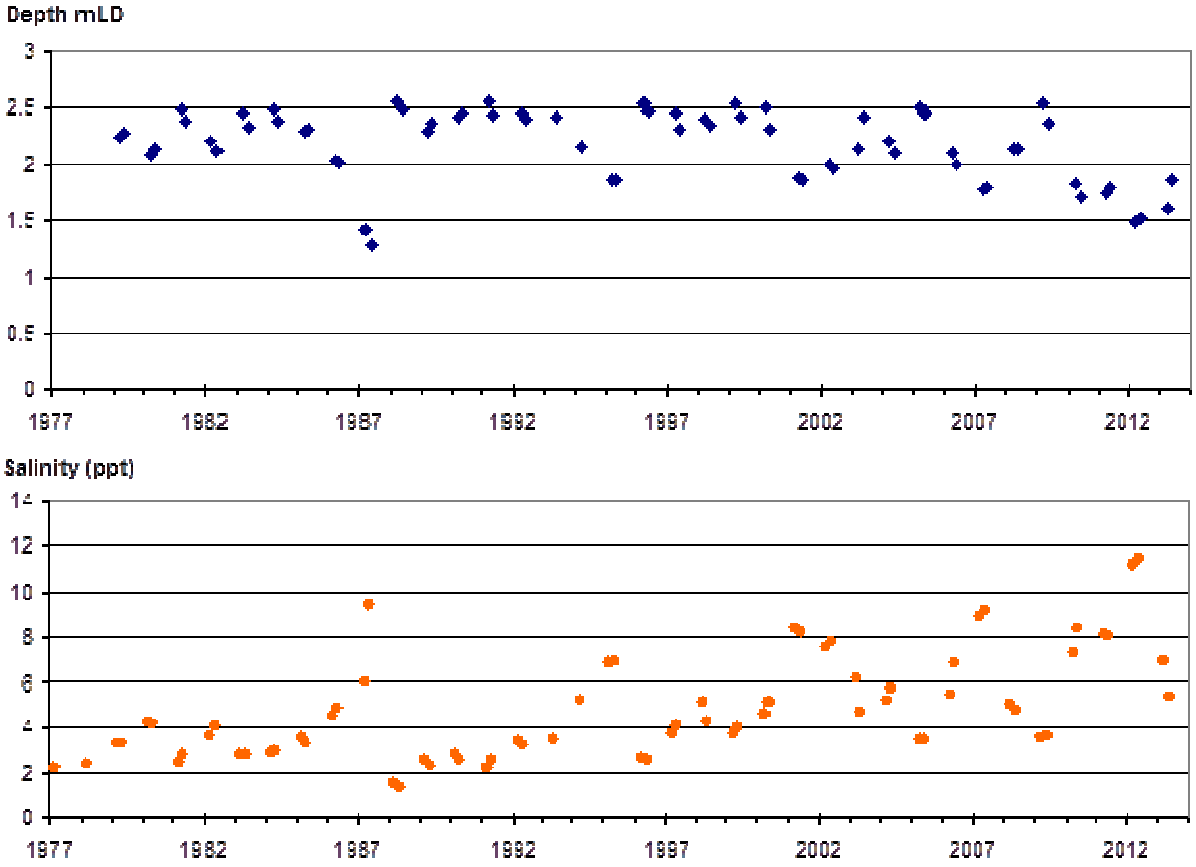
SOUTH WEST WETLANDS MONITORING PROGRAM REPORT 1977 – 2013



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Cover: Variations in water level (depth) and salinity of Byenup Lagoon — the second-largest peat swamp in the Muir-Byenup System Ramsar 'Wetland of International Importance' — from 1977 to 2013. These graphs illustrate the value of long-term, systematically-collected data in determining trends and interpreting recent observations.

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SUMMARY

This report presents 1977–2013 data from SWWMP, the South West Wetlands Monitoring Program conducted by the Western Australian Department of Parks and Wildlife (DPaW). Since 1997, this program has been funded under the WA Salinity Action Plan / Salinity Strategy as updated by the Government's response to the Salinity Taskforce report. In recent times SWWMP has become increasingly significant in the context of climate change. Rainfall is declining over much of the south-west and this is affecting many wetlands.

In this report we present all routinely-collected September and November water level, salinity and pH data to 2013. These data are presented in graphical form for all 103 currently-monitored SWWMP wetlands. Data concerning nutrients (not monitored beyond 2007) in these wetlands, and concerning water level, salinity, pH and nutrient concentrations in other, historically-monitored wetlands, may be found in Lane *et al.* (2009a). Administrative information concerning all 156 SWWMP wetlands, their map coordinates, the periods during which each has been monitored, their locations in terms of DPaW Regions and Districts and Local Government Authorities (LGA's), and their tenure, is also presented.

This report provides an up-to-date overview of the data that have been collected over the past thirty-six years and ready-reference lists of the wetlands. This information will be useful for those with a responsibility or interest in the conservation and management of these and other wetlands in south-western Australia. Most of the monitored wetlands are within Nature Reserves or National Parks and DPaW is responsible for their management. Some are also within Natural Diversity Recovery Catchments and 'Ramsar' Sites and many are 'Directory' (nationally significant) Sites.

Researchers will also find the report useful as it identifies wetlands that have long periods of systematic monitoring of physico-chemical attributes, knowledge which will assist in the selection of most-suitable wetlands for study. Pronounced year-to-year or longer-term variations or trends are readily apparent in the graphs of some wetlands, as is the absence of pronounced variations or trends in others. Thus the wetlands of SWWMP demonstrate a wide variety of hydrological responses to landscape setting, surface and groundwater catchment characteristics, local climates and, in some cases, management interventions.

Attention is drawn to a number of wetlands of particular interest or concern. These are Bambun, Bennetts, Broadwater, Bryde, Byenup, Chandala, Clifton, Corrigin 12900 ('Paperbark Swamp'), Crackers, Davies, Dobaderry, Dumbleyung, Egret, Esperance 26410, Forrestdale, Gore, Guraga, Harvey 12632, Hinds, Jandabup, Jasper, Jerdacuttup, Joondalup, Logue, Maringup, McLarty, Muir, Nine Mile, Noobijup, Noonying, Pillenorup, Pleasant View, Powell, Range Road Yate, Shark, Taarblin, Thomsons, Toolibin, Tordit-Gurrup, Towerrinning, Unicup, Walbyring, Wannamal, Warden, Warrinup, Wheatfield, White (Narrogin), White Water, Wilson, Yaalup, Yarnup, Yeagarup and Yellilup. Regional, District and specialist branch staff of DPaW are encouraged to examine the data for all wetlands in their respective areas of responsibility as other wetlands may also show changes of interest or management concern.

2013 was a year of mainly average to above average rainfall in south-western Australia, with some eastern and south coastal areas experiencing very much above average rainfall. Seven SWWMP wetlands experienced their highest-recorded September and/or November water levels, whereas none experienced its lowest. Eleven wetlands were dry in both monitoring months of 2013, whereas 22 were dry in 2012. Seven wetlands experienced their lowest-recorded salinities in 2013 and five experienced their highest. Eleven wetlands experienced their lowest pH values and two their highest.

Between 1997 and 2009, detailed bathymetries (lakebed and shoreline contours and inflow and outflow channels) of 19 monitored wetlands were mapped under SWWMP, with Department of Environment and Conservation (now DPaW) Regional and District funding support. This work enables water surface areas, water volumes and salt loads to be calculated from SWWMP water level and salinity data. This permits modelling of water and salt balances and will facilitate assessments of likely hydrological and ecological impacts of drainage, diversion, pumping and storage proposals, proposed land use changes and predicted climate change. All 39 SWWMP wetlands known by the authors to have been bathymetrically-mapped are listed in this report, together with the years of mapping, methods employed, products and custodians / sources.

High resolution, low altitude, aerial oblique photography is useful for mapping wetland vegetation, monitoring vegetation condition, planning and conducting biological surveys, planning recreational activities and facilities, and in interpretation and extension. During the period 2008–2012, 152 of the 156 SWWMP wetlands were flown and photographed and a sample of these photographs and enlargements is presented in this report. Copies of the original, high resolution photographs in digital format may be obtained on request.

During the period 2009–2012, continuous water level recorders and tipping-bucket rainfall gauges were installed on 14 SWWMP wetlands between Cataby (140km N of Perth) and Esperance. This equipment is being kept in place for several years and then moved to other high conservation value wetlands of special interest (e.g. for the specially-protected Australasian Bittern *Botaurus poiciloptilus*) and/or under threat. Collection of continuous water level and rainfall data will enable salt and water balance models to be developed for these and other south-western Australian wetlands and will thereby assist in their conservation management. The data will also assist in development of an improved understanding of the likely consequences of predicted climate change, particularly rainfall decline, on the wetlands of south-western Australia. In 2013 the water level recorders and rainfall gauges were removed from the five northern-most (Cataby to Busselton) of the 14 wetlands.

Facilitation of appropriate recreational activities in natural areas managed by DPaW is a primary focus of the new agency. In this report we detail some past and present activities as a first step in identifying future possibilities. Some existing forms of recreational use could be expanded and other, new activities could be introduced. With appropriate planning and guidance, enhanced recreational benefits could be achieved with limited disturbance of wildlife.

In this report we also detail the occurrence of threatened vertebrate fauna on SWWMP wetlands. Notable is the Australasian Bittern or 'Bunyip Bird'. This large, superbly camouflaged bird with a booming voice is now largely confined in Western Australia to the rushbeds of a relatively small number of wetlands, mostly SWWMP wetlands, on and near the south coast.

This report is the seventh in a series of annual reports aimed at putting most-recent SWWMP data in front of readers as soon as possible after data collection.

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1. INTRODUCTION

This report presents 1977–2013 data and other information from SWWMP, the South West Wetlands Monitoring Program conducted by the Western Australian Department of Parks and Wildlife (DPaW)[1] and its predecessors over more than three decades. Since 1997, this program has been funded under the Western Australian Salinity Action Plan (Government of Western Australia 1996a) and State Salinity Strategy (State Salinity Council 2000a,b) as updated by the Government's response (Government of Western Australia 2002) to the Salinity Taskforce report (Frost *et al.* 2001). A detailed account of SWWMP, including analyses of data to 2000, may be found in Lane *et al.* (2004). Reviews of this and other programs under the Salinity Action Plan have been published (Wallace 2001, Wallace *et al.* 2011).

In this report we present, in graphical form, all September and November water depth, salinity and pH data routinely collected from 103 currently-monitored[2] SWWMP wetlands. Data concerning nutrient concentrations[3] in most of these wetlands, and concerning water level, salinity, pH and nutrient concentrations in other, historically-monitored SWWMP wetlands, may be found in Lane *et al*. (2009a) and are not repeated here. The locations of all 156 current and historically-monitored SWWMP wetlands are shown in Figure 1. Administrative information concerning these wetlands, their map coordinates, the periods during which each has been monitored, their locations in terms of DPaW Regions and Districts and Local Government Authorities (LGA's), and their tenure, is also presented (Tables 1–3).

The main purposes of this report are to provide an up-to-date visual overview of data that have been collected over the past thirty-six years and ready-reference lists of the wetlands. This information will be useful for those with a responsibility or interest in the conservation and management of these and other wetlands in south-western Australia. Most of the monitored wetlands are within National Parks and Nature Reserves vested in the Conservation Commission[4] of Western Australia and DPaW is responsible for their management. Some are within Natural Diversity Recovery Catchments (Government of Western Australia 1996a; Wallace & Lloyd 2008) and Ramsar Sites (Government of Western Australia 1990, 2000; Ramsar Secretariat 2013) and many are Directory Sites (Environment Australia 2001) (Tables 4 & 5).

Researchers will also find the report useful as it identifies those wetlands that have long periods of systematic monitoring of physico-chemical attributes, knowledge which will assist in the selection of wetlands most-suitable for study. Pronounced year-to-year or longer-term variations or trends are readily apparent in the graphs of some wetlands, as is the absence of pronounced variations or trends in others. The wetlands of SWWMP demonstrate a wide variety of hydrological responses to landscape setting, surface and groundwater catchment characteristics, local climates and, in some cases, management interventions. Many are also exhibiting pronounced responses to the decline in annual rainfall that has occurred over much of south-western Australia since the mid 1970s.

Facilitation of appropriate recreational activities in natural areas managed by DPaW is a primary focus of the new agency. In this report (Appendices 2 & 3) we again detail some past and present activities on SWWMP and other wetlands as a first step in identifying future possibilities. Some existing forms of recreational use could be expanded and other, new activities could be introduced. With appropriate planning, guidance and management, increased and enhanced recreational benefits could be achieved with limited disturbance of wildlife.

The wetlands of south-western Australia provide essential habitat for a variety of threatened species of flora and fauna. In this report we also detail the occurrence of threatened vertebrate fauna on SWWMP wetlands (Appendix 4). Notable amongst these is the Australasian Bittern or 'Bunyip Bird'. This large, superbly camouflaged bird with a booming call is now largely confined in Western Australia to the rushbeds of a relatively small number of wetlands, mostly SWWMP wetlands, on and near the south coast.

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[1] DPaW commenced operations on 1 July 2013 following the separation of the former Department of Environment and Conservation (DEC) into DPaW and the Department of Environment Regulation. DEC's predecessors in regard to SWWMP were the Department of Conservation and Land Management (CALM; 1985–2006) and the Department of Fisheries and Wildlife (pre-1985).

[2] Currently monitored as at Nov 2013. Monitoring was discontinued at two wetlands, Hebitons and Goorly, at the end of 2009, thereby reducing the number of 'current' SWWMP wetlands from 103 to 101 and increasing the number of 'historical' wetlands from 49 to 51. At the end of 2010, monitoring was also discontinued at Blue Gum, Frasers and 'Esperance 27985', but in 2011 was resumed at Eneminga and initiated at Yeagarup and Yeagarup South, thus maintaining the number of 'current' SWWMP wetlands at 101 while increasing the number of 'historical' wetlands to 53. In 2012 monitoring was initiated at Big Boom and Gingilup, thereby increasing the number of current SWWMP wetlands to 103 with the number of historical SWWMP wetlands unchanged at 53. No changes were made in 2013.

[3] Total nitrogen and total phosphorus, both filtered and unfiltered. These parameters have not been monitored beyond 2007.

[4] To be replaced by the Conservation and Parks Commission.

2. RESULTS

In order to make this report available in a timely fashion, statistical trend analyses to 2013 have not been performed on the physico-chemical data presented here. Trends to 2000 of 41 SWWMP wetlands (those monitored for 20 or more years at that time) have previously been reported (Lane *et al.* 2004) and readers may find it useful to compare the latest data with the results of that earlier work. A report on depth trends of multiple groups of current and historical SWWMP wetlands over decadal and multi-decadal periods from 1981–2010 is in preparation and updates are proposed.

Without statistical analysis, it would be potentially misleading to present lists of wetlands that appear to show trends, as opposed to those that do not. On the other hand, it is considered useful to draw the reader's attention here to a number of wetlands of particular interest or concern. These wetlands follow below, with the relevant LGA's in brackets. The data referred to are presented in the relevant Graphs (page 63 onwards), which are also arranged alphabetically.

Bambun (Gingin): Bambun's salinities have steadily risen during the past four years. It is now fresh (1<3ppt)[1] whereas throughout most of the preceding 24 years (1986–2009) it was very fresh (<1ppt). In the early 1980s it was slightly more saline than at present.

Bennetts (Lake Grace): Water-skiing at Bennetts Lake has official approval (see Appendix 2). However, since 2003, the water level has been too low for this recreational activity to be conducted.

Broadwater (Busselton): The September (4.5ppt) and November (8.4ppt) salinities of 2006 were markedly higher than those of all other monitoring years (1985–2013), including years of similar or lower depths (1987, 2001 & 2010). A probable explanation is that, sometime between November 2005 and September 2006, seawater was allowed to enter the Broadwater via the New River by unauthorised opening of a drainage structure connecting the Vasse River Diversion Drain (VRDD) to the New River. Seawater may enter the VRDD at any time when the sea level in Geographe Bay is high, but particularly during summer-autumn when freshwater flows through the VRDD cease.

Bryde (Kent): This wetland has now been dry in September and November each year for six years (2008–2013). This is an exceptionally long period for Bryde, which has been monitored under SWWMP for 34 years.

