662	AGD84	50	Gingin	5/79 - 5/85, 9/87		
Kent 29020	KENT	676818	6307261	AGD84	50	Kent	9/80 - 5/85, 9/00 onwards	Y	
Kondinin	KOND	612045	6404002	GDA94	50	Kondinin	6/79 - 11/91		
Kwobrup	KWOB	593360	6267500	AGD84	50	Kent	6/79 - 11/91		
Kwornicup	KWOR	538289	6176148	AGD84	50	Plantagenet	11/79 onwards	Y	
Little White	LITT	541321	6347413	AGD84	50	Narrogin	7/79 - 11/91, 9/97 onwards	Y	
Logue	LOGU	321121	6695889	AGD84	50	Carnamah	5/79 onwards	Y	Y
Maringup	MARI	426551	6144692	GDA94	50	Manjimup	6/91 - 9/99, 9/00 onwards	Y	
Martinup	MART	516458	6290003	AGD84	50	Woodanilling	6/79 - 11/91, 9/97 onwards	Y	
McLarty	MCLA	379224	6379374	AGD84	50	Murray	11/93 - 11/94, 9/96 onwards	Y	
Mears	MEAR	533104	6433898	AGD84	50	Brookton	6/78 - 11/91, 9/97 onwards	Y	
Mettler	METT	646280	6171960	AGD84	50	Albany	9/82 onwards	Y	
Miripin	MIRI	518158	6288702	AGD84	50	Woodanilling	6/81 - 5/85, 5/92		
Moates	MOAT	600874	6131559	AGD84	50	Albany	11/79 onwards	Y	

Appendix 1: Cont.

Wetland Name	Code	Easting	Northing	Datum	Zone	Local Authority	Period monitored	100 SSS Wetlands	25 SSS Biological Wetlands
Mollerin	MOLL	554031	6625291	AGD84	50	Koorda	7/80 - 5/85		
Mortijinup	MORT	373540	6259270	AGD84	51	Esperance	9/00 onwards	Y	
Mount Le Grand	MLGR	418930	6240030	AGD84	51	Esperance	9/00 onwards	Y	
Mount Marshall 26687	MTMA	560816	6579513	AGD84	50	Mt Marshall	7/81 - 11/91		
Muir	MUIR	470860	6184900	AGD84	50	Manjimup	11/79 onwards	Y	
Mungala	MUNG	395050	6521250	AGD84	50	Gingin	6/79 - 5/85		
Murapin	MURA	517630	6289374	AGD84	50	Woodanilling	6/81 - 5/85		
Murray 24739	MURR	378648	6381888	AGD84	50	Murray	9/80 - 5/85		
Nambung	NAMB	394450	6521750	AGD84	50	Gingin	6/79 - 5/85		
Ngopitchup	NGOP	531580	6242540	AGD84	50	Broomehill	9/00 onwards	Y	
Ninan	NINA	467083	6575665	AGD84	50	Wongan-Ballidu	7/78 - 11/91, 9/97 onwards	Y	
Nine Mile	NINE	385413	6376287	AGD84	50	Murray	6/81 onwards	Y	
Nonalling	NONA	557249	6400137	AGD84	50	Corrigin	7/79 - 5/85		
Noobijup	NOOB	480725	6192505	AGD84	50	Cranbrook	9/00 onwards	Y	Y
Noonying	NOON	542474	6497793	AGD84	50	Tammin	6/79 - 11/91, 9/97 onwards	Y	
North Parriup	NPAR	281440	6250085	AGD84	51	Ravensthorpe	9/00 onwards	Y	
Owingup	OWIN	507122	6126650	AGD84	50	Denmark	7/91 onwards	Y	
Pabelup South	PABE	725630	6222120	AGD84	50	Jerramungup	9/00 onwards	Y	
Pallarup	PALL	756745	6322250	AGD84	50	Lake Grace	7/80 - 11/91		
Parkeyerring	PARK	533220	6307298	AGD84	50	Wagin	5/78 - 11/91, 9/97 onwards	Y	Y
Pillenorup	PILL	601310	6187680	AGD84	50	Plantagenet	9/00 onwards	Y	
Pinjarrega	PINJ	395272	6670431	AGD84	50	Coorow	5/79 - 11/91		
Plantagenet 25386	PLAN	597720	6176630	AGD84	50	Plantagenet	11/79 - 5/85, 11/94 - 11/96		
Pleasant View	PLEA	608385	6145281	AGD84	50	Albany	11/79 onwards	Y	Y
Poorginup	POOR	476405	6177093	AGD84	50	Manjimup	6/77 onwards	Y	
Powell	POWE	567380	6124950	AGD84	50	Albany	6/81 onwards	Y	
Queerearrup	QUEE	521244	6291517	AGD84	50	Woodanilling	10/78 - 5/85, 9/88		
Range Road Yate	RANG	665930	6275015	AGD84	50	Kent	9/00 onwards	Y	
Red (Bruce Rock)	REDB	602419	6436959	AGD84	50	Bruce Rock	7/81 - 5/85, 9/00 onwards	Y	
Red (Manjimup)	REDM	468450	6189430	AGD84	50	Manjimup	11/81 - 11/91		
Ronnerup	RONN	744020	6317630	AGD84	50	Lake Grace	9/00 onwards	Y	Y
Shark	SHAR	394588	6263079	AGD84	51	Esperance	11/79 onwards	Y	
Shaster	SHAS	287030	6250550	AGD84	51	Ravensthorpe	11/79 - 11/91		
Station	STAT	402696	6259247	AGD84	51	Esperance	3/80 onwards	Y	
Streets	STRE	402311	6614731	AGD84	50	Moora	10/78 - 11/91		
Taarblin	TAAR	551309	6350370	AGD84	50	Narrogin	5/78 onwards	Y	
Thomsons	THOM	389412	6441385	AGD84	50	Cockburn	11/78 onwards	Y	
Toolibin	TOOL	557653	6357270	AGD84	50	Wickepin	5/78 onwards	Y	Y
Tordit-Gurrup	TORD	476227	6179473	AGD84	50	Manjimup	6/77 onwards	Y	
Towerrinning	TOWE	480710	6283895	AGD84	50	West Arthur	12/77 onwards	Y	Y
Twin Swamps	TWIN	406430	6489973	AGD84	50	Swan	7/79 - 11/84		
Unicup	UNIC	474444	6200043	GDA94	50	Cranbrook	9/80 onwards	Y	
Varley	VARL	724430	6379670	AGD84	50	Kulin	6/81 - 11/91, 9/00 onwards	Y	
Wagin 2088	WAGI	533266	6311875	AGD84	50	Wagin	7/82 - 5/85		

Appendix 1: Cont.

Wetland Name	Code	Easting	Northing	Datum	Zone	Local Authority	Period monitored	100 SSS Wetlands	25 SSS Biological Wetlands
Walbyring	WALB	555519	6355255	AGD84	50	Wickepin	7/79 onwards	Y	
Wallering	WALL	395570	6521440	AGD84	50	Gingin	7/81 - 5/85		
Walyormouring	WALY	488051	6554391	AGD84	50	Goomalling	7/78 - 11/91, 9/97 onwards	Y	Y
Wannamal	WANN	409509	6556557	AGD84	50	Gingin	7/78 onwards	Y	
Warden	WARD	396833	6257473	AGD84	51	Esperance	11/79 onwards	Y	
Wardering	WARG	523339	6290230	AGD84	50	Woodanilling	5/78 - 11/91		
Warrinup	WARR	523536	6199426	AGD84	50	Cranbrook	3/80 onwards	Y	
West Arthur 5456	WEST	496500	6293081	AGD84	50	West Arthur	8/80 - 11/91, 9/97 onwards	Y	
Wheatfield	WHEA	400925	6258680	AGD84	51	Esperance	9/00 onwards	Y	Y
White (Albany)	WHIA	606270	6152320	AGD84	50	Albany	6/81 - 5/85, 9/98		
White (Narrogin)	WHIN	542558	6347370	AGD84	50	Narrogin	6/81 - 5/85, 9/97 onwards	Y	
White Water	WHIW	558738	6399922	AGD84	50	Corrigin	6/81 - 11/91, 9/97 onwards	Y	
Wild Horse	WILD	473600	6273300	AGD84	50	West Arthur	6/81 - 5/85		
Wilson	WILS	382396	6189431	GDA94	50	Manjimup	5/91 onwards	Y	
Yaalup	YAAL	647441	6263829	GDA94	50	Kent	7/82 onwards	Y	Y
Yarnup	YARN	487307	6196536	AGD84	50	Cranbrook	9/80 onwards	Y	
Yarra Yarra	YARR	379896	6726844	AGD84	50	Carnamah	7/81 - 5/85, 9/97 onwards	Y	
Yealering	YEAL	558536	6393399	AGD84	50	Wickepin	6/78 onwards	Y	
Yellilup	YELL	686966	6201315	AGD84	50	Jerramungup	11/85 onwards	Y	
Yurine	YURI	385028	6543449	AGD84	50	Gingin	5/79 - 11/91		

Notes:

1. This table includes all wetlands that have been regularly monitored at any time since commencement of the F&W / CALM South-West Wetland Monitoring Program in 1977, sorted by wetland name.
2. Wetland monitoring was conducted every second month (Jan, Mar, May, Jul, Sep, Nov) from May 1981 to May 1985 and twice-yearly (Sep, Nov) prior to and after that four-year period.
3. A few wetlands have been monitored more frequently for short periods of time.
4. Coordinates are of the benchmark locations at each wetland.
5. Un-named wetlands are identified by Local Authority and Reserve No. (e.g. Albany 26385).
6. Boyup Brook 18239 is also known as Kulicup Swamp and Corrigin 12900 as Paperbark Swamp.
7. The ‘100 SSS Wetlands’ are the 100 wetlands being routinely monitored by CALM for depth, salinity, pH and nutrients under the State Salinity Strategy.
8. The ‘25 SSS Biological Wetlands’ are the 25 wetlands being intensively monitored by CALM for biological and other (chemical) attributes under the State Salinity Strategy.
9. ‘Period Monitored’ is described by the first and last records (for any parameter) of discrete periods of monitoring.

Appendix 2: September depths (years monitored, years dry, means, percentiles, ranges, variability, trends) of all 151 monitored wetlands (metres).