Byenup (Manjimup): As is the case with nearby (and hydrologically-connected) Tordit-Gurrup (see below), there is a pronounced inverse relationship between water levels and salinities, with levels lowest and salinities generally highest in 1987, 1995, 2001, 2002, 2007 and 2010–2012. September and November salinities were lower in 2013, after peaking in September (11.2ppt) and November (11.4ppt) 2012.

Chandala (Chittering): September and November 2010 water levels were the lowest for at least 32 years (monitoring began in 1979), yet salinities and pH values were within the normal ranges of 0.5–1.5ppt and 6–8 pH units. In 2013, September depth was at a record high (1.03m) and salinites returned to their normal range, having been higher in 2012.

This 120ha, spring-fed, melaleuca — eucalypt swamp previously supported thousands of nesting Straw-necked Ibis *Threskiornis spinicollis* and was considered a candidate for listing as a Wetland of International Importance under the Ramsar *Convention on Wetlands* (Jaensch & Watkins 1999).

Clifton (Mandurah): The trend of increasing salinities and salt loads in Lake Clifton from the early 1990s to 2000 (Knott *et al*. 2003) continued to 2012, with record and near-record high levels in September (57ppt) and November (58ppt) respectively. In 2013 water levels were higher than in the preceding seven years, however there was little reduction in salinity from 2012.

In November 2008 the authors initiated routine sampling at three fixed sites extending from near the shoreline to the end of the boardwalk (jetty), rather than one non-fixed site in this general area, as previously. In November 2008 (at water level 4.24m) the salinity values at these three sites were fairly similar, however in September 2009 (water level 4.14m) and November 2009 (water level 4.02m) the values were very different, due to the influence of freshwater seepage near the shoreline. Substantial salinity differences were also apparent in September 2010 and November 2011. Lower water levels prevented sampling at the 'inner sedge area' sampling site in both sampling months of 2010–2012 and at the 'outer sedge area' site in November 2010. In 2013 the influence of freshwater seepage was again evident.

The pattern of water level change at Clifton is similar in appearance to that of 'Harvey 12632' (≈20km SSE) and Nine Mile (12 km E).

Comparison of recent and historical data concerning the composition of the lake's internationally significant thrombolite community indicates a large reduction in relative abundance of cyanobacterial species believed to be fundamental for the thrombolite structure (Smith *et al*. 2010).

[1] In this report, the salinity categories 'very fresh' (<1ppt), 'fresh' (1<3ppt), 'brackish' (3<10ppt), 'saline' (10<50ppt) and 'hypersaline' (≥50ppt) are used, as in Lane *et al.* (2004). 'ppt' = parts per thousand.

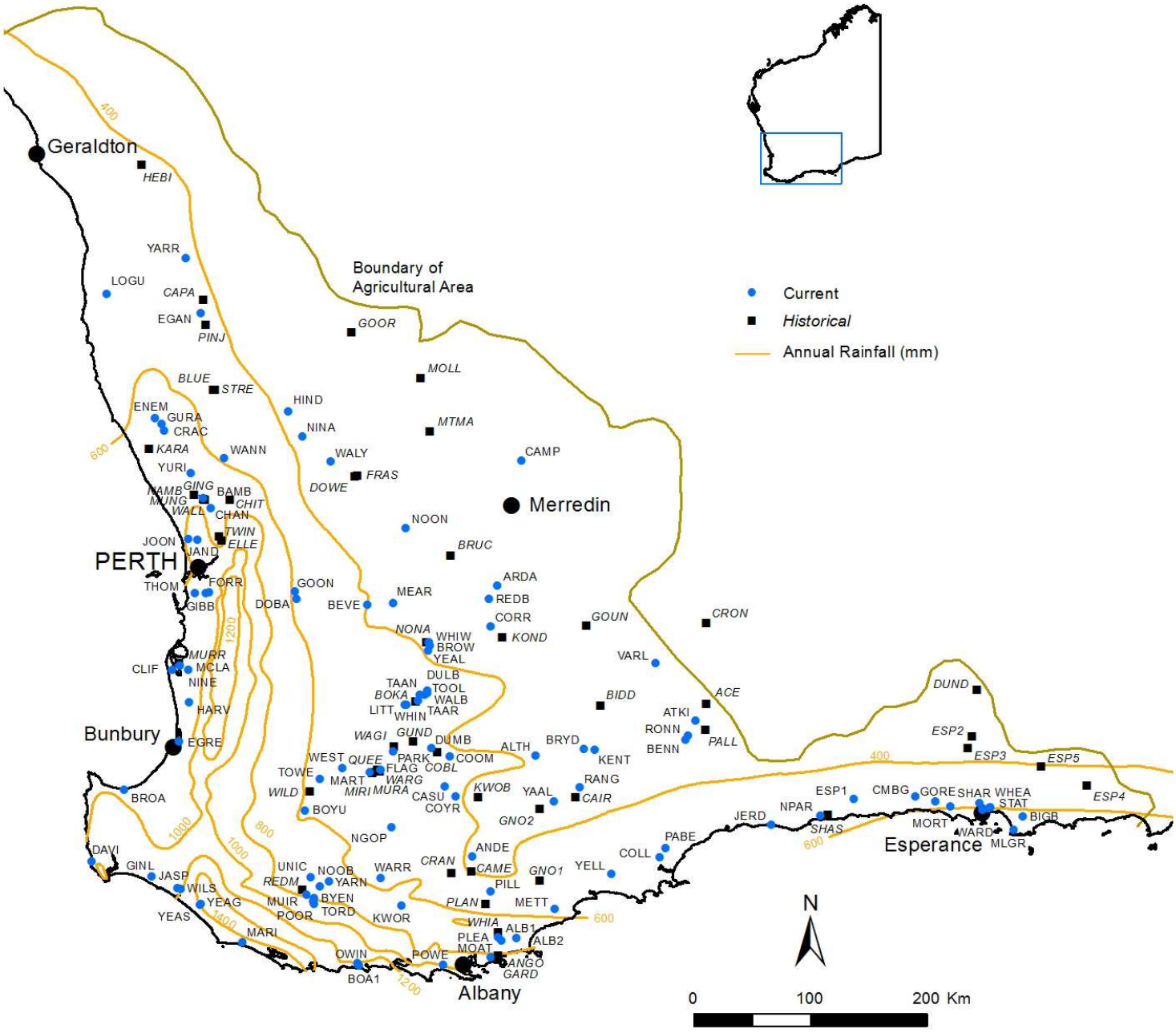

Figure 1. Wetlands currently (2013) and previously monitored under SWWMP

Corrigin 12900, also known as Paperbark Swamp (Corrigin): Water levels were high in September and November 2013, after six years of continuous drought, and its waters were again very fresh (<1ppt). Vegetated (meleleuca) freshwater swamps such as Corrigin 12900 are now rare in the inland agricultural conservation estate.

Crackers (Dandaragan): Crackers has become more saline, particularly since 2006. Salinities in recent years have predominantly been in the fresh (1<3ppt), rather than very fresh (<1ppt), category. Crackers' extensive lake floor vegetation could be under threat. For an account of the interesting hydrological history of this wetland, see Lane *et al.* (2004).

Davies (Augusta-Margaret River): Salinities have risen since 2000, after a period of eight years (1993–2000) of little change preceded by an apparent rise in earlier years (monitoring began in 1991). This wetland is now at the high end of fresh (1<3ppt). The possible causes of this rise, and the impacts on flora and fauna, have been the subject of work by Davies (2010). September and November 2013 salinities were at record (Sept) and near record (Nov) levels.

Dobaderry (Beverley): Dobaderry was dry in September and November of 2010. Much of the lake floor vegetation (≈1m tall *Melaleuca lateritia*) appeared severely stressed (compare Photos 52 and 51) and indications at the time were that this was due to drought. In 2011 the lake floor was inundated and by November 2011 the vegetation was recovering. In 2012 Dobaderry was dry again in both monitoring months and the lake floor vegetation was severely stressed. In 2013 the vegetation was again in poor health, despite the lake floor being inundated in September.

Dumbleyung (Dumbleyung / Wagin): Dumbleyung last overflowed in 1983, following the post-cyclonic rains (Cyclone Bruno) of January 1982 and heavy winter rains the following year. Since 1983, there have been only three substantial filling events, in 1988, 1993 and 2005. In most years the waters of Dumbleyung are hypersaline (≥50ppt), but in years of major inflow, September and November salinities may fall as low as 13ppt. In 2013, September and November water levels were very low (<0.5m) and salinities were again hypersaline. Bathymetric surveys arranged and assisted by SWWMP staff in April 2001 indicate that Dumbleyung overflows at 4.42m (258.10mAHD), at which level the stored volume of the lake is ≈190 million cubic metres.

Egret (Harvey): Egret's pH values were exceptionally low (≈3 pH units) from 1985 to 1989. From 1992 to 2007 they were mainly within the range 5–7. Since 2008 they have again been low, ranging from 3 to 4 pH units. The cause(s) of these changes have not been investigated.

Esperance 26410 (Esperance): This Flat-topped Yate *Eucalyptus occidentalis* lake has a narrow inner zone of dead trees, with some regeneration (Jaensch *et al.* 2009, Clarke *et al.* 2011). The deaths, which have not been mapped or aged, could be due to salinity or perhaps to prolonged inundation, as occurred for example in the late 1980s and early 1990s. Salinities have been rising and similar-depth salinity comparisons (e.g. 2013 with 1989) indicate a very substantial increase in salt load. Water levels have been high for an unprecedentedly long period since 2010, with ≥32 year maxima of **≈**2.5m in September and November 2013. Further tree deaths seem likely.

Forrestdale (Armadale): September and November water levels have trended downwards since the early 1990s, however salinities have remained mainly fresh (1<3ppt). Lower water levels have facilitated the spread of bulrush *Typha orientalis* in shallow parts of the lake. The record high salinity in November 2012 was probably due to the very low water level (near 0.00m) at which the sample was taken, i.e. at maximum evapoconcentration.

Gore (Esperance): Gore's September and November water levels have been more consistent during the past 17 years (1997–2013 inclusive) than in the preceding 18 years (1979–1996 inclusive), whereas Mortijinup's (10 km east) water levels have steadily declined (to 2011) since monitoring began in 2000. Gore's September and November salinities have been relatively stable and within a narrower range from 2002 onwards.

Guraga (Dandaragan): September and November water levels have declined since their peak of ≈3m in 1999 and 2000 and have been consistently low (0.65–0.00m) for the past seven years (2007-2013). This is the longest period of continuously low water levels since monitoring began more than three decades ago.

Harvey 12632 (Harvey): Water levels have trended downwards from a peak of ≈1.6m in the early 1990s, and in 2010 'Harvey 12632' was dry in September and November for the first time since monitoring began in 1980. Salinities rose over the same period. In September 2011 a marked change in vegetation was evident. Much of the fringing vegetation was stressed, dying or dead, however there were many well-established young shrubs growing on the shallowly-inundated, peaty lake floor (see Photo 53). These shrubs have since flourished (Photo 54).

The pattern of water level change at Harvey 12632 since the early 1990s is similar in appearance to that of Clifton (**≈**20km NNW). Nine Mile (28 km N) has shown a similar downward trend over a longer period (1983–2013).

Hinds (Wongan-Ballidu): There was an exceptional filling event (to >4m) in 1999 and it took 2–3 years for water levels to decline to 'normal' (for the period 1979–2013). There have been no major filling events since 1999. Note that this wetland was not monitored from 1992 (when recreational duck hunting in Western Australia was banned) to 1996 (when the WA Salinity Action Plan was launched) (See Section 2 of Lane *et al.* 2004 for the relevant history). The 2009–2011

September and November salinities of ≈335ppt were far above those of the flood year of 1999 (≈16ppt). Samples of the still-hypersaline waters were not taken in 2012 or 2013 due to the treacherous nature of the shallowly-inundated mud.

Jandabup (Wanneroo): September and November pH values returned to 'normal' (for the periods 1983–1997 and 2000–2013) following their fall to low levels (pH 4–5) in 1998 and 1999. This temporary acidification initially followed (lag of one year) and then coincided with a period of 2–3 years of lower water levels and prolonged drying of the lake bed and is thought to have possibly been due to the oxidation of sulfur compounds from one or more sources (Sommer & Horwitz 2001). Pumping of groundwater was recommenced in summer 1999/2000 (it had ceased in autumn 1996), because minimum water level criteria were not reached during the preceding two summers. This prevented the wetland from drying in summer 1999/2000 (Sommer & Horwitz *op. cit.*). Since 2000, September and November pH values have been within the normal range, despite water levels in several years being at or below those of 1997–1999. This wetland has remained very fresh (<1ppt) throughout the entire period of monitoring.

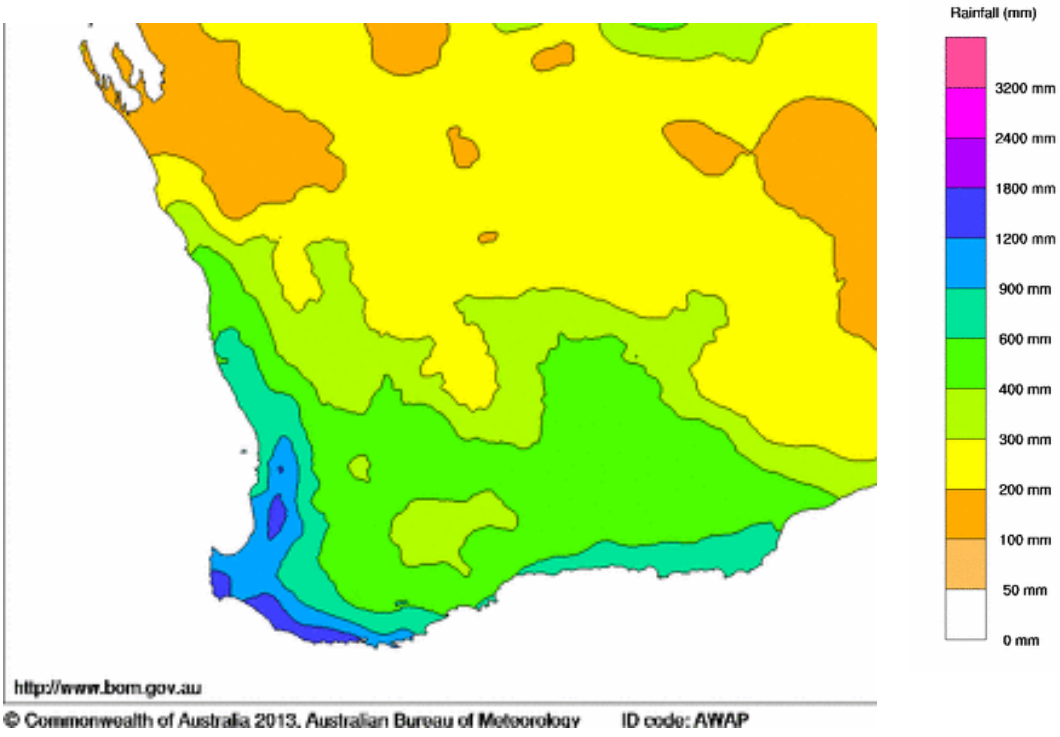

Figure 2. Rainfall (mm) recorded in the 12 month period from 01 Nov 2012 to 31 Oct 2013

Jasper (Nannup): Jasper remains very fresh (<1ppt), however salinities have been higher (>0.25ppt) in most years since 2000, the end of a 13 year period of consistently high water levels and lower salinities. Similar-depth salinity comparisons (2009 with 1999 & 2000, 2011 with 2002, 2012 with 1987, and 2013 with 1988) strongly suggest that Jasper's salt load has also increased.

Probing of a peat deposit in the south-east corner of Jasper in 1995 by divers with steel rods has revealed that Jasper is, by one estimation (Dortch 1996), at least 16m deep, not 9-10m. In our 1977–2010 report we stated that 'Whichever measurement / estimate is used, Jasper is the deepest of all SWWMP wetlands and Maringup the second-deepest (Lane *et al*. 2004)'. We have since discovered that this statement is at least partially incorrect. ARL (1992) reported a depth of 10.8m in Yeagarup Lake, without probing the lake floor, and in March 2014 a bathymetric survey of Yeagarup (see below) confirmed that it is more than 10m deep, again without attempting to probe the lake floor.

Jerdacuttup (Ravensthorpe): Water levels (0.0–4.5m) and salinities (5–250ppt) of Jerdacuttup continue to oscillate markedly over 5–15 year time periods, there being a strong inverse relationship between these two parameters in this wetland. Water levels in 2012 and 2013 have been higher than in most years and salinities have been 'mid-range'.

Joondalup (Joondalup): September and November water levels have been fairly stable around 2.5–2.7m since 1998 following earlier periods at ≈3.0m (1981–1990 and 1995 & 1996) and ≈3.5m (1992 & 1993). September and November salinities remain very fresh (<1ppt) in most years.

Logue (Carnamah): This wetland was dry / near-dry in September and November 2013, as it has been for nine of the past ten years. This is an exceptionally long period for Logue, which has been monitored under SWWMP for more than three decades. There has been no major input of water to this wetland since 1999, when it filled to ≈4.0m. Healthy *Casuarina* (predominantly) and *Melaleuca* trees and saplings, previously restricted to the lake margins, are now encroaching and scattered in low numbers on areas of the lake floor.

Maringup (Manjimup): During the past two decades of monitoring, September and November salinities of this relatively deep wetland have varied within a narrow range (≈0.2–0.3ppt) and prior to 2013 September and November depths oscillated between 6.0m and 6.6m, with no clear trend. In September 2013 the water level was at a 20 year maximum (6.83m) and flooding of the access track prevented collection of water samples. The 2013 water levels were determined by later download from a previously installed logger.

McLarty (Murray): September and November water levels have fluctuated markedly during the period of monitoring (1993–2012) with the long term trend being downwards. Salinities are mainly <4ppt, with occasional values approaching 12ppt when water levels are lowest.

Muir (Manjimup): September (≈0.4m) and November (≈0.2m) 2010 water levels were the lowest in at least 34 years and far below the level (≈4.0m) at which this 4,600 ha lake would overflow into the Deep River, an event that is thought to have last occurred around 1900–1901 (pers. comm. Ash Muir via Roger Hearn, 07 August 2009). During the past three years water levels recovered somewhat, to ≈0.6m in 2013.

As previously noted (Lane *et al.* 2004), from 1979 to 1989 SWWMP monitoring of Muir was undertaken at the northern end of the lake, near the discharge point of a seasonally-inflowing drain. From 1990 onwards all monitoring has been undertaken at a more satisfactory, deeper-water location near the eastern shoreline, away from surface drainage discharge points.

Nine Mile (Murray): The pronounced downward trend in water levels, which began from a peak of ≈2.0m in 1983, has perhaps 'stabilised' at ≈0.3m in recent years. Salinities have remained mainly within the range 0.2–0.5ppt over the entire period of monitoring and are 'very fresh'. 'Harvey 12632' (28 km south) has shown a similar downward trend in water levels since 1991 but, unlike Nine Mile, its salinities have been rising.

Noobijup (Cranbrook): September and November depths (≈0.3m) and pH values (≈4) remained low in 2013. Similar declines (and recoveries) in pH have been observed at nearby Unicup and Yarnup (see below) and also at distant Jandabup (see above).

Noonying (Tammin): This wetland has been dry or very shallow (<0.2m) in most Septembers and Novembers for the past 13 years (2001–2013). This is an exceptionally long period for Noonying. From 1979 to 1990, and possibly to 1999 (there was a gap in monitoring from 1992 to 1996), Noonying water levels were often in the range 1.0–1.4m.

Pillenorup (Plantagenet): Water levels in this large and relatively pristine wetland on the south side of the Stirling Ranges fell from a flood level of ≈2.7m in September-November 2005 to 0.0m (i.e. dry) in 2010. As the water levels fell, salinities rose, from 0.2ppt in 2005 to 2.6ppt in 2009. The four (2005–2009) or so years of continuous inundation resulted in extensive death of tall and low sedges (*Baumea* spp.?) on the lake floor. In September 2010 some sedge regeneration was occurring, mainly on shallower parts of the floor. Most of the melaleucas and eucalypts on the lake floor and margins appeared to have survived the prolonged immersion, however some loss of vigour was apparent. In September 2012, melaleuca seedlings (≈0.1m tall) were noticeable over a large area of the central lake floor. In November 2013, melaleuca seedlings were growing on the lake bed near depth gauge 'B' and eucalypt seedlings on previously-flooded parts of the lake access (foot) track were ≈0.4m tall.

Pleasant View (Albany): September and November water levels of Pleasant View have oscillated between 0.1–2.2m and salinities have mainly been within the range 0.2–0.9ppt (exceptionally to 1.6ppt) over the past 34 years (monitoring began in 1979). In 2013 water levels were mid-range (≈1.1m) and salinities were low (≈0.2ppt). Similar-depth salinity comparisons (e.g. 2013 with 1981, 1988, 1990, 1991 & 2009) show no evidence of a salt load increase. This remains a very fresh (<1ppt) wetland.

Powell (Albany): Powell is unusual among SWWMP wetlands in that in most years (but not in 2013) its water level is higher in November than September. This is presumably a consequence of management arrangements for the surface water drainage network that it lies within. It is interesting that the six recordings of unusually high salinities (2–5ppt) were all made in Novembers, this despite the corresponding November depths being higher than the September depths in four of these six years. All September and most November salinities of the past 32 years have been in the range 0.2–1.5ppt.

Range Road Yate (Kent): Despite being located in the inland agricultural region, an area of widespread secondary salinisation, Range Road Yate remains fresh (1<3ppt) to very fresh (<1ppt) in most years, with no evidence of September

and November salinities trending upwards over the past 14 years of monitoring. Nearby Yaalup (20km SW) similarly remains very fresh in most years.

Shark (Esperance): In our 1977–2010 report we wrote: 'This lake's water levels exhibit an unusual pattern … with considerable variation from 1979 (the start of monitoring) to 1999, and relatively little since'. This was true until 2011, when water levels returned to the lows of pre-1999. Salinities in recent years have been at or near the upper limit (3ppt) of fresh and similar-depth salinity comparisons suggest this wetland's salt load is increasing. This wetland has been an important habitat for waterbirds, including species particularly sensitive to the loss of fringing and emergent vegetation (Jaensch *et al.* 2009, Clarke *et al.* 2011).

Taarblin South and Taarblin North (Narrogin): The 1983 filling (to 2.4m) of this large, formerly 'live-treed', now mainly 'dead-treed' lake near the northern (upper) end of the Blackwood River catchment was a 1 in 35 year — and possibly longer — event. For the remainder of the period 1979–2013, September and November water levels in the southern basin (Taarblin South) have mostly been within the range 0.0–0.5m (≈0.05m in 2013), though they did reach ≈0.9m in September 1996. High resolution, aerial oblique photography taken in 2010 (see Photo 35 & Table 7) shows long, narrow bands of living trees (Swamp Sheoak *Casuarina obesa*) on elevated ground within this basin. The northern basin (Taarblin North) receives pumped saline groundwater from bores in the bed of Toolibin (Durell *et al.* 2010).

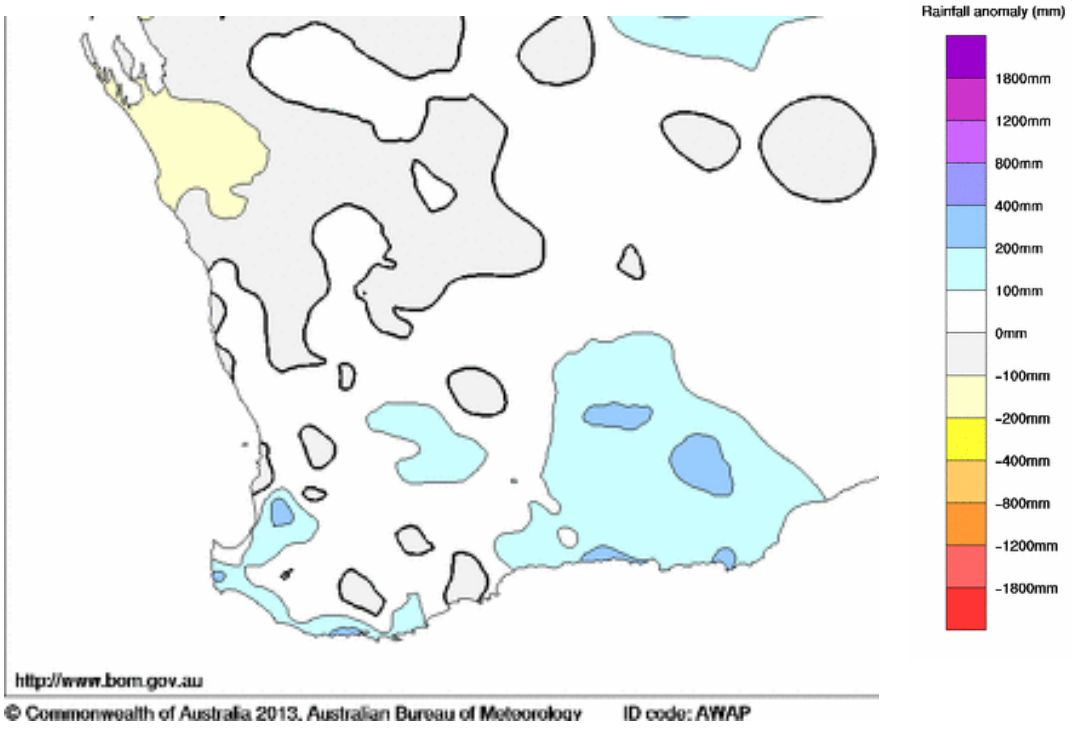

Figure 3. Rainfall anomalies (mm above or below average) in the 12 month period from 01 Nov 2012 to 31 Oct 2013

Thomsons (Cockburn): Water supply to this Ramsar-listed wetland has been supplemented by diversion of surface drainage each winter–spring since and including 2004 (DEC 2009). Supplementation is intended '... to help ensure that water levels remain adequate for the protection of the reserve's Ramsar values and waterbird habitat, and to enable the fledgling cygnets to survive at the lake until they are able to fly' (CALM 2005) and is subject to a specific plan (CALM 2004). In years 2009–2013, supplementation was 15 July – 30 Nov, 14 July – 15 Sept, 18 July – 19 Sept, 11 July – 27 Sept and 17 July – 17 Sept respectively (DEC 2012; Anon. 2013, 2014).

The level of public and private compliance with minimum water level criteria for Thomsons Lake, which is impacted by a variety of factors including rainfall, stormwater disposal and groundwater pumping from the Jandakot Mound, is reported annually by the Water Corporation to the EPA (CALM 2005).

Toolibin (Wickepin): This iconic wetland (Hooper & Wallace 1994) has now been dry / near-dry in September and November each year for 14 years (2000–2013). This in an unusually long period for Toolibin (at least in the past 35 years)

and is due to a combination of drier years and diversion of higher-salinity surface flows away from the lake (Jones *et al.* 2009). The recent slow spread of casuarinas and melaleucas onto the floor of the mainly fresh (1<3ppt) Lake Logue (Carnamah) makes an interesting comparison with the predicament of long-established casuarinas and melaleucas on the floor of Toolibin.

Tordit-Gurrup (Manjimup): As is the case with nearby (and hydrologically-connected) Byenup (see above), there is a pronounced inverse relationship between water levels and salinities of Tordit-Gurrup. September and November 2012 water levels were the lowest (≈0.85m) and salinities the highest (4.8–6.9ppt) since 1977, when monitoring began. Water levels and salinites showed slight improvements in 2013, but pH fell dramatically to ≈4 pH units.

Towerrinning (West Arthur): High water levels (3.0–3.5m) and relatively low salinities (5–10ppt) have been achieved in Towerrinning in most years since remedial engineering works were undertaken in 1993 and 1994 (see Lane *et al.* 2004, pp. 48–49 for more history). This is a popular lake for water-based recreational activities, particularly water-skiing.

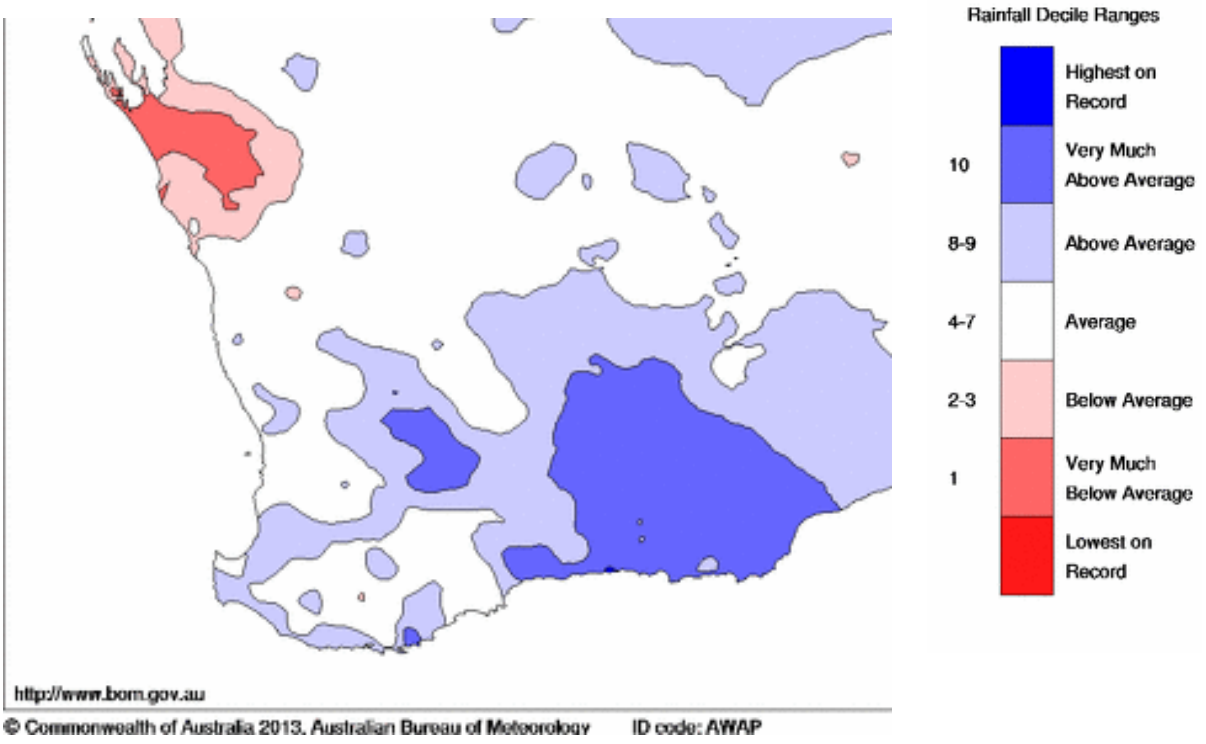

Figure 4. Rainfall deciles for the 12 month period from 01 Nov 2012 to 31 Oct 2013.

Unicup (Cranbrook): pH values rose after the major filling event (to ≈2.1m) of 1988 and have consistently been within the range 7–9 pH units from 1991 to 2012. Prior to 1988, values were generally within the range 4–6. Gibson *et al.* (2004) reported a 'major collapse' of Jointed Twig-rush *Baumea articulata* in a Unicup (and nearby Yarnup, see below) vegetation monitoring quadrat between October 1997 and October 2002, with cover abundance scores changing from 30–70% to 2–10%. These authors did not identify the cause of the collapse, but did point to 'a marked decline in water depth [to ≈1.0m] — and increase in salinity [to ≈10ppt] — of Lake Unicup in 2001 and 2002'. Water levels were ≈0.25m in September and November of 2012 and 2013. These are the lowest levels recorded since the major filling event of 1988. During the past four years Unicup's September and November salinities have ranged ≈10–22ppt.

Walbyring (Wickepin): This wetland has been dry in September and November each year for the past four years (2010–2013). This is the longest period of being continuously dry in these months in 35 years of monitoring.