Code	Years measured (=n)	DRY/BD	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%) /50%	p value	Trend
ACE	80-84	80	5	0.08	0.00			0.08			0.15			
ALB1	81-84,98-00		7	0.66	0.25			0.68			0.94			
ALB2	80-84		5	0.83	0.58			0.79			1.10			
ALTH	80-91,00		13	0.41	0.03		0.12	0.21	0.33		1.33	1.00		
ANDE	81-91,00		12	1.10	0.25		0.66	1.03	1.49		2.29	0.81		
ANGO	81-84,90		5	2.09	1.83			1.95			2.79			
ARDA	00		1	1.23	1.23			1.23			1.23			
ATKI	00		1	4.67	4.67			4.67			4.67			
BAMB	79,81,83-93,96-00		18	2.50	2.42		2.47	2.50	2.52		2.65	0.02		
BENN	95,97-00		5	1.15	0.08			0.80			2.84			
BEVE	79-00		22	1.37	0.03	0.74	0.95	1.45	1.85	1.91	2.49	0.62	0.468	None
BIDD	82-84		3	0.47	0.24			0.26			0.92			
BLUE	00		1	0.81	0.81			0.81			0.81			
BOA1	92,93,95-00		8	1.12	0.98			1.16			1.21			
BOKA	79-84	79	6	0.54	0.00			0.50			1.60			
BOYU	80-92,95-00	80, 82, 86, 87	19	0.19	0.00		0.08	0.17	0.22		0.76	0.82		
BROA	86-97,99-00		14	0.92	0.67		0.85	0.94	0.96		1.14	0.12		
BROW	79-91,97-00	80	17	0.94	0.00		0.40	0.97	1.49		2.08	1.12		
BRUC	82-84		3	1.22	1.18			1.21			1.27			
BRYD	79-00	79, 80, 85, 86, 95, 96	22	0.81	0.00	0.00	0.01	0.65	1.68	1.97	2.03	2.57	0.138	None
BYEN	79-92,94-00		21	2.31	1.42	2.04	2.20	2.42	2.49	2.54	2.56	0.12	0.358	None
CAIR	80-84		5	0.11	0.04			0.08			0.25			
CAME	80-84		5	0.29	0.10			0.35			0.38			
CAMP	79-91,99-00	80	15	0.59	0.00		0.29	0.40	0.77		1.70	1.20		
CAPA	81-84		4	0.64	0.18			0.70			0.96			
CASU	79-00	79	22	1.09	0.00	0.25	0.81	1.20	1.35	1.61	2.25	0.45	0.262	None
CHAN	79,81,83-00		20	0.94	0.79	0.84	0.90	0.94	0.99	1.02	1.02	0.10	0.106	None
CHIT	79-85		7	1.30	0.80			1.30			1.67			
CLIF	86-92,94-00		14	4.41	4.20		4.30	4.43	4.49		4.68	0.04		
CMBG	00		1	3.09	3.09			3.09			3.09			
COBL	79-91		13	2.73	0.97		1.48	2.78	3.38		4.80	0.68		
COOM	79-84,97-00		10	0.91	0.06		0.68	1.07	1.13		1.53	0.42		
CORR	82-92,95,97,99-00	85, 87, 97	18	0.85	0.00		0.76	0.95	1.11		1.53	0.37		
COYR	79-00		22	1.33	0.07	0.10	0.51	1.39	2.02	2.42	2.60	1.09	0.315	None
CRAC	81-00		20	1.09	0.10	0.95	1.11	1.18	1.24	1.28	1.33	0.11	0.009	Increasing
CRAN	80-84		5	0.24	0.14			0.20			0.45			
CRON	81-84	83	4	0.18	0.00			0.14			0.45			
DAVI	93-00		8	4.72	4.53			4.73			4.88			
DOBA	80-00	80	21	0.52	0.00	0.41	0.46	0.52	0.59	0.66	0.82	0.25	0.178	None
DOWE	79-80		2	0.13	0.11			0.13			0.15			
DULB	79-00	79-80, 85-87, 89, 95	22	0.58	0.00	0.00	0.00	0.83	0.89	0.90	1.39	1.07	0.065	None
DUMB	79-00		22	1.70	0.05	0.39	0.69	1.74	2.60	3.28	4.19	1.10	0.728	None
DUND	80-89,91	80, 82, 91	11	0.13	0.00		0.03	0.16	0.17		0.34	0.88		
EGAN	79-00	80	22	2.05	0.00	1.03	1.77	2.44	2.64	2.74	2.87	0.36	0.054	None
EGRE	85-92,94-00	90, 94	15	0.39	0.00		0.23	0.34	0.64		0.75	1.21		

Appendix 2: Cont.

Code	Years measured (=n)	DRY/BD	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%) /50%	p value	Trend
ELLE	79-80,82-83		4	0.42	0.39			0.41			0.45			
ENEM	81-91		11	1.77	0.29		1.28	1.60	2.58		2.75	0.81		
ESP1	82-00	82-83, 85, 96	19	0.67	0.00		0.04	0.59	1.00		2.35	1.63		
ESP2	81-84	81-82	4	0.03	0.00			0.03			0.05			
ESP3	81-91,00		12	0.10	0.03		0.08	0.10	0.13		0.21	0.50		
ESP4	82-84	82-83	3	0.12	0.00			0.00			0.37			
ESP5	81-84	81	4	0.05	0.00			0.04			0.12			
FLAG	79-91,97-00		17	0.71	0.10		0.38	0.55	0.88		1.81	0.91		
FORR	81-91,93-00		23	0.76	0.27	0.46	0.66	0.75	0.82	1.12	1.19	0.21	0.047	Decreasing
FRAS	00		1	1.25	1.25			1.25			1.25			
GARD	81-84,89-90		6	2.23	2.10			2.18			2.39			
GIBB	92-00		9	0.70	0.46			0.74			0.96			
GING	79,81,83-84		4	2.22	2.00			2.27			2.35			
GNO1	80-91	80-81, 85	12	0.27	0.00		0.02	0.17	0.27		1.00	1.47		
GNO2	82-84	82, 84	3	0.12	0.00			0.00			0.35			
GOON			0											
GOOR	00		1	0.69	0.69			0.69			0.69			
GORE	80-00		21	1.49	0.68	0.95	1.21	1.53	1.79	1.89	2.10	0.38	0.390	None
GOUN	80-91	85	12	0.53	0.00		0.19	0.28	0.52		1.97	1.18		
GUND	79-91		13	1.49	0.62		1.12	1.56	1.80		2.36	0.44		
GURA	82-00		19	1.62	0.20		0.85	1.74	2.22		3.00	0.79		
HARV	80-92,94-00		20	1.29	0.72	0.97	1.09	1.24	1.52	1.63	1.90	0.35	0.498	None
HEBI	00	00	1	0.00	0.00			0.00			0.00			
HIND	79-91,97-00		17	1.00	0.25		0.35	0.55	1.26		4.45	1.65		
JAND	81-00		20	1.23	0.95	1.03	1.09	1.23	1.34	1.45	1.54	0.20	0.177	None
JASP	86-00		15	9.63	9.21		9.58	9.68	9.72		9.79	0.01		
JERD	80-00		21	1.77	0.05	0.53	0.82	1.58	2.82	3.45	4.45	1.27	0.814	None
JOON	81-00		20	3.05	2.62	2.77	2.90	3.03	3.12	3.36	3.67	0.07	0.276	None
KARA	79-84,87		7	1.05	0.90			1.00			1.19			
KENT	80-84,00	80, 84	6	0.12	0.00			0.07			0.44			
KOND	79-91		13	0.78	0.07		0.25	0.31	1.05		2.60	2.58		
KWOB	79-91	80-81, 86-87	13	0.48	0.00		0.00	0.35	0.85		1.22	2.43		
KWOR	80-92,95-00		19	0.49	0.14		0.29	0.43	0.64		1.24	0.81		
LITT	79-91,97-00		17	0.70	0.08		0.40	0.79	0.98		1.48	0.73		
LOGU	79-00	90, 94	22	1.02	0.00	0.10	0.28	0.64	1.41	2.17	4.03	1.77	0.252	None
MARI	95-00		6	6.48	6.28			6.50			6.59			
MART	79-91,97-00		17	0.85	0.04		0.51	0.73	1.27		1.94	1.04		
MCLA	94,97-00		6	1.24	0.83			1.22			1.59			
MEAR	79-80,82-91,97-00	80	16	1.03	0.00		0.65	0.97	1.36		2.36	0.73		
METT	82-92,95-00	96	17	0.50	0.00		0.21	0.53	0.67		1.29	0.87		
MIRI	81-84		4	0.86	0.60			0.76			1.33			
MLGR	00		1	1.83	1.83			1.83			1.83			
MOAT	80-92,95-00		19	4.54	4.41		4.46	4.51	4.57		4.82	0.02		
MOLL	80-84	80-82	5	0.01	0.00			0.00			0.05			
MORT	00		1	3.45	3.45			3.45			3.45			
MTMA	81-91	87, 90-91	11	0.10	0.00		0.01	0.02	0.06		0.81	2.50		
MUIR	80-92,94-00		20	0.84	0.53	0.61	0.68	0.86	1.00	1.03	1.08	0.37	0.014	Increasing
MUNG	79-81,83-84		5	0.56	0.26			0.57			0.88			

Appendix 2: Cont.

Code	Years measured (=n)	DRY/BD	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%) /50%	p value	Trend
MURA	81-84		4	0.85	0.37			0.88			1.27			
MURR	80-84		5	0.60	0.50			0.60			0.71			
NAMB	79-81,83-84		5	0.49	0.20			0.55			0.80			
NGOP	00		1	0.29	0.29			0.29			0.29			
NINA	79-91,98-00		16	1.44	0.30		1.01	1.38	1.99		2.54	0.71		
NINE	81-92,94-00		19	1.37	0.65		1.10	1.35	1.64		2.05	0.40		
NONA	79-84		6	0.94	0.36			0.91			1.62			
NOOB	99-00		2	1.53	1.44			1.53			1.63			
NOON	79-91,97-00	80	17	0.78	0.00		0.27	0.90	1.28		1.42	1.12		
NPAR	00		1	0.58	0.58			0.58			0.58			
OWIN	92-93,95-00		8	1.67	1.55			1.66			1.78			
PABE	00	00	1	0.00	0.00			0.00			0.00			
PALL	80-87,89-91	82-83, 85-86, 91	11	0.03	0.00		0.00	0.04	0.05		0.08	1.25		
PARK	79-91,97-00		17	1.02	0.05		0.50	1.05	1.43		2.30	0.89		
PILL	00		1	0.38	0.38			0.38			0.38			
PINJ	79-91	87	13	1.18	0.00		0.59	1.05	2.17		2.45	1.50		
PLAN	80-84,95-96		7	0.55	0.39			0.59			0.64			
PLEA	80-92,95-00		19	0.92	0.20		0.72	0.93	1.16		1.60	0.47		
POOR	79-92,94-00		22	0.55	0.02	0.43	0.50	0.59	0.64	0.70	0.72	1.00	0.350	None
POWE	81-92,95-00		18	0.57	0.35		0.43	0.53	0.70		0.98	0.51		
QUEE	79-84,88		7	1.47	0.29			1.73			3.09			
RANG	00		1	1.42	1.42			1.42			1.42			
REDB	81-84,00		5	0.09	0.01			0.09			0.18			
REDM	82-91		10	1.07	0.10		0.32	0.46	2.11		2.55	3.89		
RONN	00		1	2.16	2.16			2.16			2.16			
SHAR	80-00		21	2.15	1.44	1.83	1.91	2.12	2.43	2.48	2.57	0.25	0.340	None
SHAS	80-91		12	0.48	0.03		0.28	0.41	0.56		1.13	0.68		
STAT	80-00		21	0.69	0.13	0.68	0.68	0.70	0.73	0.75	0.79	0.07	0.149	None
STRE	79-82,84-91	80, 82	12	0.72	0.00		0.12	0.67	1.40		1.45	1.91		
TAAR	79-00	79-80, 86, 89, 00	22	0.37	0.00	0.00	0.05	0.27	0.38	0.85	2.38	1.22	0.920	None
THOM	81-00		20	1.09	0.45	0.59	0.89	1.01	1.24	1.58	2.03	0.35	0.350	None
TOOL	79-94,96-00	79-80, 85-87, 89, 00	21	0.86	0.00	0.00	0.00	0.80	1.36	1.88	2.48	1.70	0.596	None
TORD	79-92,94-00		22	2.50	1.41	1.98	2.49	2.54	2.70	2.89	2.92	0.08	0.527	None
TOWE	79-92,95-00		20	2.74	0.62	1.19	2.33	3.17	3.29	3.59	3.76	0.30	0.005	Increasing
TWIN	79-80,82-83		4	0.16	0.13			0.16			0.21			
UNIC	80-92,94-00		20	1.16	0.25	0.33	0.61	1.32	1.71	1.94	2.08	0.83	0.0001	Increasing
VARL	81-91,00	85	12	0.15	0.00		0.07	0.10	0.12		0.92	0.50		
WAGI	82-84		3	0.86	0.37			0.74			1.48			
WALB	79-00	79-80	22	0.58	0.00	0.19	0.27	0.51	0.96	1.06	1.28	1.35	0.217	None
WALL	81,83-84		3	0.97	0.48			1.19			1.24			
WALY	79-91,97-00	80	17	0.61	0.00		0.22	0.63	0.82		1.44	0.95		
WANN	79-00		22	1.49	0.99	1.39	1.44	1.51	1.59	1.62	1.86	0.10	0.049	Increasing
WARD	80-00		21	1.33	0.25	0.66	0.87	1.10	1.50	2.26	2.90	0.57	0.053	None
WARG	79-91		13	0.94	0.23		0.67	1.16	1.20		1.34	0.46		
WARR	80-92,95-00	82, 87	19	0.39	0.00		0.23	0.30	0.52		1.15	0.97		
WEST	80-91,97-00	87	16	0.59	0.00		0.21	0.65	0.97		1.17	1.17		
WHEA	00		1	2.06	2.06			2.06			2.06			
WHIA	81-84,98	83	5	0.22	0.00			0.10			0.67			

Appendix 2: Cont.