Wannamal (Gingin): September and November water levels of this wetland are within the range 1.2–1.6m in most years and salinities are usually <15ppt. The 2010 levels of ≈0.6–0.3m and 26–94ppt were the lowest and highest for at least 32 years (routine monitoring began in 1979). An appallingly nauseating odour encountered by JL while sampling Wannamal in November 2010 seemed to be coming from recently-exposed damp muds near the eastern shoreline. After returning to

normal values in 2011, the September water level declined to a record low (0.6m) in 2012 and the September salinity rose to a record high (34ppt), while pH values were at 25 year lows. All returned to normal / near normal in 2013.

Warden (Esperance): 1999–2009 was an exceptionally long period of continuously high water levels (≈2.0–2.7m) for Warden and was due to a combination of catchment clearing (resulting in increased run-off and groundwater rise; Marimuthu *et al*. 2005) and extreme rainfall events (Kusumastuti 2006). Robertson & Massenbauer (2005) considered that rises in groundwater levels started directly impacting the wetlands by prolonging inundation from about 1986 onwards. Engineering works were considered essential to reduce Warden's water levels and thereby recover shorebird habitat and degraded riparian vegetation (Walshe & Massenbauer 2008). Water levels declined by ≈0.6m from Nov 2009 to Nov 2010 and this was thought to be partly due to artificial lowering of water levels in Wheatfield (see below), to which Warden is hydrologically-connected via Windabout and Woody Lakes (pers. comm. J. Lizamore, 05 January 2011). In 2012, September and November water levels declined to levels (≈0.75m) not seen since the mid to late 1990s and salinities rose to levels (>170ppt) not seen since the early 1980s. Water levels were higher (≈1.2m) and salinities lower (≈110ppt) in 2013. Similar-depth salinity comparisons (e.g. 2013 and 2011 with 1984, 1987, 1991 and 1994) indicate the salt load in recent years has been greater than pre-1999. Recent publications relating to studies and management of Warden include Pinder & Lizamore (2012), Pinder *et al*. (2012, 2013), Lizamore *et al.* (2013) and Higbid *et al.* (2014).

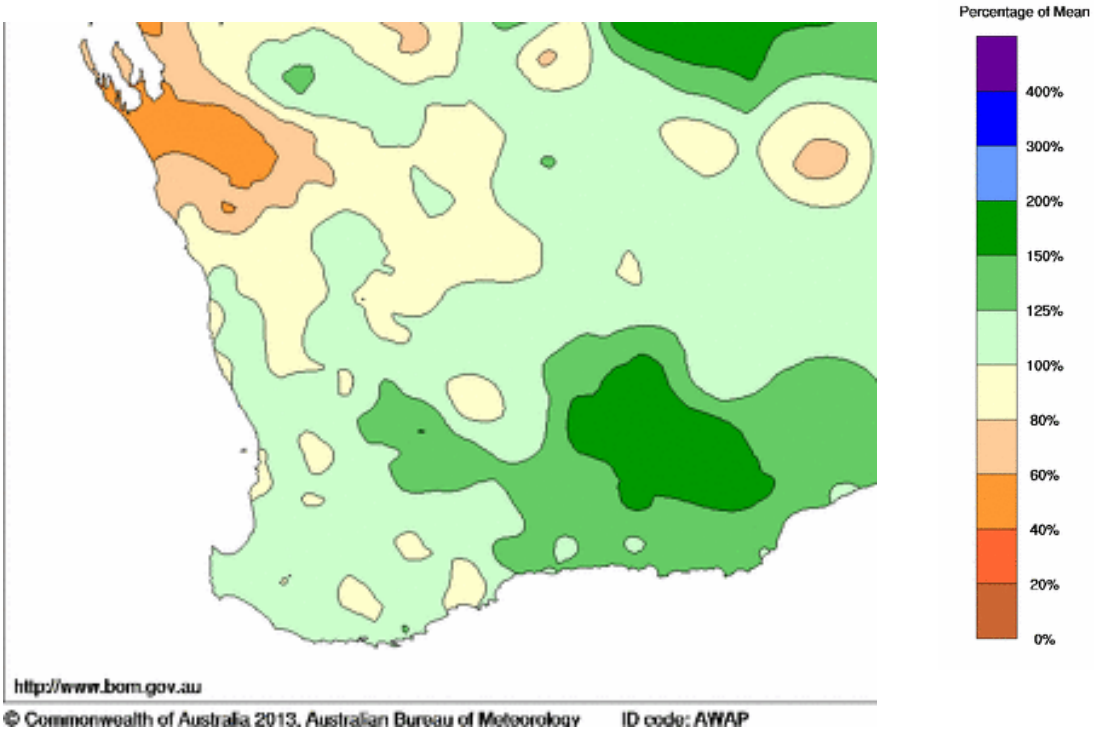

Figure 5. Rainfall percentages for the 12 month period from 01 Nov 2012 to 31 Oct 2013.

Warrinup (Cranbrook): In the eight years prior to the filling event (to ≈1.1m) of 1988, September and November water levels did not exceed 0.3m. Post-1988, levels have generally been higher than 0.3m, frequently exceeding 0.4m and occasionally exceeding 0.8m, perhaps indicating a shift in the hydrological balance of this still 'very fresh' (<1ppt) swamp.

Wheatfield (Esperance): A gravitational pipeline constructed in February–March 2009 is being used to lower water levels in Wheatfield, which is hydrologically-connected (at various cease-to-flow levels) to Woody, Windabout and Warden Lakes. Since construction, the pipeline has been open from April 2009 to January 2010, May 2011 to February 2012 and more-recently (pers. comm. J. Lizamore, 04 July 2012 & 11 September 2013). Cale *et al.* (2011) have reported results of biodiversity monitoring of Wheatfield from 1997–2009 under the State Salinity Strategy.

White (Narrogin): The filling event (to ≈2m) of 1983 was perhaps a once in three decades event, like that of Taarblin, seven kilometers to the north-east. However, due to a gap in monitoring from 1985 to 1996, this is not known for certain. This lake has been dry / near dry every September and November for the past 14 years and possibly longer.

White Water (Narrogin): This wetland has been dry in September and November for the past six years (2008–2013). This is the longest period of being continuously dry in these months in 33 years of monitoring.

Yarnup (Cranbrook): Yarnup's water levels and salinities reached their lowest (≈0.3–0.4m) and highest (8–13ppt) recorded values respectively in 2010 and since that year have shown limited improvement. Secondary salinisation of this formerly very fresh (<1ppt) wetland is evident from similar-depth salinity comparisons (e.g. 2012 & 2013 with 1987; 2009 with 1984, 1991 & 1996, and 2008 with 1985 & 1990).

Yarnup's pH values, which are normally within the range 6–8 pH units, have been lower (3–5) during and immediately following some recent years (2001, 2007, 2010 and subsequently) of lower water levels. Despite record low water levels in 2010, pH values were within their usual range in spring of that year, but dropped to 3.8 in September 2011 and then partially recovered to 5.7 in November 2011 following unseasonal rains and a rise in water level. In 2013 pH values fell again to near-record (Sept) and record (Nov) levels (3.9 & 3.6 respectively). Rising acid saline groundwater is a threat to this and other wetlands in the Muir-Unicup catchment (Smith & Hearn 2006).

Yeagarup (Manjimup): Routine September and November monitoring of the depth, salinity and pH of Yeagarup began under SWWMP in 2011[1]. Bathymetric survey by AC and YW in March 2014 confirmed that — depth of peat deposits aside (see Jasper above) — this is the deepest of all SWWMP wetlands (current and historical) with September and November depths of 2011–2013 ranging 10.3–10.5m.

Yellilup (Jerramungup): Salinities have risen dramatically since the mid 1990s when water levels began to fall following the exceptional filling event (to >4m) of 1988. The waters of Yellilup Lake (not to be confused with nearby Yellilup Swamp) were predominantly fresh (1<3ppt) prior to 1992, but by 2008 were hypersaline (≥50ppt). Similar-depth salinity comparisons, e.g. 2013 (≈34ppt) with 1987 (≈4ppt), indicate a massive increase in this lake's salt load (tonnes).

Prolonged inundation (1988 to 1994 and beyond) is thought to have been the primary cause of the extensive death of Flat-topped Yates *Eucalyptus occidentalis* and melaleucas that once extended over a large part of the lake floor. These changes have had major consequences for use by waterbirds (Jaensch *et al.* 2009, Clarke *et al.* 2011).

Highest and lowest water levels, salinities and pH values in 2013

Water levels

Seven SWWMP wetlands (Chandala, Esperance 26410, Maringup, Moates, Owingup, Powell and Wilson) recorded their highest-recorded September and/or November water levels[2] in 2013, whereas none experienced its lowest.

Thirty-two SWWMP wetlands were dry in both monitoring months of 2010 (a very dry year), while 12 were dry in the same months of 2011, 22 were dry in 2012 and 11 (Bennetts, Bryde, Colletts, Kent 29020, Pabelup South, Pillenorup, Taarblin Sth, Toolibin, Walbyring, Walyormouring and White Narrogin) were dry in 2013.

Salinities[1]

Seven SWWMP wetlands (Albany 26385, Albany 27157, Moates, Nine Mile, Pleasant View, Warrinup and Yurine) experienced their lowest-recorded September and/or November salinities in 2013. Five SWWMP wetlands (Atkins Yate, Davies, Range Road Yate, Tordit-Gurrup and Wheatfield) experienced their highest.

pH values[1]

Eleven SWWMP wetlands (Albany 26385, Albany 27157, Coomalbidgup, Goonaping, Little White, Moates, Pleasant View, Tordit-Gurrup, White Narrogin, Yarnup and Yurine) experienced their lowest-recorded September and/or November pH values in 2013. Two SWWMP wetlands (Muir and Ronnerup) experienced their highest.

Rainfall in 2013

Rainfalls in south-western Australia in 2013 ranged from <400mm to >1200mm, with the highest falls being recorded near the lower west coast and western south coast (Fig. 2). Falls in these latter areas, and near the eastern south coast and eastern central agricultural area, were generally 100–200mm above average, with some small parts near the coast being >200mm above average (Fig. 3). Elsewhere rainfalls were 0–100mm above or below average.

The rainfall deciles map (Fig. 4) shows that falls immediately east of Albany, and near the eastern south coast and eastern central agricultural area, were 'very much above average' (decile 10), while falls elsewhere in the South West were 'average' (deciles 4–7) to 'above average' (deciles 8–9).

[1] The water level was measured relative to a fixed point on the boardwalk from 2011 until a bathymetric survey was conducted and depth gauge installed by AC and YW in March 2014.

[2] Not including wetlands with less than five years of data.

3. CONCLUSIONS

Readers are encouraged to view all Graphs (Albany 26385 toYurine) of this report for other changes of possible interest or concern and perhaps for reassurance that, 36 years since commencement of SWWMP, while many wetlands are being impacted by declining rainfall, some clearly remain in good condition, at least in terms of the monitored key parameters.

Regional, District and specialist branch staff of the Department of Parks and Wildlife may find it useful to refer to Table 2 in order to readily identify monitored wetlands in their areas of management responsibility. Requests for data should be directed to jim.lane@dpaw.wa.gov.au.

Historical SWWMP wetlands

SWWMP depth gauges at the 53 historically-monitored wetlands (monitored under SWWMP at some time in the past but not currently; see Tables 1–3) are not maintained and many are now illegible or missing. Readers with a need to resume monitoring at one or more of these wetlands, even for a short period, are encouraged to contact SWWMP staff for details of the legally-protected Landgate[1] Bench Marks (local survey datums) at each of these wetlands so that new depth gauges, if needed, can be installed to the same elevations as those previously installed. Water level data 'continuity' can thereby be maintained.

Bathymetric mapping

Between 1997 and 2009, SWWMP staff, working with Landgate and contract surveyors, and with significant funding support from several DPaW Regions and Districts, mapped the bathymetry (lakebed and shoreline contours and inflow and outflow channels) of 19 SWWMP wetlands. In 2014, the beds of two SWWMP wetlands (Yeagarup and Yeagarup South) were mapped by authors AC and YW. An additional 18 SWWMP wetlands are known to have been mapped by others, in two cases (Byenup in 2009 and Tordit-Gurrup in 2011) with field assistance from SWWMP staff. A list of all 39 wetlands, together with their years of mapping, methods employed, products and custodians/sources is provided in Table 6.

Bathymetric mapping enables water surface areas, water volumes and salt loads (tonnes) to be calculated from measured depths and salinities and thereby assists in water balance and salt balance modelling and the assessment of likely impacts on specific wetlands of drainage, diversion, pumping and storage proposals, proposed land use changes and predicted climate change. Requests for bathymetric maps of SWWMP wetlands should be directed in the first instance to jim.lane@dpaw.wa.gov.au. Funded requests to map the bathymetry of additional SWWMP wetlands, particularly wetlands of high conservation value under threat, are welcome. SWWMP Senior Technical Officer Alan Clarke has considerable experience in organising, supervising and conducting bathymetric surveys.

Aerial photography

High resolution, low altitude, aerial oblique photography is useful for mapping wetland vegetation, monitoring vegetation condition, planning and conducting biological surveys, planning recreational activities and facilities, and in interpretation and extension. During the period 2008–2012, 152 of the 156 SWWMP wetlands were flown and photographed with specialised camera equipment to obtain photographs suitable for these purposes. A sample of low resolution prints and enlargements is presented in this report (photos 17–24 & 32–50). Digital copies of original, high resolution photographs of any of the 152 wetlands (see Table 7 for a list) may be obtained by directing requests to jim.lane@dpaw.wa.gov.au

Continuous water level and rainfall recording

Commencing in June 2009, authors Clarke and Winchcombe installed continuous water level recorders and tipping-bucket rainfall gauges on 14 SWWMP wetlands ('Albany 27157', Big Boom, Broadwater, Chandala, Crackers, Davies, 'Esperance 26410', Gingilup, Maringup, McLarty, Mettler, Nine Mile, Pillenorup, Pleasant View). This equipment is being kept in operation at these locations for several years and then moved to other high conservation value SWWMP wetlands of special interest (e.g. for the specially-protected Australasian Bittern, see Appendix 4) and/or under threat. Collection of continuous water level and rainfall data in this manner will enable salt and water balance models[2] to be developed for these and other south-western Australian wetlands and will thereby assist in their conservation management. The data will also assist in development of an improved understanding of the likely consequences of predicted climate change, particularly rainfall decline, on wetlands of south-western Australia. In 2013 the water level recorders and rainfall gauges were removed from the five northern-most (Broadwater, Chandala, Crackers, McLarty and Nine Mile) of the 14 wetlands.

[1] Formerly known as the WA Department of Land Information.

[2] See Peck (2000) for an early example using SWWMP data from Coyrecup Lake.

Trend analyses

This report has been prepared as the seventh in a series of annual reports aimed at putting the most-recent SWWMP data in front of readers in un-analysed form as soon as possible after data collection. Results and interpretations of statistical trend analyses are to be presented in other, less-frequent reports covering the longer time periods required to assess such trends.

Biological monitoring

The authors would like to draw readers' attention to the numerous reports and publications (e.g. Cale 2008; Cale *et al*. 2004, 2010; Cale & Halse 2006a-u; Gibson *et al.* 2004; Halse *et al.* 2002; Lyons *et al.* 2007) concerning the fringing and emergent vegetation, waterbirds, aquatic invertebrates, groundwater and detailed water chemistry of the 25 SWWMP wetlands (shown in bold in Tables 1,2,4–7) that have been intensively monitored by other DEC/DPaW scientists and collaborators under the State Salinity Strategy.

Recreation and Threatened Species & Communities

Readers' attention is also drawn to Appendices 2 & 3, which relate to recreational use of SWWMP wetlands, and Appendix 4, concerning threatened vertebrate fauna and SWWMP wetlands.

4. ACKNOWLEDGEMENTS

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Most SWWMP data have been collected by the authors of this report and by G.B. Pearson (retired from DEC in Feb 2008) and D.R. Munro (retired from CALM in May 1991, since deceased). Bill Muir, Brent Johnson and Sue Elscot each conducted a number of monitoring runs between 2000 and 2007. Keith Morris and Greg Keighery are thanked for making Brent and Bill available for this work. Ian Wheeler assisted with SW sector monitoring runs in 2005, 2007 and 2012–2014 and David Cale conducted the SE run in September 2013. Roger Hearn, Brad Barton and Adrian Pinder are thanked for their assistance.