Code	Years measured (=n)	DRY/BD	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%) /50%	p value	Trend
WHIN	81-84,97-00	97	8	0.47	-0.01			0.14			2.15			
WHIW	81-91,97-00	85	15	0.51	0.00		0.08	0.14	0.78		2.02	5.00		
WILD	81-84		4	0.76	0.28			0.75			1.25			
WILS	92-00		9	3.80	3.50			3.90			3.94			
YAAL	82-91,94-00	86-87	19	1.44	0.00		0.76	1.44	2.05		3.08	0.90		
YARN	80-92,94-00		20	1.05	0.71	0.85	1.03	1.07	1.14	1.17	1.21	0.10	0.048	Increasing
YARR	81-84,97-00		8	0.31	0.19			0.22			1.01			
YEAL	79-90,97-00		22	1.68	0.16	0.97	1.36	1.81	2.09	2.25	2.40	0.40	0.031	Increasing
YELL	86-92,95-00		13	3.22	1.18		2.62	3.13	4.30		4.84	0.54		
YURI	79,81,83-91		11	1.50	0.37		1.12	1.65	1.93		2.19	0.49		

Notes:

1. All data on which this Appendix is based were collected during the September 'routine survey period', that is, within the nine-day period commencing on the second Saturday of September each year.
2. Depths are in metres, at deepest point in each wetland.
3. 'Dry/BD' means Dry (lake was dry when visited) or Believed Dry (lake was not visited but believed to be dry).
4. 25% and 75% percentiles calculated where n ≥ 10.
5. 10% and 90% percentiles calculated where n ≥ 20.
6. Variability calculated using (75% - 25%) / 50%.
7. p value from regression analysis performed using SAS on wetlands with ≥ 20 years of September or November depth data.

Appendix 3: November depths (years monitored, years dry, means, percentiles, ranges, variability, trends) of all 151 monitored wetlands (metres).

Code	Years measured (=n)	DRY/BD	n	mean	min	10%	25%	50%	75%	90%	max	Variability (75%-25%) /50%	p value	Trend
ACE	80-84	80,82,83	5	0.01	0.00			0.00			0.03			
ALB1	81-84,98-00		7	0.60	0.18			0.64			0.84			
ALB2	80-84		5	0.81	0.59			0.77			1.10			
ALTH	81-91,00	81-82,85-87,89,00	12	0.26	0.00		0.00	0.00	0.34		1.07	Undefined		
ANDE	81-91,00		12	0.98	0.14		0.53	0.96	1.34		2.12	0.84		
ANGO	79,81-84		5	1.94	1.81			1.88			2.11			
ARDA	99-00		2	1.24	0.89			1.24			1.60			
ATKI	00		1	4.40	4.40			4.40			4.40			
BAMB	79-94,97-00		21	2.33	2.20	2.25	2.27	2.33	2.37	2.44	2.47	0.04	0.063	None
BENN	95,97-00	99	5	0.96	0.00			0.57			2.43			
BEVE	79-00	94	22	1.17	0.00	0.57	0.76	1.29	1.64	1.68	1.72	0.68	0.77	None
BIDD	82-84		3	0.30	0.05			0.11			0.74			
BLUE	99-00	99	2	0.28	0.00			0.28			0.55			
BOA1	92-00		9	1.03	0.96			1.01			1.10			
BOKA	79-80,82-84	79	5	0.39	0.00			0.20			1.34			
BOYU	80-00	81-82,85-87,89,94-95,97	21	0.12	0.00	0.00	0.00	0.07	0.13	0.27	0.65	1.86	0.366	None
BROA	85-91,93-97,99-00		14	0.71	0.52		0.67	0.71	0.78		0.84	0.15		
BROW	79-91,97-00	80,85-87	17	0.77	0.00		0.08	0.75	1.25		1.75	1.56		
BRUC	82-84		3	1.06	1.02			1.07			1.08			
BRYD	79-00	79-82,85-87,95-96,99	22	0.70	0.00	0.00	0.00	0.43	1.48	1.82	1.88	3.44	0.168	None
BYEN	79-93,95-00		21	2.26	1.28	2.01	2.27	2.34	2.41	2.45	2.48	0.06	0.485	None
CAIR	80-84	80-84	5	0.00	0.00			0.00			0.00			
CAME	80-84	81	5	0.16	0.00			0.17			0.31			
CAMP	79-91,99-00	79-80,83,85-87,91	15	0.36	0.00		0.00	0.21	0.61		1.47	2.90		
CAPA	80-84	80,82	5	0.32	0.00			0.36			0.70			
CASU	79-94,96-00	79,87	22	0.78	0.00	0.08	0.64	0.95	0.99	1.06	1.21	0.37	0.156	None
CHAN	79-00		22	0.77	0.55	0.70	0.74	0.77	0.81	0.82	0.88	0.09	0.671	None
CHIT	79-84		6	1.40	1.31			1.42			1.45			
CLIF	85-00		17	4.33	4.09		4.20	4.35	4.41		4.55	0.05		
CMBG	99-00		2	2.76	2.64			2.76			2.88			
COBL	79-91		13	2.62	0.91		1.27	2.60	3.22		5.06	0.75		
COOM	79-84,98-00	79-80	10	0.73	0.00		0.45	0.87	0.95		1.31	0.57		
CORR	82-92,94-00	85,87,98	19	0.69	0.00		0.53	0.75	0.99		1.21	0.61		
COYR	79-00	79,87	22	1.18	0.00	0.07	0.25	1.30	1.92	2.18	2.32	1.28	0.368	None
CRAC	80-00	80,82	21	0.87	0.00	0.05	0.96	1.00	1.03	1.10	1.11	0.07	0.002	Increasing
CRAN	80-84		5	0.15	0.02			0.11			0.34			
CRON	81-84,95	82-84	5	0.44	0.00			0.00			2.00			
DAVI	93-00		8	4.50	4.33			4.51			4.66			
DOBA	80-96,98-00	80,85,89,94,00	20	0.32	0.00	0.00	0.09	0.37	0.49	0.53	0.78	1.08	0.84	None
DOWE	79-80	79-80	2	0.00	0.00			0.00			0.00			
DULB	79,82-00	79,84-87,89,95	20	0.43	0.00	0.00	0.00	0.65	0.70	0.72	0.76	1.08	0.02	Increasing
DUMB	79-00		22	1.61	0.07	0.26	0.52	1.59	2.43	3.15	4.45	1.20	0.676	None
DUND	79-91	82-83,85-91	13	0.06	0.00		0.00	0.00	0.12		0.34	Undefined		

Appendix 3: Cont.

Code	Years measured (=n)	DRY/BD	n	mean	min	10%	25%	50%	75%	90%	max	Variability (75%-25%) /50%	p value	Trend
EGAN	79-91,93,95-00	80	21	1.77	0.00	0.82	1.52	2.17	2.30	2.34	2.45	0.36	0.046	Increasing
EGRE	85-00	87,89-95,97-98	16	0.14	0.00		0.00	0.00	0.34		0.55	Undefined		
ELLE	79-84	79	7	0.16	0.00			0.17			0.27			
ENEM	80-91	80	12	1.47	0.00		0.87	1.37	2.43		2.52	1.14		
ESP1	81-96,98-00	81-83,85,94-96	19	0.64	0.00		0.00	0.40	1.12		2.24	2.80		
ESP2	81-84	81-83	4	0.00	0.00			0.00			0.01			
ESP3	81-91,00	81-83,85,87-91,00	12	0.01	0.00		0.00	0.00	0.00		0.08	Indeterminate		
ESP4	82-83	82-83	2	0.00	0.00			0.00			0.00			
ESP5	81-83	81-83	3	0.00	0.00			0.00			0.00			
FLAG	79-91,97-00	79	17	0.57	0.00		0.25	0.41	0.71		1.64	1.12		
FORR	79-00		25	0.73	0.16	0.32	0.54	0.72	0.97	1.09	1.35	0.60	0.098	None
FRAS	00		1	1.05	1.05			1.05			1.05			
GARD	81-84		4	2.03	2.00			2.03			2.08			
GIBB	92-00		9	0.48	0.34			0.48			0.62			
GING	79-84		6	1.97	1.48			2.05			2.14			
GNO1	80-91	81,85,87,89	12	0.19	0.00		0.00	0.05	0.17		0.84	3.40		
GNO2	82-84	82,84	3	0.05	0.00			0.00			0.16			
GOON	00	00	1	0.00	0.00			0.00			0.00			
GOOR	00	00	1	0.00	0.00			0.00			0.00			
GORE	79-00		22	1.44	0.58	0.89	1.19	1.46	1.66	1.73	2.84	0.32	0.688	None
GOUN	80-91	80,85,87	12	0.39	0.00		0.08	0.16	0.35		1.72	1.69		
GUND	79-91		13	1.32	0.48		0.88	1.40	1.65		2.12	0.55		
GURA	82-00		19	1.60	0.18		0.80	1.80	2.24		3.40	0.80		
HARV	80-00		21	1.23	0.66	0.96	1.05	1.22	1.46	1.60	1.64	0.34	0.627	None
HEBI	00	00	1	0.00	0.00			0.00			0.00			
HIND	79-91,97-00	79-80	17	0.88	0.00		0.30	0.48	1.05		4.23	1.56		
JAND	81,83-90,92-00		18	1.12	0.86		0.98	1.12	1.25		1.42	0.24		
JASP	85-93,95-00		15	9.55	9.14		9.54	9.59	9.61		9.68	0.01		
JERD	79-00	96	22	1.71	0.00	0.26	0.61	1.42	2.69	3.36	4.13	1.46	0.527	None
JOON	79,81-90,92-00		20	2.99	2.58	2.66	2.85	3.00	3.09	3.18	3.62	0.08	0.308	None
KARA	79-84		6	0.80	0.55			0.83			0.98			
KENT	80-84,00	80-84	6	0.05	0.00			0.00			0.27			
KOND	79-91	80,88	13	0.64	0.00		0.15	0.25	0.87		2.31	2.88		
KWOB	79-91	80-81,85-87	13	0.36	0.00		0.00	0.16	0.71		1.07	4.44		
KWOR	79-00		22	0.44	0.05	0.14	0.21	0.38	0.66	0.87	1.27	1.18	0.522	None
LITT	79-80,82-91,97-00	79,00	16	0.55	0.00		0.22	0.55	0.83		1.30	1.11		
LOGU	79-00	79-80, 85,87,90,94, 97-98	22	0.90	0.00	0.00	0.00	0.47	1.48	2.32	3.65	3.15	0.27	None
MARI	93-00		8	6.23	6.13			6.22			6.36			
MART	79-91,97-00	79,87	17	0.72	0.00		0.33	0.64	1.22		1.72	1.39		
MCLA	94,97-00		7	1.08	0.75			1.04			1.37			
MEAR	79-91,97-00	80,87	17	0.84	0.00		0.50	0.72	1.02		2.03	0.72		
METT	82-00	96	19	0.51	0.00		0.25	0.47	0.68		1.21	0.91		
MIRI	81-84		4	0.72	0.43			0.70			1.06			
MLGR	00		1	1.58	1.58			1.58			1.58			
MOAT	79-00		22	4.34	4.22	4.26	4.30	4.34	4.38	4.44	4.51	0.02	0.134	None
MOLL	80-84	80,82-84	5	0.00	0.00			0.00			0.01			

Appendix 3: Cont.

Code	Years measured (=n)	DRY/BD	n	mean	min	10%	25%	50%	75%	90%	max	Variability (75%-25%) /50%	p value	Trend
MORT	00		1	3.15	3.15			3.15			3.15			
MTMA	81-91	82-88,90-91	11	0.05	0.00		0.00	0.00	0.00		0.54	Indeterminate		
MUIR	79-00		22	0.85	0.26	0.60	0.70	0.86	1.00	1.10	1.31	0.35	0.073	None
MUNG	79-84		6	0.36	0.10			0.34			0.70			
MURA	81-84		4	0.70	0.18			0.74			1.15			
MURR	80-84		5	0.44	0.32			0.44			0.57			
NAMB	79-84	79	6	0.24	0.00			0.26			0.49			
NGOP	00		1	0.10	0.10			0.10			0.10			
NINA	79-91,98-00	80	16	1.22	0.00		0.83	1.15	1.79		2.24	0.83		
NINE	81-00		20	1.35	0.63	0.89	1.07	1.43	1.62	1.78	1.96	0.38	0.0001	Decreasing
NONA	79-84	79	6	0.63	0.00			0.73			0.88			
NOOB	99-00		2	1.39	1.29			1.39			1.49			
NOON	79,81-91,98-00	85,91,98	15	0.69	0.00		0.28	0.85	1.11		1.19	0.98		
NPAR	00		1	0.35	0.35			0.35			0.35			
OWIN	92-00		9	1.26	1.17			1.27			1.37			
PABE	00	00	1	0.00	0.00			0.00			0.00			
PALL	80-91	80,82-91	12	0.00	0.00		0.00	0.00	0.00		0.04	Indeterminate		
PARK	79-91,97-00	79	17	0.84	0.00		0.33	0.92	1.25		1.84	1.00		
PILL	00		1	0.23	0.23			0.23			0.23			
PINJ	79-91	80,87,89	13	1.00	0.00		0.50	0.85	1.61		2.14	1.31		
PLAN	79-84,93-96		10	0.79	0.38		0.49	0.59	0.93		1.69	0.75		
PLEA	79-00		22	1.01	0.08	0.46	0.72	0.91	1.22	1.63	2.20	0.55	0.961	None
POOR	79-93,95-00	87	21	0.49	0.00	0.44	0.48	0.52	0.55	0.60	0.61	0.13	0.54	None
POWE	81-00		20	0.82	0.45	0.61	0.71	0.86	0.95	0.96	1.06	0.28	0.205	None
QUEE	79-84	79	6	1.12	0.00			1.16			2.34			
RANG	00		1	1.21	1.21			1.21			1.21			
REDB	81-84	82-84	4	0.01	0.00			0.00			0.04			
REDM	81-91	87	11	0.86	0.00		0.14	0.32	2.00		2.06	5.81		
RONN	00		1	1.91	1.91			1.91			1.91			
SHAR	79-00		22	2.15	1.66	1.79	1.92	2.25	2.38	2.40	2.48	0.20	0.274	None
SHAS	79-91	82,91	13	0.41	0.00		0.17	0.34	0.62		1.04	1.32		
STAT	80-00		21	0.60	0.05	0.53	0.58	0.64	0.66	0.70	0.71	0.13	0.096	None
STRE	79-91	79-80,90	13	0.64	0.00		0.03	0.92	1.22		1.27	1.29		
TAAR	79-80,82-96,98-00	79-80,82,86-89,95,00	20	0.26	0.00	0.00	0.00	0.05	0.21	0.80	2.00	4.20	0.87	None
THOM	79-00		22	1.00	0.17	0.42	0.79	0.98	1.22	1.52	2.02	0.44	0.864	None
TOOL	79,82-96,98-00	79,85-87,89,95,98-00	19	0.68	0.00		0.00	0.60	1.08		1.93	1.80		
TORD	79-93,95-00		21	2.51	1.29	1.94	2.51	2.57	2.72	2.84	2.91	0.08	0.95	None
TOWE	79-00		22	2.67	0.54	1.15	2.37	3.08	3.25	3.37	3.47	0.29	0.002	Increasing
TWIN	79-84	79-84	7	0.00	0.00			0.00			0.00			
UNIC	80-00		21	1.20	0.03	0.19	0.64	1.45	1.74	1.85	2.12	0.76	0.0007	Increasing
VARL	81-91,00	81-83,85-90	12	0.06	0.00		0.00	0.00	0.01		0.65	Undefined		
WAGI	82-84		3	0.67	0.25			0.55			1.20			
WALB	79-80,82-96,98-00	79-80,85-87,89,00	21	0.43	0.00	0.00	0.00	0.32	0.87	0.91	0.96	2.72	0.34	None
WALL	81-84		4	0.75	0.47			0.78			0.97			
WALY	79-91,97-00	80,87,97	17	0.42	0.00		0.04	0.37	0.57		1.29	1.43		
WANN	79-00		22	1.26	0.92	1.17	1.23	1.28	1.32	1.34	1.37	0.07	0.314	None

Appendix 3: Cont.

Code	Years measured (=n)	DRY/BD	n	mean	min	10%	25%	50%	75%	90%	max	Variability (75%-25%) /50%	p value	Trend
WARD	79-00		22	1.26	0.10	0.42	0.66	1.11	1.87	2.29	2.65	1.09	0.045	Increasing
WARG	79-91	87	13	0.79	0.00		0.66	1.01	1.03		1.04	0.37		
WARR	80-00	82,85,87	21	0.32	0.00	0.00	0.14	0.23	0.48	0.64	0.99	1.48	0.006	Increasing
WEST	80-91,97-00	80,86-87,97,00	16	0.49	0.00		0.00	0.66	0.84		0.90	1.27		
WHEA	99-00	99	2	0.93	0.00			0.93			1.85			
WHIA	81-84	83	4	0.08	0.00			0.04			0.23			
WHIN	82-84,98-00	82,99-00	6	0.48	0.00			0.01			1.88			
WHIW	81-91,97,99-00	82,85-89	14	0.39	0.00		0.00	0.04	0.62		1.70	15.50		
WILD	81-84		4	0.69	0.21			0.69			1.17			
WILS	92-93,95-00		8	3.64	3.46			3.69			3.80			
YAAL	82-96,98-00	86-87,96	18	1.40	0.00		0.75	1.45	2.01		2.91	0.87		
YARN	80-00		21	0.93	0.67	0.80	0.91	0.94	0.97	0.99	1.06	0.06	0.156	None
YARR	81-84,97-99	97	7	0.18	0.00			0.05			0.87			
YEAL	78-91,93-00		22	1.48	0.32	0.78	1.08	1.67	1.86	2.01	2.15	0.47	0.136	None
YELL	85-00		16	3.15	0.75		2.39	3.23	4.19		4.76	0.56		
YURI	79-91		13	1.37	0.32		0.93	1.50	1.75		2.20	0.55		

Notes:

1. All data on which this Appendix is based were collected during the November 'routine survey period', that is, within the nine-day period commencing on the first Saturday of November each year.
2. Depths are in metres, at deepest point in each wetland.
3. 'Dry/BD' means Dry (lake was dry when visited) or Believed Dry (lake was not visited but believed to be dry).
4. 25% and 75% percentiles calculated where n ≥ 10.
5. 10% and 90% percentiles calculated where n ≥ 20.
6. Variability calculated using (75% - 25%) / 50%.
7. p value from regression analysis performed using SAS on wetlands with ≥ 20 years of September or November depth data.

Appendix 4: September salinities (years monitored, years dry, means, percentiles, ranges, variability, trends) of all 151 monitored wetlands (parts per thousand).

Code	Years measured (=n)	DRY / BD	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%) /50%	p value	Trend
ACE	81-84	80	4	168.35	108.00			170.20			225.00			
ALB1	81-84,98,00		6	1.25	0.29			1.16			2.75			
ALB2	80-84		5	0.26	0.08			0.30			0.40			
ALTH	81-91,00		12	113.70	6.50		52.25	110.15	179.25		229.20	1.15		
ANDE	81-91,00		12	153.32	13.25		78.00	130.25	217.20		350.00	1.07		
ANGO	81-84,90		5	0.57	0.33			0.60			0.70			
ARDA	00		1	43.70	43.70			43.70			43.70			
ATKI	00		1	1.06	1.06			1.06			1.06			
BAMB	79,81,83-93,95-00		19	0.91	0.63		0.76	0.81	1.05		1.30	0.36		
BENN	92-00		9	43.33	4.12			15.10			183.50			
BEVE	79-00		22	58.02	2.50	14.64	19.40	31.18	67.95	132.18	270.66	1.56	0.4825	None
BIDD	82-84		3	60.77	16.10			79.20			87.00			
BLUE	00		1	22.10	22.10			22.10			22.10			
BOA1	92,93,95-00		8	0.60	0.46			0.57			0.78			
BOKA	80-84	79	5	42.23	1.41			17.20			150.40			
BOYU	81,83-85,88-92,95-00	80, 82, 86, 87	15	0.40	0.12		0.19	0.27	0.42		1.77	0.85		
BROA	86-97,99-00		14	1.43	0.96		1.08	1.25	1.64		2.80	0.45		
BROW	79,81-91,97-00	80	16	28.83	4.43		14.39	17.65	26.90		155.50	0.71		
BRUC	82-84		3	128.67	112.00			126.00			148.00			
BRYD	81-84,87-94,97-00	79, 80, 85, 86, 95, 96	16	2.36	0.15		0.39	1.12	1.39		19.70	0.89	0.0131	Increasing
BYEN	77-92,94-00		23	3.60	1.53	2.29	2.59	3.43	4.40	5.18	6.82	0.53	0.0718	None
CAIR	80-84		5	203.82	113.60			165.00			350.00			
CAME	80-84		5	66.80	38.40			74.40			99.00			
CAMP	79,81-91,99-00	80	14	184.66	23.80		101.40	182.00	244.95		360.00	0.79		
CAPA	81-84		4	47.24	15.60			30.43			112.50			
CASU	80-00	79	21	29.13	1.85	5.20	8.55	10.30	23.50	93.40	153.00	1.45	0.8522	None
CHAN	79,81,83-00		20	0.77	0.45	0.56	0.61	0.71	0.86	1.12	1.30	0.35	0.0095	Decreasing
CHIT	79-85		7	3.06	1.70			2.80			4.90			
CLIF	86-92,94-00		14	20.44	15.10		17.40	20.60	22.35		28.40	0.24		
CMBG	00		1	1.92	1.92			1.92			1.92			
COBL	79-91		13	25.02	2.25		16.20	20.10	35.10		62.50	0.94		
COOM	79-84,97-00		10	48.67	2.75		16.81	27.35	45.53		180.00	1.05		
CORR	82-84,86,88-96,99-00	85, 87, 97	15	0.26	0.14		0.18	0.23	0.33		0.50	0.65		
COYR	79,81-00		21	29.72	1.05	3.60	4.30	12.00	36.70	71.40	182.50	2.70	0.4189	None
CRAC	81-00		20	0.78	0.40	0.52	0.61	0.74	0.96	1.05	1.20	0.47	0.0210	Increasing
CRAN	81-84		4	57.78	10.20			60.25			100.40			
CRON	81-82,84	83	3	0.43	0.19			0.40			0.70			
DAVI	91-00		10	1.63	1.33		1.62	1.66	1.69		1.82	0.04		
DOBA	81-00	80	20	0.08	0.02	0.03	0.03	0.04	0.07	0.11	0.50	1.00	0.0717	None

Appendix 4: Cont.