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Wilfe Lehre, Nick Caputi, Norman Hall, Paul Gioia and Russell Marks (Greenbase Consulting) programmed a multitude of computers for the storage, analysis and reporting of SWWMP data over three decades. Matt Williams of DPaW provided statistical advice concerning trends analysis of SWWMP data to 2000 (reported in Lane *et al.* 2004).

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The Commonwealth of Australia's Bureau of Meteorology is the source and copyright holder of the rainfall maps presented in this report as Figures 2–5. These maps are presented with permission of the Bureau.

Photograph credits: Photos 1 & 3 were taken by volunteer John Winchcombe; 2, 4–9, 51–56 by Jim Lane; 10, 16, 25, 26, 28 & 29 by Yvonne Winchcombe; 11–15 & 30, 31 by Alan Clarke; 27 by Saul Cowen. Aerial photos 17–24 & 32–50 were taken by Alf Lorkiewicz of DPaW Bunbury and entirely funded under SWWMP and Jim Lane is custodian of these.

5. REFERENCES

Anon. (2013). *Water supplementation for Thomsons Lake Nature Reserve: Review of the 2012 Supplementation Program. Unpublished* report provided by G. Patorniti of WA Department of Parks & Wildlife. 6pp.

Anon. (2014). *Water supplementation for Thomsons Lake Nature Reserve: Review of the 2013 Supplementation Program. Unpublished* report provided by G. Patorniti of WA Department of Parks & Wildlife. 6pp.

ARL (1992). *Survey of the macroinvertebrate fauna and water chemistry of permanent lakes of the south coast of Western Australia*. Report ARL 022 prepared by the Aquatic Research Laboratory, Department of Zoology, University of Western Australia, for the WA Department of Conservation & Land Management.

Arnold, J.M. (1990a). *Jenny Arnold's Wetlands Resource Book. Chapters 5-6: Wetlands of the Northern and Eastern Gnangara Mound and Eastern Wanneroo Wetlands.* Bulletin 266. Environmental Protection Authority and Water Authority of Western Australia, Perth.

Arnold, J.M. (1990b). *Jenny Arnold's Wetlands Resource Book. Chapter 7: Wanneroo Linear Lakes.* Bulletin 266. Environmental Protection Authority and Water Authority of Western Australia, Perth.

Arnold, J.M. (1990c). *Jenny Arnold's Wetlands Resource Book. Chapters 9-11: East Beeliar Wetlands. Wetlands of the South West Corridor and of the Rockingham Plain.* Bulletin 266. Environmental Protection Authority and Water Authority of Western Australia, Perth.

Arnold, J.M. (1990d). *Jenny Arnold's Wetlands Resource Book. Chapters 12-15: East Beeliar Wetlands. Wetlands of the Eastern Coastal Plain and of the Inner Central Suburban Area. Wetlands of the Rivers and Estuaries and of the Serpentine Region.* Bulletin 266. Environmental Protection Authority and the Water Authority of Western Australia, Perth.

Bamford, M., Watkins, D., Bancroft, W., Tischler, G. & Wahl, J. (2008). *Migratory Shorebirds of the East Asian - Australasian Flyway; Population Estimates and Internationally Important Sites.* Wetlands International - Oceania. Canberra. 239pp.

Barrett, G., Silcocks, A., Barry, S., Cunningham, R. & Poulter, R. (2003). *The New Atlas of Australian Birds.* Royal Australasian Ornithologists Union, Melbourne.

Blakers, M., Davies, S.J.J.F. & Reilly, P.N. (1984). *The Atlas of Australian Birds.* Melbourne University Press.

Cale, D.J. (2008). *Wetland survey of the Lake Bryde natural diversity recovery catchment : waterbirds, aquatic invertebrates and water chemistry*. Report of WA Department of Environment & Conservation. 40pp.

Cale, D.J. & Halse, S.A. (2006a-u). *Altham, Ardath, Bennetts, Blue Gum, Bryde, Campion, Coomalbidgup, Coomelberrup, Coyrecup, Dumbleyung, Eganu, Fraser, Logue, Noobijup, Paperbark, Pleasant View, Ronnerup, Towerrinning, Walyormouring, Wheatfield and Yaalup waterbirds.* A series of 21 pamphlets published by the WA Department of Environment & Conservation, Perth.

Cale, D.J., Halse, S.A. & Walker, C.D. (2004). *Wetland monitoring in the wheatbelt of south-west Western Australia: site descriptions, waterbird, aquatic invertebrate and groundwater data.* Conservation Science Western Australia 5(1):20–136.

Cale, D., Lyons, M., McCormick, C., Pinder, A. & Walker, C. (2010). *State Salinity Strategy wetland biodiversity monitoring report: Lake Eganu 1998 to 2007.* WA Department of Environment & Conservation. 40pp.

Cale, D.J., McCormick, C., Lyons, M.N. & Pinder, A.M. (2011). *State Salinity Strategy Wetland Biodiversity Monitoring Report: Lake Wheatfield 1997 to 2009.* WA Department of Conservation & Environment. 62pp.

CALM (2004). *Water Supplementation Operational Management Plan for Thomsons Lake Nature Reserve*. WA Department of Conservation and Land Management, Perth.

CALM (2005). *Beeliar Regional Park Proposed Final Management Plan 2005-14.* Management Plan 57 prepared by the WA Department of Conservation and Land Management for the Conservation Commission of Western Australia.

Clarke, A.G., Lane, J.A.K. & Jaensch, R.P. (2011). *Surveys of waterbirds in selected wetlands of south-western Australia in spring-summer 2009-10, with further assessment of changes in habitat and waterbird usage over 2-3 decades.* WA Department of Environment and Conservation. 101pp.

Davies, S. (2010). *An investigation of the cause and effects of increased salinity in a freshwater coastal wetland: Lake Davies, Western Australia.* Report submitted for unit ENV421 Environmental Science Project for Degree of Bachelor of Environmental Science, Murdoch University, May 2010.

Davis, J., Froend, R., Hamilton, D., Horwitz, P., McComb, A., Oldham, C. & Thomas, D. (2001). *Environmental Water Requirements to Maintain Wetlands of National and International Importance.* Environmental Flows Initiative Technical Report No. 1. Environment Australia, Canberra.

DEC (2009). *Water Supplementation for Thomsons Lake Nature Reserve: review of the 2008 Supplementation Program.* Unpublished report of the WA Department of Environment and Conservation. 6pp.

DEC (2012). *Water Supplementation for Thomsons Lake Nature Reserve: review of the 2011 Supplementation Program*. Unpublished report of the WA Department of Environment and Conservation. 6pp.

de Tores, P.J., Hayward, M.W., Dillon, M.J. & Brazell, R. (2007). *Review of the distribution, causes for the decline and recommendations for management of the quokka, Setonix brachyurus (Macropodidae: Marsupialia), an endemic macropod marsupial from south-west Western Australia.* Conservation Science Western Australia 6(1):13-73.

DEC (2013). *Quokka (Setonix brachyurus) Recovery Plan.* Western Australian Wildlife Management Program No. 56. WA Department of Environment & Conversation, 29pp.

Dortch, C.E. (1996). *Prehistory down under: Archaeological investigations of submerged Aboriginal sites at Lake Jasper, Western Australia*. Antiquity 70:116-123.

Durell, G., Nicholson, N. & McNight, R. (2010). *Triple test: recovering natural biodiversity at Toolibin Lake and Lake Bryde.* Landscope 25(4):51-55.

Elscot, S.V., Lane, J.A.K., Clarke, A.G. & Muir, W.P. (2009). *Nomination and improved documentation of nationally important wetlands in under-represented IBRA regions in Western Australia*. WA Department of Conservation & Land Management. 77pp.

Environment Australia (2001). *A Directory of Important Wetlands in Australia, 3rd Edition.* Environment Australia, Canberra. [http://www.environment.gov.au/water/topics/wetlands/database/diwa.html in Sept 2013].

Froend, R.H. & McComb, A.J. (1991). *An account of the decline of Lake Towerrinning, a wheatbelt wetland.* J. Roy. Soc. West. Aust. 74:123-28.

Frost, F.M., Hamilton, B., Lloyd, M. & Pannell, D.J. (2001). *Salinity: a new balance. The report of the Salinity Taskforce established to review salinity management in Western Australia*. WA Government, Perth.

Garstone, R. (197..?). *Birds of the Great Southern: a checklist of birds of the Great Southern area of Western Australia*. Perth.

Gibson, N., Keighery, G.J. & Lane, J.A.K. (2004). *Five years of monitoring of the Lake Muir-Unicup wetland system, south-western Australia*. J. Roy. Soc. W.A. 87:29-33.

Government of Western Australia (1990). *Wetlands nominated by the Government of Western Australia for inclusion on the List of Wetlands of International Importance, Ramsar Convention.* Nominating document prepared by WA Department of Conservation and Land Management, Perth. 43pp.

Government of Western Australia (1996a). *Western Australian Salinity Action Plan.* Report to the Minister for Primary Industry and the Minister for the Environment prepared by the Chief Executive Officers of Agriculture Western Australia, the Department of Conservation and Land Management, the Department of Environmental Protection and the Water and Rivers Commission, November 1996.

Government of Western Australia (1996b). *Salinity: a situation statement for Western Australia.* Report to the Minister for Primary Industry and the Minister for the Environment prepared by the Chief Executive Officers of Agriculture Western Australia, the Department of Conservation and Land Management, the Department of Environmental Protection and the Water and Rivers Commission, November 1996.

Government of Western Australia (2000). *Wetlands nominated by the Government of Western Australia for inclusion on the List of Wetlands of International Importance, Ramsar Convention.* Nominating document prepared by WA Department of Conservation and Land Management, Perth. 48pp.

Government of Western Australia (2002). *Salinity: a new balance.* Government's response to the Salinity Taskforce report of 2001 (Frost *et al.* 2001). Government of Western Australia, Perth.

Halse, S.A., Cale, D.J., Jasinska, E.J. & Shiel, R.J. (2002). *Monitoring change in aquatic invertebrate biodiversity: sample size, faunal elements and analytical methods.* Aquatic Ecology 36:395-410.

Halse, S.A., Jaensch, R.P., Munro, D.R. & Pearson, G.B. (1990). *Annual waterfowl counts in south-western Australia – 1988/89.* WA Department of Conservation & Land Management Technical Report No.25. 43pp.

Halse, S.A, Pearson, G.B, Vervest, R.M. & Yung, F.H. (1995). *Annual waterfowl counts in south-west Western Australia – 1991/92*. CALMScience 2(1): 1-24.

Higbid, J., Lizamore, J. & Pinder, A. (2014). *The shorebirds are back in town*. Landscope 30(1):44-49.

Hooper, K., & Wallace, K. (1994). *Recovering Lake Toolibin*. Landscope 10(1):41-44.

Jaensch, R.P. (1992). *Fishes in wetlands on the south coast of Western Australia.* Report for WA Department of Conservation & Land Management. 109pp.

Jaensch, R.P., Clarke, A.G. & Lane, J.A.K. (2009). *Surveys of waterbirds in selected wetlands of south-western Australia in spring-summer 2008-9, with an assessment of changes in habitat and waterbird usage over 2-3 decades.* Report by Wetlands International – Oceania, Brisbane, to WA Department of Environment and Conservation. 78pp.

Jaensch, R.P. & Vervest, R.M. (1987). *Observations.* Western Australian Bird Notes No. 41 p.2.

Jaensch, R.P. & Vervest, R.M. (1988). *Ducks, swans and coots in south-western Australia: the 1988 count and recommendations*. Royal Australasian Ornithologists Union Report 46. 26pp.

Jaensch, R.P., Vervest, R.M. & Hewish, M.J. (1988). *Waterbirds in nature reserves of south-western Australia 1981-1985: Reserve accounts.* Royal Australasian Ornithologists Union Report 30. 290pp.

Jaensch, R.P. & Watkins, D. (1999). *Nomination of additional Ramsar wetlands in Western Australia*. Report by Wetlands International – Oceania to the Western Australian Department of Conservation and Land Management. 291pp.

Johnstone, R,E. & Storr, G.M. (1998). *Handbook of Western Australian Birds. Vol. 1 – Non-Passerines (Emu to Dollarbird).* Western Australian Museum, Perth.

Jones, S., Lacey, P. & Walshe, T. (2009). *A dynamic hydrological Monte Carlo simulation model to inform decision-making at Lake Toolibin, Western Australia*. Journal of Environmental Management 90(5):1761-1769.

Knott, B., Bruce, L., Lane, J., Konishi, Y. & Burke, C. (2003). *Is the salinity of Lake Clifton (Yalgorup National Park) increasing?* J. Roy. Soc. West. Aust. 86:119-122.

Kusumastuti, D.I. (2006). *Effects of threshold nonlinearities on the transformation of rainfall to runoff to floods in a lake-dominated catchment system.* PhD Thesis of the University of Western Australia.

Lane, J.A.K. (1981). *Waterbird survey commissioned.* SWANS [State Wildlife Advisory News] 11(3):11-14.

Lane, J.A.K., Clarke, A.G., Pearson. G.B. & Winchcombe, Y.C. (2007). *Waterbirds of the Vasse-Wonnerup wetlands in 1998-2000, including Ramsar status and comparisons with earlier data.* WA Department of Environment & Conservation report (pp.47-51).

Lane, J.A.K., Clarke, A.G. & Winchcombe, Y.C. (2010). *South West Wetlands Monitoring Program Report 1977-2009.* WA Department of Environment & Conservation. 148pp.

Lane, J.A.K., Clarke, A.G. & Winchcombe, Y.C. (2011). *South West Wetlands Monitoring Program Report 1977-2010.* WA Department of Environment & Conservation. 156pp.

Lane, J.A.K., Clarke, A.G. & Winchcombe, Y.C. (2013). *South West Wetlands Monitoring Program Report 1977-2011.* WA Department of Environment & Conservation. 158pp.

Lane, J.A.K., Clarke, A.G. & Winchcombe, Y.C. (2013). *South West Wetlands Monitoring Program Report 1977-2012.* WA Department of Parks & Wildlife. 168pp.

Lane, J.A.K., Clarke, A.G., Winchcombe, Y.C., Pearson, G.B., Muir, W.P., Johnson, B.W. & Elscot, S.V. (2009a). *South West Wetlands Monitoring Program Report 1977-2007.* WA Department of Environment & Conservation. 331pp.

Lane, J.A.K., Clarke, A.G., Winchcombe, Y.C., Pearson, G.B., Muir, W.P., Johnson, B.W. & Elscot, S.V. (2009b). *South West Wetlands Monitoring Program Report 1977-2008.* WA Department of Environment & Conservation. 142pp.

Lane, J.A.K., Pearson, G.B., Clarke, A.G., Winchcombe, Y.C. & Munro, D.R. (dec.) (2004). *Depths and salinities of wetlands in south-western Australia: 1977-2000.* WA Department of Conservation & Land Management. 129pp.

Lizamore, J., Simons, J., Davies, S., Pinder, A. & Vogwill, R. (2013). *Managing and adapting to secondary salinity and altered hydrology in a Ramsar listed lake suite: Lake Warden wetland system case study.* Abstract of Paper presented at the WA State Coastal Conference, Balancing communities and coasts, Esperance, 2013. WA Department of Parks & Wildlife. pp.1-2.

Lyons, M.N., Halse, S.A., Gibson, N., Cale, D.J., Lane, J.A.K., Walker, C.D., Mickle, D.A. & Froend, R.H. (2007). *Monitoring wetlands in a salinizing landscape: case studies from the wheatbelt region of Western Australia*. Hydrobiologia 591:147–164.

Marchant, S. & Higgins, P.J. (Eds) (1993). *Handbook of Australian, New Zealand, & Antarctic Birds. Vol. 2, Raptors to Lapwings.* Oxford University Press, Melbourne.

Marimuthu, S., Reynolds, D. & Gal La Salle, C. (2005). *A field study of hydraulic, geochemical and stable isotope relationships in a coastal wetlands system.* Journal of Hydrology 315:93-116.

Morgan, D.L., Beatty, S.J., Klunzinger, M.W., Allen, M.G. & Burnham, Q.F. (2011). *A field guide to freshwater fishes, crayfishes, & mussels of south-western Australia*. South East Regional Centre for Urban Landcare (SERCUL), Perth.