Code	Years measured (=n)	DRY / BD	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%) /50%	p value	Trend
DOWE	79-80,99		3	122.60	35.00			92.81			240.00			
DULB	81-84,88,90-94,96-00	79-80, 85-87, 89, 95	15	4.64	0.82		2.84	3.82	5.21		10.60	0.62	0.3833	None
DUMB	79-00		22	93.85	13.10	15.73	27.55	61.95	143.20	181.82	350.00	1.87	0.3389	None
DUND	84,86,89	80, 82, 91	3	152.37	90.30			157.40			209.40			
EGAN	79,81-00	80	21	35.69	8.50	9.93	13.30	19.00	42.50	109.80	121.20	1.54	0.6225	None
EGRE	85-89,91,95-00	90, 94	12	0.74	0.35		0.54	0.71	0.82		1.36	0.39		
ELLE			0											
ENEM	81-91		11	0.56	0.13		0.17	0.38	0.54		2.21	0.97		
ESP1	84,86-95,97-00	82-83, 85, 96	15	3.04	0.25		0.83	1.60	2.63		19.00	1.13		
ESP2	83-84	81-82	2	75.55	41.00			75.55			110.10			
ESP3	81-91,00		12	151.64	57.00		81.25	115.95	175.70		368.00	0.81		
ESP4	84	82-83	1	0.43	0.43			0.43			0.43			
ESP5	82-84	81	3	88.07	58.00			66.20			140.00			
FLAG	79-91,97-00		17	75.34	11.40		40.90	60.00	80.40		268.00	0.66		
FORR	81-00		20	1.55	0.80	1.07	1.20	1.47	1.77	2.11	3.00	0.39	0.3523	None
FRAS	00		1	0.60	0.60			0.60			0.60			
GARD	81-84,89-90		6	1.32	0.49			1.00			2.42			
GIBB	92-00		9	0.13	0.10			0.13			0.20			
GING	79,81,83-84		4	0.86	0.77			0.84			1.00			
GNO1	82-84,86,88-91	80-81, 85	8	45.24	6.10			54.10			83.50			
GNO2	83	82, 84	1	4.80	4.80			4.80			4.80			
GOON	00		1	0.05	0.05			0.05			0.05			
GOOR	00		1	170.00	170.00			170.00			170.00			
GORE	80-00		21	46.65	6.50	18.20	25.84	41.30	58.00	69.90	160.00	0.78	0.2105	None
GOUN	80-84,86-91	85	11	205.45	10.00		139.20	234.00	291.00		350.00	0.65		
GUND	79-91		13	44.63	5.55		21.50	30.25	52.60		125.00	1.03		
GURA	82-00		19	8.76	1.66		4.40	5.96	10.40		24.70	1.01		
HARV	81-92,95-00		18	0.45	0.17		0.27	0.45	0.59		0.87	0.71	0.7235	None
HEBI		00	0											
HIND	79,81-83,85-91,98-00		14	172.48	15.40		67.80	169.25	270.25		340.00	1.20		
JAND	81-00		20	0.29	0.11	0.17	0.19	0.24	0.34	0.46	0.80	0.63	0.3752	None
JASP	86-00		15	0.20	0.17		0.19	0.20	0.21		0.22	0.10		
JERD	80-00		21	49.57	4.10	7.15	11.14	34.20	57.00	100.80	206.00	1.34	0.7765	None
JOON	81-00		20	0.62	0.21	0.48	0.57	0.63	0.68	0.80	0.90	0.17	0.3197	None
KARA	79-84,87		7	0.34	0.13			0.31			0.65			
KENT	81-83,00	80, 84	4	0.70	0.36			0.72			1.00			
KOND	79,81-91		12	205.41	27.70		83.90	230.50	329.25		350.00	1.06		
KWOB	79,82-85,88-91	80-81, 86-87	9	5.98	0.42			7.25			14.50			
KWOR	80-92,95-00		19	20.89	4.30		14.00	18.10	25.00		46.20	0.61		

Appendix 4: Cont.

Code	Years measured (=n)	DRY / BD	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%) /50%	p value	Trend
LITT	79-91,97-00		17	35.35	6.55		12.98	19.42	50.40		156.00	1.93		
LOGU	79,81-84,86-89,91-93,95-00	90, 94	18	2.16	0.40		1.26	1.77	2.26		5.13	0.56	0.0242	Increasing
MARI	95-00		6	0.21	0.18			0.22			0.24			
MART	79-91,97-00		17	24.61	5.30		15.50	18.70	27.50		71.70	0.64		
MCLA	94,96-00		6	1.19	0.53			1.17			1.89			
MEAR	79,82-91,97-00	80	15	41.48	4.20		16.60	20.90	59.70		158.00	2.06		
METT	82-92,95,97-00	96	16	0.34	0.08		0.15	0.22	0.49		1.12	1.55		
MIRI	81-84		4	7.26	3.30			7.03			11.70			
MLGR	00		1	0.36	0.36			0.36			0.36			
MOAT	80-92,95-00		19	0.45	0.21		0.35	0.44	0.57		0.61	0.50		
MOLL	83-84	80-82	2	75.25	56.00			75.25			94.50			
MORT	00		1	2.77	2.77			2.77			2.77			
MTMA	81,84-86,88-89	87, 90-91	6	151.95	6.50			118.00			344.00			
MUIR	80-92,94-00		20	8.59	0.72	0.95	1.49	5.94	10.38	14.29	57.00	1.50	0.9576	None
MUNG	79-81,83-84		5	2.95	1.34			3.80			4.20			
MURA	81-84		4	24.43	9.50			20.10			48.00			
MURR	80-84		5	0.48	0.30			0.47			0.60			
NAMB	79-81,83-84		5	2.76	1.20			3.40			4.05			
NGOP	00		1	0.12	0.12			0.12			0.12			
NINA	79-91,97-00		17	82.07	13.60		44.80	77.60	122.00		167.20	0.99		
NINE	81-92,94-00		19	0.34	0.24		0.30	0.33	0.36		0.50	0.18		
NONA	79-84		6	12.78	5.04			12.31			21.20			
NOOB	99-00		2	0.83	0.82			0.83			0.83			
NOON	79,81-91,97-00	80	16	35.55	3.50		5.40	15.50	51.48		123.10	2.97		
NPAR	00		1	30.20	30.20			30.20			30.20			
OWIN	92-93,95-00		8	0.28	0.19			0.26			0.47			
PABE		00	0											
PALL	80,84	82-83, 85-86, 91	2	291.50	233.00			291.50			350.00			
PARK	79-91,97-00		17	44.59	6.75		20.40	24.70	71.30		114.00	2.06		
PILL	00		1	0.91	0.91			0.91			0.91			
PINJ	79-86,88,90-91	87	11	68.80	11.60		19.83	54.50	112.25		172.80	1.70		
PLAN	80-84,95-96		7	137.33	101.00			140.30			165.00			
PLEA	80-92,95-00		19	0.49	0.09		0.28	0.50	0.63		0.88	0.70		
POOR	77-92,94-00		24	0.31	0.11	0.14	0.16	0.22	0.40	0.40	1.51	1.09	0.0023	Decreasing
POWE	81-92,95-00		18	0.51	0.23		0.35	0.39	0.55		1.12	0.51		
QUEE	79-84		6	40.45	9.60			23.80			112.40			

Appendix 4: Cont.

Code	Years measured (=n)	DRY / BD	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%) /50%	p value	Trend
RANG	00		1	0.21	0.21			0.21			0.21			
REDB	81-84,00		5	85.98	29.60			83.80			150.30			
REDM	82-91		10	4.62	1.03		1.65	3.55	6.33		11.10	1.32		
RONN	00		1	10.35	10.35			10.35			10.35			
SHAR	80-00		21	1.35	0.46	0.77	0.86	1.44	1.60	2.15	2.24	0.51	0.8595	None
SHAS	80-81,83-91		11	23.94	7.50		15.05	21.80	27.60		60.60	0.58		
STAT	80-00		21	13.51	5.70	7.60	10.40	12.14	15.40	17.90	41.60	0.41	0.2180	None
STRE	79,81,84-91	80, 82	10	19.96	3.50		5.05	6.40	32.55		73.00	4.30		
TAAR	81-85,87-88,90-99	79-80, 86, 89, 00	17	15.70	1.04		5.90	11.00	26.30		40.90	1.85	0.9551	None
THOM	81-00		20	1.30	0.52	0.79	0.91	1.23	1.58	2.14	2.25	0.54	0.0092	Increasing
TOOL	81-84,88,90-99	79-80, 85-87, 89, 00	15	5.86	0.96		2.49	3.40	8.45		21.00	1.75	0.0055	Increasing
TORD	77-92,94-00		24	1.18	0.07	0.76	1.00	1.09	1.21	1.41	3.00	0.19	0.1955	None
TOWE	79-92,95-00		20	10.30	3.63	4.98	5.32	7.90	12.35	16.28	30.00	0.89	0.0123	Decreasing
TWIN			0											
UNIC	81-92,94-00		19	4.42	1.09		2.75	4.46	5.50		9.10	0.62	0.8674	None
VARL	81-84,86-91,00	85	11	115.82	20.30		83.90	121.00	133.60		233.00	0.41		
WAGI	82-84		3	20.00	5.20			12.30			42.50			
WALB	81-00	79-80	20	4.10	0.45	0.85	1.15	2.70	6.34	8.74	11.30	1.92	0.2531	None
WALL	81,83-84		3	1.51	0.82			1.10			2.60			
WALY	79,81-91,97-00	80	16	17.53	5.32		11.58	15.05	22.65		37.20	0.74		
WANN	79-00		22	6.85	3.10	3.80	4.80	7.66	8.40	9.30	11.70	0.47	0.8754	None
WARD	80-00		21	62.01	15.00	23.80	29.40	49.00	73.80	86.00	219.60	0.91	0.1839	None
WARG	79-91		13	12.32	1.95		8.90	10.55	17.60		27.90	0.82		
WARR	80-81,83-86,88-92,95-00	82, 87	17	0.14	0.08		0.10	0.11	0.16		0.40	0.55		
WEST	80-86,88-91,97-00	87	15	15.80	2.25		5.95	9.20	21.95		53.25	1.74		
WHEA	00		1	6.56	6.56			6.56			6.56			
WHIA	81-82,84,98	83	4	0.50	0.13			0.56			0.75			
WHIN	81-84,97-00		8	28.14	3.28			25.30			55.60			
WHIW	81-84,88-91,97-00	85	12	26.68	4.14		12.07	28.80	35.50		55.89	0.81		
WILD	81-84		4	6.33	2.20			6.05			11.00			
WILS	92-00		9	0.13	0.10			0.13			0.17			
YAAL	82-85,88-00	86-87	17	3.56	0.12		0.40	0.56	0.90		30.90	0.89		
YARN	80-92,94-00		20	1.44	0.54	0.80	0.89	1.66	1.88	2.06	2.25	0.60	0.0019	Increasing
YARR	81-84,97-00		8	188.03	57.80			176.45			369.00			
YEAL	79-00		22	28.19	0.43	11.43	14.73	20.60	25.93	31.43	195.20	0.54	0.6780	None
YELL	86-92,95-00		13	5.22	0.98		1.64	3.90	7.92		15.50	1.61		
YURI	79,81,83-91		11	1.20	0.47		0.56	0.85	1.62		3.25	1.25		

Appendix 4: Cont.

Notes:

1. All data on which this Appendix is based were collected during the September 'routine survey period', that is, within the nine-day period commencing on the second Saturday of September each year.
2. Salinities are in parts per thousand (ppt).
3. 'Dry/BD' means Dry (lake was dry when visited) or Believed Dry (lake was not visited but believed to be dry).
4. 25% and 75% percentiles calculated where $n \geq 10$.
5. 10% and 90% percentiles calculated where $n \geq 20$.
6. Variability calculated using (75% - 25%) / 50%.
7. p value from regression analysis performed using SAS on wetlands with ≥ 20 years of September or November depth data.

Appendix 5: November salinities (years monitored, years dry, means, percentiles, ranges, variability, trends) of all 151 monitored wetlands (parts per thousand).