Peck, A.J. (2000). *Salt lake hydrology: potential impact of drainage schemes.* Paper presented at *Hydro 2000,* 3rd International Hydrology and Water Resources Symposium, 20-23 November 2000, Perth, Western Australia.

Pickering, R. (2012). *Summary of the Bittern project 2011/12*. Western Australian Bird Notes No. 142. pp.16-17.

Pickering, R. (2013). *Australasian Bittern in Southwest Australia*. Unpublished report by Robyn Pickering of 'Birdlife Australia' dated March 2013. 120pp.

Pinder. A, Cale, D., Halse, S. & Leung, A. (2012). *Waterbird monitoring of the Warden and Gore wetlands in November 2010 and February 2011*. WA Department of Environment & Conservation. 55pp.

Pinder, A., Cale, D., Halse, S. & Quinlan, K. (2012). *Waterbird monitoring of the Warden and Gore wetlands in December 2011 and February 2012*. WA Department of Environment & Conservation. 56pp.

Pinder, A., Cale, D. & Lizamore, J. (2013). *Restore it and they will come?* Hydrology and waterbirds in the Lake Warden wetlands. Abstract of paper presented at the WA State Coastal Conference, Balancing communities and coasts, Esperance, 2013. WA Department of Parks & Wildlife. 1p.

Pinder, A. & Lizamore, J. (2012). *Change in waterbird communities of the Warden wetlands.* WA South Coast Shorebird Network Newsletter 4, pp.2-3.

Ramsar Secretariat (2013). The Ramsar List of Wetlands of International Importance (http://www.ramsar.org/cda/en/ramsar-documents-list/main/ramsar/1-31-218_4000_0__) accessed Sept 2013.

Robertson, D. & Massenbauer, T. (2005). *Applying hydrological thresholds to wetland management for waterbirds, using bathymetric surveys and GIS.* MODSIM Conference Proceedings, Melbourne.

Smith, M.D., Goater, S.E., Reichwaldt, E.S., Knott, B. & Ghadouani, A. (2010). *Effects of recent increases in salinity and nutrient concentrations on the microbialite community of Lake Clifton (Western Australia): are the thrombolites at risk?* Hydrobiologia DOI 10.1007/s10750-010-0246-3

Smith, M.G. & Hearn, R.W. (2006). *The Lake Muir-Unicup catchment: clarifying the geology.* In *Regolith 2006 – Consolidation and Dispersion of Ideas.* Proceedings of the CRC LEME Regolith Symposium, November 2006, South Australia, eds R.W. Fitzpatrick & P. Shand. pp. 322-325.

Sommer, B. & Horwitz, P. (2001). *Water quality and macroinvertebrate response to acidification following intensified summer droughts in a Western Australian wetland*. Mar. Freshwater Res. 52:1015-21.

State Salinity Council (2000a). *Natural Resource Management in Western Australia – The Salinity Strategy*. Government of Western Australia.

State Salinity Council (2000b). *Natural Resource Management in Western Australia – Salinity Actions*. Government of Western Australia.

Wallace, K.J. (2001). *State Salinity Action Plan 1996: Review of the Department of Conservation and Land Management's programs, January 1997 to June 2000*. WA Department of Conservation & Land Management, Perth.

Wallace, K., Connell, K., Vogwill, R., Edgely, M., Hearn, R., Huston, R., Lacey, P., Massenbauer, T., Mullan, G., & Nicholson, N. (2011). *Natural Diversity Recovery Catchment Program: 2010 Review*. WA Department of Environment and Conservation, Perth.

Wallace, K. & Lloyd, C. (2008). *Managing salinity and water for conservation outcomes.* In Proceedings, 2nd International Salinity Forum: Salinity, water and society - global issues, local action, 31 March – 3 April 2008. Adelaide, South Australia. http://www.internationalsalinityforum.org/14_final.html

Walshe, T. & Massenbauer, T. (2008). *Decision-making under climatic uncertainty: A case study involving an Australian Ramsar-listed wetland.* Ecological Management & Restoration 9(3):202-208.

PHOTOS

Photo 1: DPaW depth gauge 'D' at Lake Muir on 18Sep2008 read 0.74m.

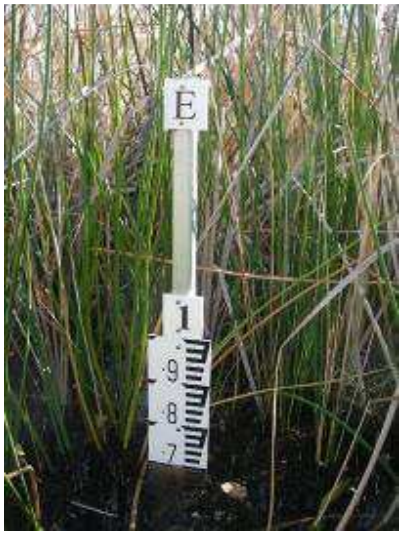


Photo 2: DPaW depth gauge 'E' at Thomsons Lake on 04Aug2008 read 0.70m.

Photo 3: DPaW depth gauge 'A' at Lake Wilson on 03Nov2008 read 3.85m.

Photo 4: DPaW depth gauge 'A' at Parkeyerring Lake on 18Jul2008 read 0.40m.

Photo 5: DPaW depth gauge 'C' at Lake Clifton on 13Sep2008 read 4.30m.

Photo 6: DoW water level gauge at Gibbs Road Swamp on 04Aug2008 read 24.59mAHD

Photographs 1–6: SWWMP Depth Gauges. Each depth gauge consists of one or more 1.00m metal or plastic gauge plates attached to a metal or wooden post. The gauge plate markings are in 0.01m increments, with labelling at 0.10m intervals. Labels 1, 2, 3, etc., at the top of each depth gauge indicate the height in metres (i.e. 1.00m, 2.00m, etc.) at the top of the uppermost gauge plate. Labels A, B, C, etc., where present, identify individual depth gauges at each wetland.

DPaW gauge readings indicate the water depth at the deepest location in the wetland, even though gauges are usually not at the deepest location, but instead are closer to the shore, to facilitate viewing.

Readings are taken from Department of Water (DoW) gauges at several metropolitan wetlands. These DoW gauges indicate height above Australian Height Datum (mean sea level), which SWWMP personnel convert to wetland water depth.

Since 2007, the standard practice of SWWMP personnel when taking gauge readings has been to take a digital photograph of the gauge at the time of reading, so that all records may be checked and verified or corrected back in the office.

Photo 7: 'Munro Datum' (3.00m) at Lake Logue in Sep 2008.

Photo 8: 'Landgate' Bench Mark HZ929 at Thomsons Lake in Aug 2008.

Photo 9: 'Landgate' Witness Plate at Goonaping Swamp in Sep 2008.

Photo 10: 'Landgate' Bench Mark and Witness Plate at 'Cranbrook 25812' in Nov 2008.

Photographs 7–10: SWWMP Datums and Bench Marks. Depth gauges installed prior to 1997 were surveyed to a nearby 'Munro Datum'; a block of concrete installed by (then) SWWMP Senior Technical Officer Don Munro (dec.) for data security. Numbers on top of these Datums indicate the height (m) above the deepest location in the wetland.

Since 1997, legally-protected 'Landgate' (WA Department of Land Information) Bench Marks (BM's) have been installed at all except six SWWMP wetlands and the gauges and Munro Datums have been surveyed to them. The BM's have since been surveyed to Australian Height Datum (mean sea level). BM installation and survey was a cooperative program of CALM/DEC and Landgate.

Photo 11: An amphibious vehicle is used to traverse the long distances involved in bathymetric survey of large dry or very shallow lakes. Steven Lowth, Lake Campion, 24May2004.

Photo 12: Vegetated lake beds and banks are traversed on foot. Brian Hugessen of Landgate, Byenup Lagoon, 26Mar2009.

Photo 13: Deeper wetlands are traversed by flat-bottomed punt. Lindsey Schuiling of Landgate, Byenup Lagoon, 22Mar2009.

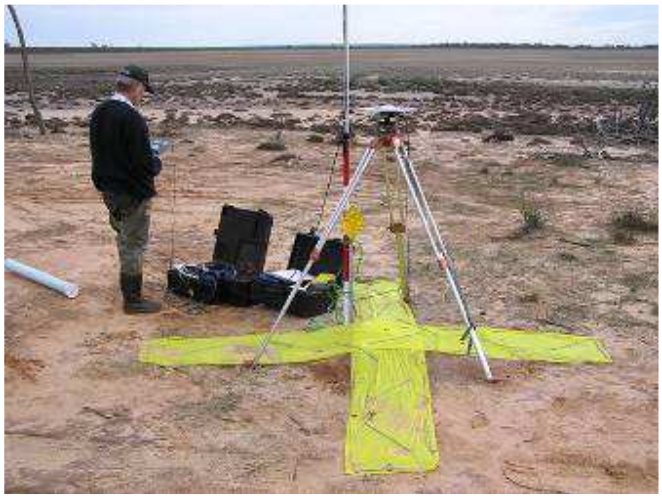


Photo 14: Photogrammetric surveys require targets (e.g. yellow crosses) with accurately-known positions and elevations. Doug Hardman of Landgate, Mollerin Lake, 16Jun2004.

Photo 15: Thick vegetation may pose a challenge for surveyors. Brian Hugessen of Landgate, Byenup Lagoon, 30Mar2009.

Photo 16: Unconventional flotation devices may be needed to reach depth gauges at large flooded wetlands accessible only on foot. Alan Clarke, Pillenorup Swamp, 22Mar2007.

Photo 17: Lake Jasper (Nannup Shire) is the second-deepest of all SWWMP wetlands (Lake Yeagarup is the deepest). Photo 20May2008.

Photo 18: Yarnup Swamp (Cranbrook) values are being impacted by salinisation and acidification. Photo 24May2008.

Photo 19: 'Boat Harbour 1' (Denmark) water levels and salinities have been more variable since 2000. Photo 20May2008.

Photo 20: Lake Muir (Manjimup) is thought to have last overflowed into the Deep River around 1900. Photo 20May2008.

Photo 21: Yellilup Lake (Jerramungup) trees were killed by continuous flooding from 1988 to 1994. Photo 21May2008.

Photo 22: Nine Mile Swamp (Murray), once open water, is now covered by bulrush due to several decades of declining water levels. Photo 19May2008.

Photo 23: Lake Warden (Esperance) water levels were too high for shorebirds and fringing vegetation for more than a decade. Since 2009 they have been lowered by engineering. Photo 16May2009.

Photo 24: Jerdacuttup Lakes (Ravensthorpe) water levels and salinities oscillate markedly over 5–15 yr time periods. Photo 16May2009.

Photo 25: Depth gauge installation. Alan Clarke, Yurine Swamp, 02Jun2010.

Photo 26: Water level logger, with support tube and angle iron. Nine Mile Swamp, 04Aug2009.

Photo 27: Telemetric download of water level logger data to laptop. Alan Clarke, Lake Pleasant View, 10Aug2010.

Photo 28: Tipping bucket rainfall recorders have been installed on 14 wetlands. Alan Clarke, 17Jun2009.

Photo 29: Reading the gauge and collecting water samples. Volunteer John Winchcombe, 'Albany 26385', 07Nov2006.

Photo 30: A kayak is the most efficient method of accessing the water level logger at 'Albany 27157'. 09Aug2010.

Photo 31: Amphibious vehicle and laptop used for downloading data from the Crackers water level logger. 13Oct2009.

Photo 32: Lake Bambun (Gingin) salinities have been increasing for the past four years and have recently returned to early 1980s levels. It is now fresh rather than very fresh. Photo 06Jun2010.

Photo 33: Chandala Swamp (Chittering) is a freshwater, melaleuca – eucalypt swamp that used to support thousands of nesting Straw-necked Ibis *Threskiornis spinicollis*. Photo 06Jun2010.

Photo 34: Crackers Swamp (Dandaragan) salinities are trending upwards and its extensive lake floor vegetation could be under threat. Photo 07Jun2010.

Photo 35: Taarblin Lake (Narrogin), though secondarily salinised, has bands of young, live Swamp Sheoak *Casuarina obesa* on elevated ground in the southern basin. Photo 26May2010.

Photo 36: Mortijinup Lake (Esperance) water levels fell and salinities rose from 2000 to 2011. These trends were reversed in 2012. Photo 16May2009.

Photo 37: Forrestdale Lake (Armadale) depths have trended lower since the early 1990s, facilitating the spread of the introduced bulrush *Typha orientalis*. Photo 06Jun2010.

Photo 38: High resolution aerial oblique photos, e.g. of Atkins Yate Swamp (Lake Grace) are suitable for enlargement. Photo 17May2009.

Photo 39: Enlarged section of Photo 38 (Atkins Yate Swamp), showing vegetation banding, structure, composition and vigour. Photo 17May2009.

Photo 40: Shallowly-inundated eastern floor and distant shoreline of Dumbleyung Lake (Dumbleyung / Wagin). Photo 26May2010.

Photo 41: Enlarged section of Photo 40 (Dumbleyung Lake), showing shoreline vegetation structure, composition and vigour. Photo 26May2010.

Photo 42: Dulbinning Lake (Wickepin) is immediately upstream of Toolibin and has also been affected by secondary salinisation. Photo 26May2010.

Photo 43: Enlarged section of Photo 42 (Dulbinning Lake), showing live *Casuarina obesa* on elevated banks of old dam and dead trees on lake floor. Photo 26May2010.

Photo 44: 'Harvey 12632' (Harvey Shire) water levels have trended lower since the early 1990s. Photo 19May2008.

Photo 45: Towerrinning (West Arthur) water levels have been higher and salinities lower since flow diversion and other works in the early 1990s. Photo 24May2008.

Photo 46: Egret (Harvey) is the rectangle of trees in foreground, adjacent to Leschenault Inlet. Egret's pH values have, at times, been very low (≈3 pH units). Photo 19May2008.

Photo 47: Red (Bruce Rock) is usually dry or very shallow, hypersaline and acidic (pH 3–4). Photo 07Jun2010.

Photo 48: Joondalup (Joondalup) water levels have been consistently lower since the mid 1990s. Photo 06Jun2010.

Photo 49: Jandabup (Wanneroo) was temporarily acidic (pH ≈ 4) in the late 1990s. Photo 06Jun2010.

Photo 50: Wannamal (Gingin) produced a nauseating odour when the water level was exceptionally low in Nov 2010. Photo 06Jun2010.

Photo 51: Dobaderry (Beverley) lake floor vegetation (*Melaleuca lateritia*) appeared healthy in late 2009. Photo 13Nov2009.

Photo 52: Dobaderry vegetation (same photo site and direction as in Photo 51) was drought-stressed in 2010, partially recovered in 2011 and was severely stressed again in 2012 and 2013. Photo 16Sep2010.

Photo 53: Shrubs are colonising the floor of 'Harvey 12632' following two decades of declining water levels. Photo 14Sep2011.

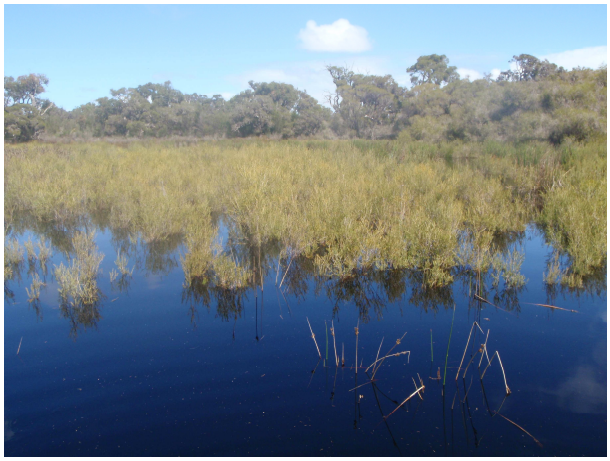


Photo 54: Same photo site and direction as in Photo 53. Two years on, the shrubs on the floor of 'Harvey 12632' are well-established. Photo 17Sep2013.

Photo 55: Casuarinas and melaleucas are advancing onto the floor of Logue (Carnamah) following a decade of drought. Photo 16Sep2011

Photo 56: Same photo site and direction as in Photo 55. Two years on, the saplings are now small trees. Photo 20Sep2013.

TABLES

Table 1. Monitored wetlands, codes, coordinates, tenure, Local Government Authorities and monitoring periods. This Table includes all wetlands ('current' and *'historical'*) regularly monitored at any time since commencement of the South West Wetlands Monitoring Program in 1977, sorted alphabetically by wetland name.

Wetland Name[1]	Code	Easting[2]	Northing[2]	Zone	Tenure[3]	Local Government Authority	Period monitored[4,5,6]
Ace[7]	*ACE*	*758029*	*6344741*	*50*	*CCWA*	*Lake Grace*	*7/80 - 5/85, 4/00*
Albany 26385[8]	ALB1	606041	6148594	50	CCWA	Albany	5/81 - 5/85, 9/98 onwards
Albany 27157	ALB2	618826	6147490	50	CCWA	Albany	3/80 - 5/85, 9/08, 9/09 onwards
Altham[9]	ALTH	634562	6302593	50	CCWA	Kent	7/80 - 11/91, 4/00 onwards
Anderson	ANDE	588666	6217158	50	CCWA	Tambellup	5/81 - 3/92, 9/00 onwards
Angove	*ANGO*	*605850*	*6132590*	*50*	*CCWA*	*Albany*	*11/79 - 5/85, 9/90, 4/00*
Ardath	ARDA	609068	6448377	50	CCWA	Bruce Rock	9/99 onwards
Atkins Yate	ATKI	750023	6330530	50	Private	Lake Grace	4/00 onwards
Bambun	BAMB	394880	6522829	50	CCWA	Gingin	5/79 onwards
Bennetts	BENN	742440	6314572	50	CCWA	Lake Grace	9/92 onwards
Beverley[10]	BEVE	514297	6432612	50	CCWA / LGA	Beverley / Brookton / Quairading	6/78 onwards
Biddy	*BIDD*	*682152*	*6344888*	*50*	*CCWA*	*Lake Grace*	*7/82 - 5/85, 9/91 - 1/93, 4/00, 7/09*
Big Boom	BIGB				UCL	Esperance	9/12 onwards
Blue Gum	*BLUE*	*401231*	*6615183*	*50*	*Private*	*Moora*	*11/99 – 11/10*
Boat Harbour 1	BOA1	508245	6124962	50	CCWA	Denmark	8/91 onwards
Bokan	*BOKA*	*549253*	*6349883*	*50*	*CCWA*	*Narrogin*	*7/79 - 5/85,11/08*
Boyup Brook 18239[10]	BOYU	469777	6257199	50	CCWA	Boyup Brook	9/80 onwards
Broadwater	BROA	341176	6273426	50	CCWA	Busselton	11/85 onwards
Brown	BROW	559606	6397735	50	CCWA	Corrigin	7/79 - 11/91, 9/97 onwards
Bruce Rock 30969	*BRUC*	*575133*	*6473941*	*50*	*CCWA*	*Bruce Rock*	*5/82 - 5/85*
Bryde	BRYD	669625	6308051	50	MWR	Kent	6/79 onwards
Byenup	BYEN	476449	6182437	50	CCWA	Manjimup	6/77 onwards
Cairlocup	*CAIR*	*662520*	*6266817*	*50*	*CCWA*	*Kent*	*9/80 - 5/85, 4/00, 5/09*
Camel	*CAME*	*588033*	*6204762*	*50*	*CCWA*	*Cranbrook*	*8/80 - 5/85, 4/00*
Campion	CAMP	627676	6554227	50	CCWA	Nungarin / Merredin	3/79 - 11/91, 5/99 onwards
Capamaura	*CAPA*	*393132*	*6691441*	*50*	*CCWA*	*Carnamah*	*7/80 - 5/85, 3/90, 11/09*
Casuarina	CASU	569525	6277315	50	CCWA	Katanning	5/78 onwards
Chandala	CHAN	400545	6514425	50	CCWA	Chittering	5/79 onwards
Chittering	*CHIT*	*414089*	*6521328*	*50*	*CCWA*	*Chittering*	*4/78 - 11/86*
Clifton	CLIF	374037	6376139	50	CCWA	Mandurah / Waroona	11/85 onwards
Coblinine	*COBL*	*564476*	*6306117*	*50*	*CCWA*	*Dumbleyung*	*6/79 - 11/91*
Collets Road	COLL			50	CCWA	Jerramungup	9/01 onwards
Coomalbidgup	CMBG	349163	6267892	51	LGA	Esperance	11/99 onwards
Coomelberrup	COOM	573060	6303130	50	CCWA	Dumbleyung	5/78 - 5/85, 3/93, 9/97 onwards
Corrigin 12900[10]	CORR	603415	6413294	50	CCWA	Corrigin	7/82 onwards
Coyrecup	COYR	577072	6268374	50	CCWA	Katanning	5/78 onwards
Crackers	CRAC	365586	6579519	50	CCWA	Dandaragan	7/80 onwards
Cranbrook 25812	*CRAN*	*573707*	*6203482*	*50*	*CCWA*	*Cranbrook*	*8/80 - 8/85, 4/00, 11/08*
Cronin	*CRON*	*760036*	*6413700*	*50*	*CCWA*	*Kondinin*	*4/81 - 5/85, 11/95, 4/01, 07/09*
Davies	DAVI	318852	6211560	50	CCWA	Augusta-Margaret River	4/91 onwards
Dobaderry	DOBA	463077	6437224	50	CCWA	Beverley	9/80 onwards
Dowerin	*DOWE*	*505689*	*6541494*	*50*	*LGA*	*Dowerin*	*6/79 - 5/81, 9/99*
Dulbinning	DULB	557418	6359015	50	CCWA	Wickepin	7/79 onwards

Table 1 continued.

Wetland Name	Code	Easting	Northing	Zone	Tenure	Local Government Authority	Period monitored
Dumbleyung	DUMB	560071	6309876	50	CCWA / LGA	Dumbleyung / Wagin	6/79 onwards
Dundas 33113	*DUND*	*391998*	*6359382*	*51*	*CCWA*	*Dundas*	*11/79 – 11/91, 4/00*
Eganu	EGAN	391567	6680556	50	CCWA	Coorow	7/78 onwards
Egret	EGRE	379666	6314855	50	CCWA	Harvey	5/85 onwards
Ellen Brook	*ELLE*	*408758*	*6486521*	*50*	*CCWA*	*Swan*	*7/79 – 11/84*
Eneminga	ENEM	358697	6590178	50	CCWA	Dandaragan	7/80 – 11/91, 09/08, 9/11 onwards
Esperance 26410	ESP1	304849	6265010	51	CCWA	Esperance	11/81 onwards
Esperance 27768	*ESP2*	*388786*	*6319769*	*51*	*CCWA*	*Esperance*	*6/81 - 5/85, 4/00*
Esperance 27985	*ESP3*	*385963*	*6309342*	*51*	*CCWA*	*Esperance*	*6/81 – 11/91, 4/00 -11/10*
Esperance 32128	*ESP4*	*471180*	*6278570*	*51*	*CCWA*	*Esperance*	*7/82 - 5/85*
Esperance 32776	*ESP5*	*438274*	*6294596*	*51*	*CCWA*	*Esperance*	*6/81 - 5/85, 4/00*
Flagstaff	FLAG	523642	6291467	50	CCWA	Woodanilling	6/79 – 11/91, 9/97 onwards
Forrestdale	FORR	400062	6442240	50	CCWA	Armadale	11/77 onwards
Frasers[10]	*FRAS*	*507236*	*6542443*	*50*	*Private*	*Dowerin*	*11/99 – 11/10*
Gardner	*GARD*	*605828*	*6129943*	*50*	*CCWA*	*Albany*	*5/81 - 5/85, 9/89, 9/90, 4/00, 9/08*
Gibbs	GIBB	397627	6441667	50	CCWA	Armadale	9/92 onwards
Gingilup	GINL				CCWA	Nannup	9/12 onwards
Gingin 31241	*GING*	*387922*	*6525676*	*50*	*CCWA*	*Gingin*	*6/79 - 5/85, 9/08*
Gnowangerup 26264	*GNO1*	*636100*	*6196278*	*50*	*CCWA*	*Gnowangerup*	*3/80 – 11/91, 9/08*
Gnowangerup 26569	*GNO2*	*636830*	*6257497*	*50*	*CCWA*	*Gnowangerup*	*7/82 - 5/85, 4/00*
Goonaping	GOON	461797	6443309	50	CCWA	Beverley	11/99 onwards
Goorly	*GOOR*	*503350*	*6664801*	*50*	*UCL*	*Dalwallinu*	*9/00 – 11/09*
Gore	GORE	363166	6263536	51	CCWA	Esperance	11/79 onwards
Gounter	*GOUN*	*672878*	*6413022*	*50*	*CCWA*	*Kondinin*	*7/80 – 11/91, 5/98, 7/09*
Gundaring	*GUND*	*546974*	*6315587*	*50*	*CCWA*	*Wagin*	*5/78 – 11/91*
Guraga	GURA	363476	6585412	50	LGA	Dandaragan	9/82 onwards
Harvey 12632	HARV	386550	6348919	50	CCWA	Harvey	8/80 onwards
Hebitons	*HEBI*	*345831*	*6806160*	*50*	*Private*	*Mullewa*	*9/00 – 11/09*
Hinds	HIND	456859	6596884	50	CCWA	Wongan-Ballidu	6/79 – 11/91, 9/97 onwards
Jandabup	JAND	390937	6486982	50	CCWA	Wanneroo	4/78 onwards
Jasper	JASP	379737	6190394	50	CCWA	Nannup	11/85 onwards
Jerdacuttup	JERD	246655	6241791	51	CCWA	Ravensthorpe	11/79 onwards
Joondalup	JOON	384352	6487435	50	CCWA	Joondalup	4/78 onwards
Karakin	*KARA*	*354428*	*6563848*	*50*	*WRC*	*Gingin*	*5/79 - 5/85, 9/87*
Kent 29020[10]	KENT	676818	6307259	50	CCWA	Kent	9/80 - 5/85, 4/00 onwards
Kondinin	*KOND*	*612045*	*6404006*	*50*	*CCWA*	*Kondinin*	*6/79 – 11/91, 4/00*
Kwobrup	*KWOB*	*593500*	*6267648*	*50*	*Private*	*Kent*	*6/79 – 11/91, 4/00*
Kwornicup	KWOR	538575	6176168	50	CCWA	Plantagenet	11/79 onwards
Little White	LITT	541357	6347281	50	CCWA	Narrogin	7/79 – 11/91, 9/97 onwards
Logue	LOGU	321114	6695888	50	CCWA	Carnamah	5/79 onwards
Maringup	MARI	426553	6144690	50	CCWA	Manjimup	6/91 onwards
Martinup	MART	516363	6289934	50	CCWA	Woodanilling	6/79 – 11/91, 9/97 onwards
McLarty	MCLA	379489	6379596	50	CCWA	Murray	11/93 - 11/94, 9/96 onwards
Mears	MEAR	533098	6433941	50	CCWA	Brookton	6/78 – 11/91, 9/97 onwards
Mettler	METT	646369	6172015	50	CCWA	Albany	9/82 onwards
Miripin	*MIRI*	*518066*	*6288832*	*50*	*CCWA*	*Woodanilling*	*6/81 - 5/85, 5/92, 9/09*

Table 1 continued.

Wetland Name	Code	Easting	Northing	Zone	Tenure	Local Government Authority	Period monitored
Moates	MOAT	600908	6131536	50	CCWA	Albany	11/79 onwards
Mollerin	*MOLL*	*554214*	*6625482*	*50*	*CCWA*	*Koorda*	*7/80 – 5/85*
Mortijinup	MORT	373710	6259469	51	CCWA	Esperance	4/00 onwards
Mount Le Grand	MLGR	419066	6240163	51	CCWA	Esperance	9/00 onwards
Mount Marshall 26687[10]	*MTMA*	*560937*	*6579648*	*50*	*CCWA*	*Mt Marshall*	*7/81 – 11/91, 5/99*
Muir	MUIR	471032	6185028	50	CCWA	Manjimup	11/79 onwards
Mungala	*MUNG*	*395151*	*6521364*	*50*	*CCWA*	*Gingin*	*6/79 – 5/85*
Murapin	*MURA*	*517681*	*6289397*	*50*	*CCWA*	*Woodanilling*	*6/81 – 5/85*
Murray 24739	*MURR*	*378784*	*6382052*	*50*	*CCWA*	*Murray*	*9/80 – 5/85, 8/08*
Nambung	*NAMB*	*394607*	*6521821*	*50*	*CCWA*	*Gingin*	*6/79 – 5/85*
Ngopitchup	NGOP	531747	6242644	50	WRC	Broomehill	4/00 onwards
Ninan	NINA	467029	6575597	50	CCWA	Wongan-Ballidu	7/78 – 11/91, 9/97 onwards
Nine Mile	NINE	385536	6376505	50	CCWA	Murray	6/81 onwards
Nonalling	*NONA*	*557243*	*6400132*	*50*	*CCWA*	*Corrigin*	*7/79 – 5/85*
Noobijup	NOOB	480867	6192653	50	CCWA	Cranbrook	9/99 onwards
Noonying	NOON	542507	6497744	50	CCWA	Tammin	6/79 – 11/91, 9/97 onwards
North Parriup	NPAR	281562	6250268	51	CCWA	Ravensthorpe	4/00 onwards
Owingup	OWIN	507258	6126756	50	CCWA	Denmark	7/91 onwards
Pabelup South	PABE	725800	6222286	50	CCWA	Jerramungup	4/00 onwards
Pallarup	*PALL*	*756890*	*6322416*	*50*	*CCWA*	*Lake Grace*	*7/80 – 11/91, 4/00, 11/08, 7/09*
Parkeyerring	PARK	533156	6307263	50	CCWA	Wagin	5/78 – 11/91, 9/97 onwards
Pillenorup	PILL	601412	6187773	50	CCWA	Plantagenet	4/00 onwards
Pinjarrega	*PINJ*	*395416*	*6670552*	*50*	*CCWA*	*Coorow*	*5/79 – 11/91*
Plantagenet 25386	*PLAN*	*597710*	*6176617*	*50*	*CCWA*	*Plantagenet*	*11/79 – 5/85, 11/93 – 11/96, 6/98, 11/08*
Pleasant View	PLEA	608357	6145314	50	CCWA	Albany	11/79 onwards
Poorginup	POOR	476447	6177128	50	CCWA	Manjimup	6/77 onwards
Powell	POWE	567497	6125091	50	CCWA	Albany	6/81 onwards
Queerearrup	*QUEE*	*521251*	*6291518*	*50*	*LGA*	*Woodanilling*	*10/78 – 5/85, 9/88, 11/08*
Range Road Yate	RANG	666083	6275186	50	MWR	Kent	4/00 onwards
Red (Bruce Rock)	REDB	602548	6437065	50	CCWA	Bruce Rock	7/81 – 5/85, 9/00 onwards
Red (Manjimup)	*REDM*	*468592*	*6189580*	*50*	*UCL*	*Manjimup*	*11/81 – 11/91, 4/00, 9/08*
Ronnerup	RONN	744169	6317786	50	CCWA	Lake Grace	4/00 onwards
Shark	SHAR	394568	6263073	51	CCWA	Esperance	11/79 onwards
Shaster	*SHAS*	*287219*	*6250710*	*51*	*CCWA*	*Ravensthorpe*	*11/79 – 11/91, 5/09*
Station	STAT	402615	6259237	51	CCWA	Esperance	3/80 onwards
Streets	*STRE*	*402493*	*6614985*	*50*	*Private*	*Moora*	*10/78 – 11/91, 9/08*
Taarblin North[11]	TAAN			50	CCWA	Narrogin	9/04 onwards
Taarblin South[11]	TAAR	551258	6350395	50	CCWA	Narrogin	5/78 onwards
Thomsons	THOM	389516	6441482	50	CCWA	Cockburn	11/78 onwards
Toolibin	TOOL	557650	6357248	50	CCWA	Wickepin	5/78 onwards
Tordit-Gurrup	TORD	476135	6179406	50	CCWA	Manjimup	6/77 onwards
Towerrinning	TOWE	480708	6283950	50	CCWA	West Arthur	12/77 onwards
Twin Swamps N-W	*TWIN*	*406579*	*6490175*	*50*	*CCWA*	*Swan*	*7/79 – 11/84, 7/09*
Unicup	UNIC	474399	6200082	50	CCWA	Cranbrook	9/80 onwards
Varley	VARL	722520	6379843	50	CCWA	Kulin	9/81 – 11/91, 4/00 onwards

Table 1 continued.