Code	Years measured (=n)	DRY/BD	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%) /50%	p value	Trend
ACE	84	80, 82, 83	1	252.00	252.00			252.00			252.00			
ALB1	81-84,98-00		7	1.56	0.73			1.50			3.26			
ALB2	80-84		5	0.50	0.15			0.46			0.80			
ALTH	83-84,88,90-91	81-82, 85-87, 89, 00	5	92.80	12.50			29.50			219.00			
ANDE	81-91,00		12	166.18	21.30		97.95	151.00	227.65		346.00	0.86		
ANGO	79,81-84		5	0.66	0.35			0.67			0.90			
ARDA	99-00		2	60.84	60.38			60.84			61.30			
ATKI	00		1	1.31	1.31			1.31			1.31			
BAMB	79-00		22	1.05	0.71	0.80	0.84	0.92	1.21	1.49	1.70	0.40	0.0001	Decreasing
BENN	92-98,00	99	8	36.96	4.82			19.65			153.80			
BEVE	79-93,95-00	94	21	76.08	14.72	23.70	30.70	38.03	120.80	177.60	216.00	2.37	0.0280	Decreasing
BIDD	82-84		3	208.53	27.00			225.60			373.00			
BLUE	99-00		2	22.95	6.89			22.95			39.00			
BOA1	92-00		9	0.69	0.57			0.69			0.84			
BOKA	80,82-84	79	4	94.29	2.05			88.55			198.00			
BOYU	80,83-84,88,90-93,96,98-00	81-82, 85-87, 89, 94-95, 97	12	0.54	0.29		0.37	0.43	0.68		1.01	0.72	0.0757	None
BROA	85-91,93-00		15	2.47	1.70		1.96	2.37	2.90		3.70	0.40		
BROW	79,81-84,88-91,97-00	80, 85-87	13	28.96	5.50		19.95	21.50	31.70		111.20	0.55		
BRUC	82-84		3	150.80	138.40			152.00			162.00			
BRYD	83-84,88-94,97-98,00	79-82, 85-87, 95-96, 99	12	1.76	0.18		0.42	1.06	1.63		7.40	1.14	0.0030	Increasing
BYEN	79-93,95-00		21	3.83	1.38	2.52	2.80	3.30	4.20	5.14	9.40	0.42	0.4458	None
CAIR		80-84	0											
CAME	80,82-84	81	4	140.35	88.00			134.20			205.00			
CAMP	81-82,84,88-90,99-00	79-80, 83, 85-87, 91	8	185.05	38.40			153.14			354.00			
CAPA	81,83-84	80, 82	3	40.33	29.10			34.50			57.40			
CASU	80-86,88-00	79, 87	20	33.17	6.30	8.54	11.74	15.76	28.37	62.14	167.10	1.06	0.6582	None
CHAN	79-00		22	1.24	0.74	0.91	1.00	1.20	1.36	1.79	2.10	0.30	0.0760	None
CHIT	79-84		6	3.82	2.98			3.78			4.75			
CLIF	85-00		16	21.22	16.50		17.98	20.72	23.90		26.05	0.29		
CMBG	99-00		2	2.79	2.11			2.79			3.46			
COBL	79-91		13	41.82	12.50		24.50	34.20	64.00		79.60	1.15		
COOM	81-84,97-00	79-80	8	33.76	5.60			29.96			71.60			
CORR	82-84,86,88-97,99-00	85, 87, 98	16	0.51	0.25		0.29	0.36	0.51		1.84	0.61		
COYR	81-86,88-00	79, 87	19	34.69	1.52		4.84	11.88	35.80		181.00	2.61	0.0737	None
CRAC	81,83-00	80, 82	19	1.02	0.68		0.84	1.06	1.15		1.40	0.29	0.4232	None
CRAN	80-81,83-84		4	147.25	51.00			113.00			312.00			
CRON	81,95	82-84	2	0.71	0.12			0.71			1.30			
DAVI	91,93-00		9	1.54	0.17			1.73			1.85			
DOBA	81-84,86-88,90-93,95-96,98-99	80, 85, 89, 94, 00	15	0.12	0.05		0.06	0.07	0.11		0.40	0.71	0.1266	None

Appendix 5: Cont.

Code	Years measured (=n)	DRY/BD	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%) /50%	p value	Trend
DOWE		79-80	0											
DULB	82-83,88,90-94,96-00	79, 84-87, 89, 95	13	11.18	3.75		5.95	9.60	10.90		32.90	0.52	0.5185	None
DUMB	79-00		22	106.34	13.00	20.96	35.13	69.30	155.14	232.24	351.10	1.73	0.4553	None
DUND	80	82-83, 85-91	1	310.00	310.00			310.00			310.00			
EGAN	79,81-91,93-00	80	20	58.92	12.30	16.62	19.75	26.78	61.23	156.11	240.00	1.55	0.7822	None
EGRE	85-86,88,96,99-00	87, 89-95, 97-98	6	0.91	0.68			0.89			1.26			
ELLE		79	0											
ENEM	81-91	80	11	0.91	0.16		0.21	0.44	0.83		4.55	1.41		
ESP1	84,86-93,98-00	81-83, 85, 94-96	12	2.16	0.28		0.68	1.50	2.16		9.68	0.99		
ESP2		81-83	0											
ESP3	84,86	81-83, 85, 87-91, 00	2	314.80	309.60			314.80			320.00			
ESP4		82-83	0											
ESP5		81-83	0											
FLAG	80-86,88-91,97-00	79	15	92.48	14.60		53.40	91.20	122.24		269.00	0.75		
FORR	79-00		22	2.32	0.98	1.14	1.62	1.92	2.67	4.02	5.60	0.55	0.5633	None
FRAS	00		1	0.85	0.85			0.85			0.85			
GARD	81-84		4	1.62	1.30			1.46			2.25			
GIBB	92-00		9	0.22	0.14			0.19			0.50			
GING	79-84		6	1.22	0.70			1.04			2.10			
GNO1	80,82-83,86,88,90-91	81, 85, 87, 89	7	90.71	14.70			96.50			195.00			
GNO2	83	82, 84	1	23.00	23.00			23.00			23.00			
GOON	99	00	1	0.19	0.19			0.19			0.19			
GOOR		00	0											
GORE	79-00		22	56.15	8.80	18.34	28.15	49.17	63.05	84.22	250.00	0.71	0.3218	None
GOUN	81-82,84,86,88-91	80, 85, 87	8	219.68	16.70			244.00			410.00			
GUND	79-91		13	65.98	12.00		27.30	37.00	83.60		218.00	1.52		
GURA	82-00		19	22.14	2.20		5.06	7.00	11.47		223.00	0.92		
HARV	80-00		21	0.50	0.19	0.19	0.35	0.50	0.62	0.76	0.92	0.54	0.8179	None
HEBI		00	0											
HIND	81-91,97-00	79-80	15	191.04	17.48		83.40	146.80	304.50		456.00	1.51		
JAND	81,83-90,92-00		18	0.32	0.22		0.26	0.27	0.37		0.60	0.41		
JASP	85-93,95-00		15	0.21	0.19		0.19	0.22	0.23		0.23	0.18		
JERD	79-95,97-00	96	21	56.13	5.00	8.40	10.10	30.50	75.15	150.60	200.00	2.13	0.7666	None
JOON	79,81-90,92-00		20	0.76	0.54	0.62	0.67	0.72	0.82	1.00	1.20	0.21	0.3637	None
KARA	79-84		6	1.12	0.67			0.98			1.80			
KENT	00	80-84	1	0.72	0.72			0.72			0.72			
KOND	79,81-84,86-87,89-91	80, 88	10	203.92	3.77		121.60	201.50	313.75		380.00	0.95		
KWOB	79,82-84,88-91	80-81, 85-87	8	12.83	1.04			9.48			35.90			
KWOR	79-81,83-00		21	33.14	6.00	15.10	17.70	24.65	44.80	55.90	123.00	1.10	0.3035	None
LITT	80,82-91,97-99	79, 00	14	46.70	6.70		16.83	20.12	53.50		149.60	1.82		
LOGU	81-84,86,88-89,91-93,95-96,99-00	79-80, 85, 87, 90, 94, 97-98	14	3.09	1.13		1.74	2.21	2.74		12.06	0.45	0.8889	None
MARI	93-00		8	0.23	0.20			0.22			0.27			

Appendix 5: Cont.

Code	Years measured (=n)	DRY/BD	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%) /50%	p value	Trend
MART	80-86,88-91,97-00	79, 87	15	24.52	7.30		13.38	19.25	29.35		51.43	0.83		
MCLA	93-94,96-00		7	1.82	1.27			1.63			2.69			
MEAR	79,81-86,88-91,97-00	80, 87	15	46.62	5.00		20.30	27.60	69.40		136.40	1.78		
METT	83-95,97-00	96	17	0.34	0.10		0.19	0.24	0.46		0.83	1.13		
MIRI	81-84		4	9.29	4.50			9.93			12.80			
MLGR	00		1	0.43	0.43			0.43			0.43			
MOAT	79-00		22	0.48	0.30	0.35	0.39	0.46	0.57	0.64	0.70	0.39	0.8254	None
MOLL	81	80, 82-84	1	25.00	25.00			25.00			25.00			
MORT	00		1	3.37	3.37			3.37			3.37			
MTMA	81,89	82-88, 90-91	2	17.75	13.20			17.75			22.30			
MUIR	79-81,83-88,90-00		20	14.65	0.58	1.94	5.83	10.81	17.98	23.17	60.60	1.12	0.9136	None
MUNG	79-84		6	7.58	2.60			7.20			14.40			
MURA	81-84		4	46.93	15.00			40.15			92.40			
MURR	80-84		5	0.66	0.40			0.74			0.80			
NAMB	80-84	79	5	10.09	3.40			7.95			25.20			
NGOP	00		1	0.44	0.44			0.44			0.44			
NINA	79,81-91,97-00	80	16	120.49	23.40		53.20	108.67	163.98		340.00	1.02		
NINE	81-00		20	0.39	0.28	0.29	0.31	0.36	0.43	0.51	0.70	0.33	0.9749	None
NONA	80-84	79	5	15.87	10.50			14.50			22.00			
NOOB	99-00		2	1.11	1.02			1.11			1.19			
NOON	79,81-84,86-90,99-00	85, 91, 98	12	24.85	4.00		8.43	12.27	30.46		85.50	1.80		
NPAR	00		1	56.90	56.90			56.90			56.90			
OWIN	92-00		9	0.89	0.40			0.66			1.43			
PABE		00	0											
PALL		80, 82-91	0											
PARK	80-91,97-00	79	16	73.36	9.00		25.11	29.83	102.90		296.00	2.61		
PILL	00		1	1.58	1.58			1.58			1.58			
PINJ	79,81-86,88,90-91	80, 87, 89	10	105.19	17.50		24.48	102.05	160.00		244.00	1.33		
PLAN	79-84,93-96		10	183.11	36.65		116.95	180.75	218.58		346.00	0.56		
PLEA	79-00		22	0.56	0.19	0.29	0.29	0.58	0.70	0.88	1.41	0.71	0.2491	None
POOR	79-86,88-93,95-00	87	20	0.30	0.10	0.21	0.22	0.26	0.33	0.43	0.80	0.42	0.1359	None
POWE	81-00		20	0.86	0.35	0.40	0.50	0.65	1.06	1.42	2.47	0.86	0.5462	None
QUEE	80-84	79	5	43.96	12.40			24.20			125.50			
RANG	00		1	0.25	0.25			0.25			0.25			
REDB	81	82-84	1	54.00	54.00			54.00			54.00			
REDM	81,83-86,88-91	87	9	5.57	1.14			5.25			14.50			
RONN	00		1	13.21	13.21			13.21			13.21			
SHAR	79-00		22	1.41	0.55	0.80	0.96	1.43	1.76	2.11	2.54	0.56	0.9322	None
SHAS	79-81,83-90	82, 91	11	53.60	9.40		21.60	39.80	69.80		178.40	1.21		
STAT	80-00		21	30.71	7.97	14.38	15.10	16.55	21.00	25.00	297.00	0.36	0.1759	None
STRE	81-89,91	79-80, 90	10	79.45	6.30		7.64	9.25	114.30		296.00	11.53		
TAAR	83-85,90-94,96,98-99	79-80, 82, 86-89, 95, 00	11	33.61	1.51		10.43	23.81	27.74		117.00	0.73	0.6194	None
THOM	79-00		22	1.75	0.69	0.83	1.00	1.40	1.89	3.62	4.76	0.64	0.0670	None

Appendix 5: Cont.

Code	Years measured (=n)	DRY/BD	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%) /50%	p value	Trend
TOOL	82-84,88,90-94,96	79, 85-87, 89, 95, 98-00	10	5.78	1.33		3.10	4.40	5.48		19.60	0.54		
TORD	79-93,95-00		21	1.25	0.65	0.84	0.91	1.20	1.26	1.58	3.10	0.29	0.9024	None
TOWE	79-00		22	12.21	3.22	5.42	5.78	10.77	13.35	17.19	45.70	0.70	0.0106	Decreasing
TWIN		79-84	0											
UNIC	80-00		21	7.12	1.14	2.33	3.28	4.39	6.21	13.50	41.60	0.67	0.2209	None
VARL	84,91,00	81-83, 85-90	3	214.80	32.40			264.00			348.00			
WAGI	82-84		3	35.23	7.50			21.00			77.20			
WALB	82-84,88,90-99	79-80, 85-87, 89, 00	14	6.56	0.82		1.55	2.03	10.72		29.90	4.52	0.1551	None
WALL	81-84		4	3.23	1.25			3.20			5.25			
WALY	79,81-86,88-91,98-00	80, 87, 97	14	58.73	7.72		19.21	24.45	77.88		207.50	2.40		
WANN	79-00		22	8.56	3.85	4.35	6.13	8.90	10.02	12.18	16.00	0.44	0.5962	None
WARD	79-82,84-00		21	66.48	16.20	25.80	30.78	55.80	89.70	109.20	166.00	1.06	0.8528	None
WARG	79-86,88-00	87	12	18.33	4.00		9.01	12.25	23.08		72.00	1.15		
WARR	80-81,83-84,86,88-00	82, 85, 87	18	0.17	0.10		0.11	0.15	0.18		0.50	0.47	0.4646	None
WEST	81-85,88-91,98-99	80, 86-87, 97, 00	11	13.98	5.70		6.85	8.10	11.95		65.88	0.63		
WHEA	99-00		2	6.25	5.62			6.25			6.87			
WHIA	81-82,84	83	3	0.62	0.35			0.70			0.80			
WHIN	83-84,98	82, 99-00	3	37.63	3.40			16.60			92.88			
WHIW	81,83-84,90-91,97,99-00	82, 85-89	8	45.49	4.50			26.10			145.98			
WILD	81-84		4	7.64	2.60			7.63			12.70			
WILS	92-93,95-00		8	0.14	0.12			0.15			0.16			
YAAL	82-85,88-95,98-00	86-87, 96	15	1.19	0.16		0.34	0.69	0.93		7.43	0.86		
YARN	80-00		21	1.73	0.94	1.00	1.20	1.70	2.23	2.50	2.61	0.61	0.0001	Increasing
YARR	81-83,98-99	97	5	270.71	82.05			350.00			430.00			
YEAL	78-00		23	28.73	5.25	12.16	16.40	24.10	31.95	41.86	98.00	0.65	0.5982	None
YELL	85-00		16	5.22	1.03		1.84	3.55	6.91		17.70	1.43		
YURI	79-91		13	1.68	0.51		0.93	1.25	1.90		5.40	0.78		

Notes:

1. All data on which this Appendix is based were collected during the November ‘routine survey period’, that is, within the nine-day period commencing on the first Saturday of November each year.
2. Salinities are in parts per thousand (ppt).
3. ‘Dry/BD’ means Dry (lake was dry when visited) or Believed Dry (lake was not visited but believed to be dry).
4. 25% and 75% percentiles calculated where n ≥ 10.
5. 10% and 90% percentiles calculated where n ≥ 20.
6. Variability calculated using (75% - 25%) / 50%.
7. p value from regression analysis performed using SAS on wetlands with ≥ 20 years of September or November depth data.

Appendix 6a: Distance and direction to Meteorological sites closest to wetlands monitored for ≥ 20 years.

		Nearest Meteorological Site				Second nearest Meteorological Site			
Wetland	Code	Met. No.	Met. Name	Distance (km)	Bearing	Met. No.	Met. Name	Distance (km)	Bearing
Bambun	BAMB	9018	Gingin	8.5	15.2	9024	Marbling	24.2	123
Beverley	BEVE	10524	Brookton	20.4	225.4	10776	South Caroling	25.4	85.2
Boyup Brook 18239	BOYU	9525	Culicup Estate	5.7	198.8	9668	Kuranda	14.7	350.6
Bryde	BRYD	10692	Newdegate Res. Station	23.6	2	10618	Newdegate South	31.8	57.9
Byenup	BYEN	9506	Bangalup	18.5	90.1	9673	Bokerup	26.2	33.7
Casuarina	CASU	10649	Wayville	16.8	320.8	10508	Badgebup	17.6	85.8
Chandala	CHAN	9024	Marbling	12.9	118.8	9018	Gingin	16.6	335.9
Coyrecup	COYR	10526	Tammar Grove	10.9	175.5	10508	Badgebup	11.2	42.5
Crackers	CRAC	9210	Lake Namen	0.7	337.3	9026	Mimigarra	14.3	288.4
Dobaderry	DOBA	10620	Oakland	8.5	176.8	10634	Redlands	16.4	124.2
Dulbinning	DULB	10903	Karingal-Tincurrin	18	91.9	10654	Wickepin Post Office	18	319.4
Dumbleyung	DUMB	10704	Ballaying	8	300.6	10725	Congee	8.3	158.8
Eganu	EGAN	8037	Coorow Post Office	18.3	50.3	8025	Carnamah Post Office	31	1
Forrestdale	FORR	9106	Gosnells City	11.2	27.5	9137	Cardup	13.1	138.8
Gore	GORE	9822	Dalyup Park	2.4	105.7	9626	Pleasant Valley	6.5	27.3
Harvey 12632	HARV	9679	Lake Preston Lodge 2 Comp	7.6	258.3	9624	Wokalup Agric. Res. Station	17.2	152
Jandabup	JAND	9105	Wanneroo	4.2	293.6	9163	West Swan	19.1	122.1
Jerdacuttup	JERD	9829	Tallangatta	10.2	67.6	9557	Hopetoun Post Office	10.7	258.7
Joondalup	JOON	9105	Wanneroo	2	35	9056	Floreat Park	20.1	176.8
Kwornicup	KWOR	9501	Arundel	8.7	34.8	9765	Ruthven	16.4	316
Logue	LOGU	8225	Eneabba Post Office	14.4	77.8	8057	Green Grove	30.7	348.1
Moates	MOAT	9633	Tamar	8.7	7	9930	Tamaru	8.8	321.5
Muir	MUIR	9506	Bangalup	24.8	99.3	9924	Wyndarra	24.9	315.5
Nine Mile	NINE	9596	Pinjarra	16	50.3	9614	Waroona Post Office	20.6	124.3
Pleasant View	PLEA	9848	Windrush	7.5	318.8	9633	Tamar	7.7	244.4
Poorginup	POOR	9506	Bangalup	19.4	72.1	9843	Frankland Vineyards	27.7	71.7
Powell	POWE	9551	Grassmere	3	63.9	9599	Barrett Meadows	11.1	296.3
Shark	SHAR	9789	Esperance	5.5	157.7	9827	Second Beach	10.4	185.7
Station	STAT	9789	Esperance	6	259.7	9827	Second Beach	11.03	234.9
Taarblin	TAAR	10561	Rushy Pool	17	253.4	10664	Crooked Pool	17.1	297.1
Thomsons	THOM	9064	Kwinana BP Refinery	9.8	217.9	9068	Melville	10.7	0
Toolibin	TOOL	10654	Wickepin Post Office	17.4	321.9	10903	Karingal-Tincurrin	18.9	91.7
Tordit-Gurrup	TORD	9506	Bangalup	16.8	79.8	9661	Frankland Vineyards	25	76.8
Towerrinning	TOWE	10547	Duranillin Post Office	6.2	1.3	9862	Capercup	9.5	318.1
Unicup	UNIC	9673	Bokerup	18.4	57.7	9924	Bangalup	22.9	121.7
Walbyring	WALB	10654	Wickepin Post Office	17.6	326.4	10903	Karingal-Tincurrin	19.94	88.8
Wannamal	WANN	9018	Gingin	26.3	214.1	8159	Maysboro	33.4	65.55
Warden	WARD	9789	Esperance	1.1	94.2	9827	Second Beach	5.7	200.9
Warrinup	WARR	9765	Ruthven	9.4	150.6	9740	Gordon River	14.1	323
Yarnup	YARN	9506	Bangalup	11.1	144.3	9673	Bokerup	13.1	11.2
Yealering	YEAL	10662	Yealering	0.8	315	10534	Colorado	13.4	330.3

Appendix 6b: Summary of Annual Total Rainfall (mm) for all years that rainfall data is available to 2001, from Meteorological sites closest to wetlands monitored for ≥ 20 years.

Wetland Code	Met. Site Name	Met. No.	Year commenced	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%) / 50%	p value	Trend
BAMB	GINGIN	9018	1889	112	737.7	322.3	557.5	635.9	722.5	836.0	938.5	1119.2	0.28	0.0032	Decreasing
BEVE	BROOKTON	10524	1909	93	458.7	207.4	325.5	396.8	441.7	498.7	588.5	768.9	0.23	0.3512	None
BOYU	CULICUP	9525	1926	71	559.3	250.7	418.4	502.8	543.0	607.5	705.3	797.4	0.19	0.1046	None
BRYD	NEWDEGATE RES. STATION	10692	1955	47	372.5	192.6	252.2	319.0	359.8	407.7	510.4	593.4	0.25	0.0871	None
BYEN	BANGALUP	9506	1920	80	753.1	461.0	573.4	662.6	744.3	841.7	909.6	1084.7	0.24	0.0001	Decreasing
CASU	WAYVILLE	10649	1939	63	421.6	234.6	316.4	353.9	421.3	489.4	522.4	706.5	0.32	0.104	None
CHAN	MARBLIN	9024	1943	59	774.4	480.5	593.0	658.0	774.4	857.6	960.5	1185.7	0.26	0.01	Decreasing
COYR	TAMMAR GROVE	10526	1922	65	399.4	203.4	285.5	340.0	395.0	444.6	492.4	622.0	0.26	0.07	None
CRAC	LAKE NAMEN	9210	1971	28	580.2	416.8	476.2	519.9	591.3	647.7	673.4	760.0	0.22	0.474	None
DOBA	OAKLAND	10620	1912	90	542.2	240.7	384.4	457.1	536.1	590.0	805.1	909.0	0.25	0.006	Decreasing
DULB	KARINGUL-TINCURRIN	10903	1955	43	376.5	216.9	290.9	316.4	365.6	418.8	484.1	585.0	0.28	0.386	None
DUMB	BALLAYING	10704	1960	42	376.2	247.1	285.0	319.7	374.2	424.9	473.7	526.5	0.28	0.354	None
EGAN	COOROW POST OFFICE	8037	1912	87	393.8	192.5	263.8	316.5	383.3	446.7	566.8	760.2	0.34	0.495	None
FORR	GOSNELLS CITY	9106	1962	37	847.9	558.4	639.0	751.0	837.3	929.4	1078.5	1184.0	0.21	0.027	Decreasing
GORE	DALYUP PARK	9822	1900	60	592.3	315.2	464.5	518.4	581.4	655.9	721.7	877.7	0.24	0.455	None
HARV	LAKE PRESTON	9679	1961	37	869.3	594.4	650.8	728.4	843.0	973.6	1098.2	1247.6	0.29	0.0011	Decreasing
JAND	WANNEROO	9105	1906	54	817.8	470.5	616.2	709.2	790.0	905.2	1047.9	1283.9	0.25	0.0098	Decreasing
JERD	TALLANGATTA	9829	1973	28	488.9	292.7	329.9	427.7	503.3	558.7	590.4	660.6	0.26	0.034	Decreasing
JOON	WANNEROO	9105	1906	54	817.8	470.5	616.2	709.2	790.0	905.2	1047.9	1283.9	0.25	0.0098	Decreasing
KWOR	ARUNDEL	9501	1913	89	593.9	318.9	467.0	528.8	582.1	651.7	757.3	964.5	0.21	0.0004	Decreasing
LOGU	ENEABBA POST OFFICE	8225	1965	35	508.9	296.6	380.2	425.5	490.7	590.9	626.0	850.6	0.34	0.829	None
MOAT	TAMAR	9633	1947	36	745.1	579.1	606.4	677.3	721.8	795.9	940.2	1040.8	0.16	0.242	None
MUIR	BANGALUP	9506	1920	80	753.1	461.0	573.4	662.6	744.3	841.7	909.6	1084.7	0.24	0.0001	Decreasing
NINE	PINJARRA	9596	1882	115	949.4	531.8	714.1	826.2	954.6	1061.3	1190.7	1493.4	0.25	0.025	Decreasing
PLEA	WINDRUSH	9848	1960	39	671.6	485.2	505.9	607.3	671.8	716.6	795.5	942.1	0.16	0.773	None
POOR	BANGALUP	9506	1920	80	753.1	461.0	573.4	662.6	744.3	841.7	909.6	1084.7	0.24	0.0001	Decreasing
POWE	GRASSMERE	9551	1903	99	1005.5	632.8	821.0	892.0	997.3	1102.5	1200.8	1563.9	0.21	0.0001	Decreasing
SHAR	ESPERANCE	9789	1970	32	623.2	404.2	501.4	552.4	623.8	685.5	772.8	873.4	0.21	0.554	None
STAT	ESPERANCE	9789	1970	32	623.2	404.2	501.4	552.4	623.8	685.5	772.8	873.4	0.21	0.554	None
TAAR	RUSHY POOL	10561	1911	89	405.4	238.0	279.5	331.2	394.0	460.3	522.8	672.2	0.33	0.231	None
THOM	KWINANA BP REFINERY	9064	1956	44	768.1	509.6	598.8	658.9	762.1	867.2	961.3	1004.6	0.27	0.181	None
TOOL	WICKEPIN POST OFFICE	10654	1912	89	412.0	232.2	306.7	356.7	399.1	464.1	544.8	664.1	0.27	0.093	None
TORD	BANGALUP	9506	1920	80	753.1	461.0	573.4	662.6	744.3	841.7	909.6	1084.7	0.24	0.0001	Decreasing
TOWE	DURANILLIN POST OFFICE	10547	1911	87	542.7	319.8	392.8	472.9	535.8	595.8	702.1	823.4	0.23	0.0043	Decreasing
UNIC	BOKERUP	9673	1960	42	585.5	365.7	478.2	533.8	598.1	641.4	678.2	715.6	0.18	0.186	None
WALB	WICKEPIN POST OFFICE	10654	1912	89	412.0	232.2	306.7	356.7	399.1	464.1	544.8	664.1	0.27	0.093	None
WANN	GINGIN	9018	1889	112	737.7	322.3	557.5	635.9	722.5	836.0	938.5	1119.2	0.28	0.0032	Decreasing
WARD	ESPERANCE	9789	1970	32	623.2	404.2	501.4	552.4	623.8	685.5	772.8	873.4	0.21	0.554	None
WARR	RUTHVEN	9765	1937	37	545.7	373.0	423.8	510.2	544.1	602.3	645.8	828.1	0.17	0.073	None
YARN	BANGALUP	9506	1920	80	753.1	461.0	573.4	662.6	744.3	841.7	909.6	1084.7	0.24	0.0001	Decreasing
YEAL	YEALERING	10662	1916	73	368.6	227.6	279.5	329.7	361.0	411.3	464.4	534.2	0.23	0.3615	None

Appendix 6c: Summary of Annual Total Rainfall (mm) from year that wetland monitoring commenced to 2000, for Meteorological sites closest to wetlands monitored for ≥ 20 years.

Wetland Code	Met. Site Name	Met. No.	Depth or Salinity Monitoring Start Year	n	Mean	Min	10%	25%	50%	75%	90%	Max	Variability (75%-25%)/50%	p value	Trend
BAMB	GINGIN	9018	1979	22	653.3	496.4	557.2	589.4	633.9	717.6	744.2	903.4	0.20	0.5208	None
BEVE	BROOKTON	10524	1979	22	441.8	319.3	327.8	395.2	443.6	496.4	519.8	590.8	0.23	0.3762	None
BOYU	CULICUP	9525	1980	21	536.4	373.2	391.6	500.5	540.4	594.7	606.8	774.4	0.17	0.6133	None
BRYD	NEWDEGATE RESEARCH STATION	10692	1979	22	347.6	192.6	252.7	322.1	342	392.9	397.7	563.4	0.21	0.9614	None
BYEN	BANGALUP	9506	1977	23	680.7	534.2	557	591.8	683.8	732.4	817	846.8	0.21	0.048	Increasing
CASU	WAYVILLE	10649	1979	22	394.1	258.3	290.3	353.9	383.5	461.4	481.8	511.2	0.28	0.2917	None
CHAN	MARBLIN	9024	1979	22	722.5	558	595	658	718	794.8	831.9	909.1	0.19	0.5275	None
COYR	TAMMAR GROVE	10526	1979	21	377.7	251.1	299	333.4	379.9	427.9	458.7	491.6	0.25	0.9761	None
CRAC	LAKE NAMEN	9210	1980	19	589.8	468.4	476.2	493.8	614.6	658.2	674.2	760	0.27	0.8313	None
DOBA	OAKLAND	10620	1980	21	502.7	345.6	443.9	452.1	517.1	546.8	565	665.5	0.18	0.6806	None
DULB	KARINGUL-TINCURRIN	10903	1979	19	382.1	267.6	290.9	319	388.7	417.2	484.1	504.2	0.25	0.4421	None
DUMB	BALLAYING	10704	1979	22	370.6	262.2	277.6	314.4	358.8	438.6	452.8	526.5	0.35	0.8625	None
EGAN	COOROW POST OFFICE	8037	1979	21	387.7	199.1	270.8	328.1	392.8	429.4	498.4	649.3	0.26	0.2443	None
FORR	GOSNELLS CITY	9106	1979	22	811.6	627.7	646.5	738.7	822.8	894.7	929.4	1078.5	0.19	0.548	None
GORE	DALYUP PARK	9822	1979	21	578.9	315.2	466	515.2	546.4	646.2	774.6	807.6	0.24	0.365	None
HARV	LAKE PRESTON LODGE 2 COMP	9679	1980	18	812.8	594.4	642.6	712.4	799.8	927	1019.2	1028	0.28	0.071	None
JAND	WANNEROO	9105	1981	19	765.6	572	620.6	708.5	763.4	859.4	883.5	956.7	0.20	0.6152	None
JERD	TALLANGATTA	9829	1979	22	472.7	292.7	329.9	405.3	477.4	539.8	588.6	643.3	0.28	0.147	None
JOON	WANNEROO	9105	1979	21	761.5	572	656.3	708.5	763.4	790.2	877.4	956.7	0.11	0.441	None
KWOR	ARUNDEL	9501	1979	22	544.2	409	467	502.3	536.1	578.8	630.4	731	0.14	0.3218	None
LOGU	ENEABBA POST OFFICE	8225	1979	22	507.8	336.2	386.2	425.5	490.3	586.4	602.3	850.6	0.33	0.4748	None
MOAT	TAMAR	9633	1979	22	728	594.9	627.4	671.4	714.8	772.4	826	945.2	0.14	0.595	None
MUIR	BANGALUP	9506	1979	22	681.6	534.2	557	591.8	688.7	732.4	817	846.8	0.20	0.047	Increasing
NINE	PINJARRA	9596	1981	18	895.2	685.4	767.7	825.1	892.1	941.3	1048.8	1085.7	0.13	0.2458	None
PLEA	WINDRUSH	9848	1979	22	657.1	499.4	580.9	602.4	663.5	716.1	755.2	823	0.17	0.909	None
POOR	BANGALUP	9506	1977	23	680.7	534.2	557	591.8	683.8	732.4	817	846.8	0.21	0.048	Increasing
POWE	GRASSMERE	9551	1981	20	917.9	728.2	778	841.5	915.4	979	1041.4	1113	0.15	0.1932	None
SHAR	ESPERANCE	9789	1979	22	603.9	404.2	468.2	520.8	568.1	660	772.8	873.4	0.25	0.371	None
STAT	ESPERANCE	9789	1980	21	599	404.2	468.2	520.8	563.8	651.4	772.8	873.4	0.23	0.1921	None
TAAR	RUSHY POOL	10561	1979	22	375.2	272.8	294.6	318.2	368.1	423	451.4	519.2	0.28	0.8141	None
THOM	KWINANA BP REFINERY	9064	1979	22	756.2	570.1	625.6	689.8	762.1	823.4	868	961.3	0.18	0.208	None
TOOL	WICKEPIN POST OFFICE	10654	1979	21	385.3	292.3	325.6	348.7	377.8	420.1	443	510.1	0.19	0.9932	None
TORD	BANGALUP	9506	1977	23	680.7	534.2	557	591.8	683.8	732.4	817	846.8	0.21	0.048	Increasing
TOWE	DURANILLIN POST OFFICE	10547	1979	22	502.6	319.8	391.6	441.2	512.8	571	585.7	663.8	0.25	0.0563	None
UNIC	BOKERUP	9673	1980	21	569.8	425.5	478.2	533.8	566.2	629.5	642.1	675.9	0.17	0.1391	None
WALB	WICKEPIN POST OFFICE	10654	1979	21	385.3	292.3	325.6	348.7	377.8	420.1	443	510.1	0.19	0.9932	None
WANN	GINGIN	9018	1979	22	653.3	496.4	557.2	589.4	633.9	717.6	744.2	903.4	0.20	0.5208	None
WARD	ESPERANCE	9789	1979	22	603.9	404.2	468.2	520.8	568.1	660	772.8	873.4	0.25	0.371	None
WARR	RUTHVEN	9765	1980	20	531	423.8	435.9	506.5	528	568.7	612.1	645.8	0.12	0.6711	None
YARN	BANGALUP	9506	1980	21	686.9	534.2	557	605.8	693.6	732.4	817	846.8	0.18	0.1008	None
YEAL	YEALERING	10662	1978	21	356.4	248.9	263.3	323.4	368.7	389	417.4	442.2	0.18	0.249	None

Appendix 7: Number of wetlands with 1, 2, 3, etc. years of September or November data as at November 2000.

Number of years of Sep. or Nov. data at Nov. 2000	SSS Wetlands		NON-SSS Wetlands	
	Depth	Salinity	Depth	Salinity
0		2		2
1	13	11		2
2	5	5	1	3
3			5	7
4		1	6	8
5	2	1	11	7
6	1		8	6
7	2	2	3	2
8	4	3		1
9	4	5		1
10	1	2	1	3
11		1	2	4
12	3	5	4	1
13	1		10	4
14	1	1		
15	3	9		
16	5	7		
17	9	8		
18		2		
19	5	1		
20	4	8		
21	13	10		
22	24	12		
23		4		
Total Wetlands:	**100**	**100**	**51**	**51**

Notes:

Monitoring of the 100 State Salinity Strategy (SSS) wetlands is continuing post-2000 under the South-West Wetland Monitoring Program (SWWMP), whereas monitoring of the 51 non-SSS wetlands is not.

APPENDIX 8. Reports and publications in which significant use is made of SWWMP data.

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