Wetland Name	Code	Easting	Northing	Zone	Tenure	Local Government Authority	Period monitored
Wagin 2088	*WAGI*	*533281*	*6311808*	*50*	*CCWA*	*Wagin*	*7/82 – 5/85*
Walbyring	WALB	555534	6355214	50	CCWA	Wickepin	7/79 onwards
Wallering	*WALL*	*395706*	*6521624*	*50*	*CCWA*	*Gingin*	*7/81 – 5/85, 9/08*
Walyormouring	WALY	488021	6554454	50	CCWA	Goomalling	7/78 – 11/91, 9/97 onwards
Wannamal	WANN	409642	6556691	50	CCWA	Gingin	7/78 onwards
Warden	WARD	396947	6257428	51	CCWA	Esperance	11/79 onwards
Wardering	*WARG*	*523381*	*6290253*	*50*	*CCWA*	*Woodanilling*	*5/78 – 11/91*
Warrinup	WARR	523495	6199485	50	CCWA	Cranbrook	3/80 onwards
West Arthur 5456	WEST	496510	6293047	50	CCWA	West Arthur	8/80 – 11/91, 9/97 onwards
Wheatfield	WHEA	401069	6258818	51	CCWA	Esperance	11/99 onwards
White (Albany)	*WHIA*	*606407*	*6152434*	*50*	*CCWA*	*Albany*	*6/81 - 5/85, 9/98, 9/08*
White (Narrogin)	WHIN	542630	6347335	50	CCWA	Narrogin	6/81 - 5/85, 9/97 onwards
White Water	WHIW	558770	6399914	50	CCWA	Corrigin	6/81 - 11/91, 9/97 onwards
Wild Horse	*WILD*	*473637*	*6273462*	*50*	*CCWA*	*West Arthur*	*6/81 - 5/85, 4/00, 9/09*
Wilson	WILS	382325	6189429	50	CCWA	Manjimup	5/91 onwards
Yaalup	YAAL	647443	6263830	50	CCWA	Kent	7/82 onwards
Yarnup	YARN	487368	6196543	50	CCWA	Cranbrook	9/80 onwards
Yarra Yarra	YARR	379957	6726980	50	CCWA	Carnamah	7/81 - 5/85, 9/97 onwards
Yeagarup	YEAG			50	CCWA	Manjimup	9/11 onwards
Yeagarup South	YEAS			50	CCWA	Manjimup	9/11 onwards
Yealering	YEAL	558587	6393389	50	LGA	Wickepin	6/78 onwards
Yellilup	YELL	686899	6201353	50	Private	Jerramungup	11/85 onwards
Yurine	YURI	385171	6543598	50	CCWA	Gingin	5/79 - 11/91, 5/09 onwards

Notes:

1. Wetlands without official names at the commencement of monitoring are identified by Local Government Authority and Reserve Number (e.g. Albany 26385).
2. Coordinates (eastings and northings) are of depth gauge Bench Marks (local survey datums). These have been installed on higher ground at or near the edge of each monitored wetland, close to the depth gauge or gauge 'cluster' of that wetland. The accuracy of the coordinates of most (all coords except those highlighted in gray) has been improved from approx ±100m to approx ±5m in 2008-09 and subsequent years, principally by re-survey with hand-held GPS units (Garmin GPSmap 60Cx), using the WGS84 world datum, which for practical purposes equates to GDA94. Bench Marks have not yet been installed at Big Boom, Colletts Road, Gingilup, Taarblin North, Yeagarup and Yeagarup South.
3. CCWA (Conservation Commission of Western Australia); LGA (Local Government Authority); MWR (Minister for Water Resources); UCL (Unallocated Crown Land); WRC (Water & Rivers Commission). DPaW has management responsibility for wetlands vested in CCWA.
4. 'Period Monitored' is described by the first and last records, for any parameter, of discrete periods of monitoring.
5. Routine 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 and, in the case of the 103 'current' wetlands (i.e. those not shown in italics above) is ongoing.
6. A few wetlands (e.g. Forrestdale, Clifton) have been monitored more frequently (than at two-month intervals) for varying periods.
7. The 53 SWWMP wetlands shown in *italics* have been monitored under SWWMP at various times in the past, but are not currently monitored, not at least under SWWMP. They are additional to the 103 'current' wetlands.
8. Wetlands not shown in italics are the 103 'current' SWWMP wetlands being routinely monitored by the authors for surface water depth, salinity, pH and (until 2007) nutrients, under the State Salinity Strategy.
9. Wetlands shown in **bold** are the 25 SWWMP wetlands that have been Intensively Monitored under the State Salinity Strategy by other DPaW scientific staff for potential changes in plant and animal communities, shallow groundwater levels and detailed water chemistry.
10. Beverley Lakes is also known as Yenyenning Lakes; Boyup Brook 18239 as Kulicup Swamp; Corrigin 12900 as Paperbark Swamp, Frasers Lake as Maisey's 1 or Maisey's A; Kent 29020 as East Lake Bryde and Mt Marshall 26687 as Wallambin North.

Table 1 Notes continued.

11. Taarblin North and Taarblin South refer to the northern and southern basins respectively of one wetland (Taarblin).

Table 2. Monitored wetlands by DPaW Regions and Districts, with tenure, Reserve No. and Name.

See Table 1 for the coordinates (eastings and northings) of each wetland.

No.	DPaW Region	No.	DPaW District	No.	Wetland[1]	Tenure[2]	Reserve No.[7]	Reserve Name[3, 7]
1	*Midwest*	*1*	*Geraldton*	*1*	*Hebitons*	*Private*	-	-
2	*Midwest*	*2*	*Moora*	*1*	***Blue Gum***[4]	*Private*	-	-
3	*Midwest*	*3*	*Moora*	*2*	*Capamaura*[5]	*CCWA*	A 24618	Capamauro NR
4	Midwest	4	Moora	3	Crackers	CCWA	28558	Namming NR
5	Midwest	5	Moora	4	**Eganu**	CCWA	A 25210	Pimjarrega NR
6	Midwest	6	Moora	5	Eneminga	CCWA	A 27394	Eneminga NR
7	Midwest	7	Moora	6	Guraga	LGA	31223	-
8	Midwest	8	Moora	7	**Logue**	CCWA	29073	Lake Logue NR
9	*Midwest*	*9*	*Moora*	*8*	*Pinjarrega*	*CCWA*	*A 25210*	*Pimjarrega NR*
10	*Midwest*	*10*	*Moora*	*9*	*Streets*	*Private*	-	-
11	Midwest	11	Moora	10	Yarra Yarra	CCWA	A 26442	Yarra Yarra Lakes NR
12	South Coast	1	Albany	1	Albany 26385	CCWA	26385	-
13	South Coast	2	Albany	2	Albany 27157	CCWA	27157	Cheyne Road NR
14	*South Coast*	*3*	*Albany*	*3*	*Angove*	*CCWA*	*A 27956*	*Two Peoples Bay NR*
15	*South Coast*	*4*	*Albany*	*4*	*Camel*	*CCWA*	*A 26161*	*Camel Lake NR*
16	South Coast	5	Albany	5	Collets Road	CCWA	-	Fitzgerald River NP
17	*South Coast*	*6*	*Albany*	*6*	*Cranbrook 25812*	*CCWA*	*A 25812*	-
18	*South Coast*	*7*	*Albany*	*7*	*Gardner*	*CCWA*	*A 27956*	*Two Peoples Bay NR*
19	*South Coast*	*8*	*Albany*	*8*	*Gnowangerup 26264*	*CCWA*	*26264*	*Mailalup NR*
20	South Coast	9	Albany	9	Jerdacuttup	CCWA	A 40156	Jerdacuttup Lakes NR
21	South Coast	10	Albany	10	Mettler	CCWA	26894	Mettler Lake NR
22	South Coast	11	Albany	11	Moates	CCWA	A 27956	Two Peoples Bay NR
23	South Coast	12	Albany	12	Pabelup South	CCWA	-	Fitzgerald River NP
24	South Coast	13	Albany	13	Pillenorup	CCWA	-	Stirling Range NP
25	*South Coast*	*14*	*Albany*	*14*	*Plantagenet 25386*	*CCWA*	*A 25386*	*Chillinup NR*
26	South Coast	15	Albany	15	**Pleasant View**	CCWA	A 15107	Lake Pleasant View NR
27	South Coast	16	Albany	16	Powell	CCWA	A 25809	Lake Powell NR
28	*South Coast*	*17*	*Albany*	*17*	*White (Albany)*	*CCWA*	*A 36550*	*North Sister NR*
29	South Coast	18	Albany	18	Yellilup	Private	-	-
30	South Coast	19	Esperance	1	Big Boom	UCL		
31	South Coast	20	Esperance	2	**Coomalbidgup**	LGA	24633	-
32	*South Coast*	*21*	*Esperance*	*3*	*Dundas 33113*	*CCWA*	*A 33113*	-
33	South Coast	22	Esperance	4	Esperance 26410	CCWA	26410	-
34	*South Coast*	*23*	*Esperance*	*5*	*Esperance 27768*	*CCWA*	*27768*	-
35	*South Coast*	*24*	*Esperance*	*6*	*Esperance 27985*	*CCWA*	*27985*	-
36	*South Coast*	*25*	*Esperance*	*7*	*Esperance 32128*	*CCWA*	*A 32128*	-
37	*South Coast*	*26*	*Esperance*	*8*	*Esperance 32776*	*CCWA*	*A 32776*	-
38	South Coast	27	Esperance	9	Gore	CCWA	A 32419	Lake Gore NR
39	South Coast	28	Esperance	10	Mortijinup	CCWA	A 35557	Lake Mortijinup NR
40	South Coast	29	Esperance	1`	Mount Le Grand	CCWA	A 22795	Cape Le Grand NP
41	South Coast	30	Esperance	12	North Parriup	CCWA	A 32339	Lake Shaster NR
42	South Coast	31	Esperance	13	Shark	CCWA	A 31197	Shark Lake NR
43	*South Coast*	*32*	*Esperance*	*14*	*Shaster*	*CCWA*	*A 32339*	*Lake Shaster NR*
44	South Coast	33	Esperance	15	Station	CCWA	A 23825	Mullet Lake NR
45	South Coast	34	Esperance	16	Warden	CCWA	A 32257	Lake Warden NR
46	South Coast	35	Esperance	17	**Wheatfield**	CCWA	A 15231	Woody Lake NR
47	South West	1	Blackwood	1	**Boyup Brook 18239**[6]	CCWA	18239	Kulicup NR
48	South West	2	Blackwood	2	Broadwater	CCWA	27080	
49	South West	3	Blackwood	3	Davies	CCWA	30826	Leeuwin-Naturaliste NP
50	South West	4	Blackwood	4	Gingilup	CCWA	30626	Gingilup Swamps NR
51	South West	5	Wellington	1	Egret	CCWA	38393	Morangel NR
52	South West	6	Wellington	2	Harvey 12632	CCWA	12632	Riverdale NR
53	South West	7	Wellington	3	**Towerrinning**	CCWA	A 24917	Towerrinning NR
54	*South West*	*8*	*Wellington*	*4*	*Wild Horse*	*CCWA*	*A 1740*	*Wild Horse Swamp NR*
55	Swan	1	Perth Hills	1	Chandala	CCWA	A 37060	Chandala NR
56	*Swan*	*2*	*Perth Hills*	*2*	*Chittering*	*CCWA*	*A 29538*	*Chittering Lakes NR*

Table 2 continued.

No.	DPaW Region	No.	DPaW District	No.	Wetland	Tenure	Reserve No.	Reserve Name
57	Swan	3	Perth Hills	3	Dobaderry	CCWA	A 43281	Wandoo Cons. Park
58	Swan	4	Perth Hills	4	Goonaping	CCWA	A 43281	Wandoo Cons. Park
59	Swan	5	Swan Coastal	1	Bambun	CCWA	A 26756	Bambanup NR
60	Swan	6	Swan Coastal	2	Clifton	CCWA		Yalgorup NP
61	*Swan*	*7*	*Swan Coastal*	*3*	*Ellen Brook*	*CCWA*	*A 27620*	*Ellen Brook NR*
62	Swan	8	Swan Coastal	4	Forrestdale	CCWA	A 24781	Forrestdale Lake NR
63	Swan	9	Swan Coastal	5	Gibbs	CCWA	48797	
64	*Swan*	*10*	*Swan Coastal*	*6*	*Gingin 31241*	*CCWA*	*31241*	
65	Swan	11	Swan Coastal	7	Jandabup	CCWA	7349	Jandabup NR
66	Swan	12	Swan Coastal	8	Joondalup	CCWA	A 31048	Lake Joondalup NR
67	*Swan*	*13*	*Swan Coastal*	*9*	*Karakin*	*WRC*	*7504*	-
68	Swan	14	Swan Coastal	10	McLarty	CCWA	A 39404	Lake McLarty NR
69	*Swan*	*15*	*Swan Coastal*	*11*	*Mungala*	*CCWA*	A 26756	Bambanup NR
70	*Swan*	*16*	*Swan Coastal*	*12*	*Murray 24739*	*CCWA*	*A 24739*	
71	*Swan*	*17*	*Swan Coastal*	*13*	*Nambung*	*CCWA*	A 26756	Bambanup NR
72	Swan	18	Swan Coastal	14	Nine Mile	CCWA	A 16907	Nine Mile Lake NR
73	Swan	19	Swan Coastal	15	Thomsons	CCWA	A 15556	Thomsons Lake NR
74	*Swan*	*20*	*Swan Coastal*	*16*	*Twin Swamps N-W*	*CCWA*	*A 27621*	*Twin Swamps NR*
75	*Swan*	*21*	*Swan Coastal*	*17*	*Wallering*	*CCWA*	A 26756	Bambanup NR
76	Swan	22	Swan Coastal	18	Wannamal	CCWA	A 9838	Lake Wannamal NR
77	Swan	23	Swan Coastal	19	Yurine	CCWA	A 9676	Yurine Swamp NR
78	Warren	1	Donnelly	1	Byenup	CCWA	A 31880	Lake Muir NR
79	Warren	2	Donnelly	2	Jasper	CCWA	36996	D'Entrecasteaux NP
80	Warren	3	Donnelly	3	Maringup	CCWA	36996	D'Entrecasteaux NP
81	Warren	4	Donnelly	4	Muir	CCWA	A 31880	Lake Muir NR
82	Warren	5	Donnelly	5	**Noobijup**	CCWA	A 26680	Noobijup NR
83	Warren	6	Donnelly	6	Poorginup	CCWA	A 31880	Lake Muir NR
84	*Warren*	*7*	*Donnelly*	*7*	*Red (Manjimup)*	*UCL*		
85	Warren	8	Donnelly	8	Tordit-Gurrup	CCWA	A 31880	Lake Muir NR
86	Warren	9	Donnelly	9	Unicup	CCWA	A 25798	Unicup NR
87	Warren	10	Donnelly	10	Wilson	CCWA	A 36996	D'Entrecasteaux NP
88	Warren	11	Donnelly	11	Yarnup	CCWA	29601	Yarnup NR
89	Warren	12	Donnelly	12	Yeagarup	CCWA	A 47878	Greater Hawke NP
90	Warren	13	Donnelly	13	Yeagarup South	CCWA	A 36996	D'Entrecasteaux NP
91	Warren	14	Frankland	1	Boat Harbour 1	CCWA	A 41010	Owingup NR
92	Warren	15	Frankland	2	Kwornicup	CCWA	32284	Kwornicup NR
93	Warren	16	Frankland	3	Owingup	CCWA	A 41010	Owingup NR
94	Wheatbelt	1	Central	1	**Ardath**	CCWA	A 25062	Seagroatt NR
95	Wheatbelt	2	Central	2	Beverley[6]	CCWA / LGA	31837	Yenyenning Lakes NR
96	*Wheatbelt*	*3*	*Central*	*3*	*Bruce Rock 30969*	*CCWA*	*A 30969*	*Kwolyin NR*
97	Wheatbelt	4	Central	4	**Campion**	CCWA	24789	Lake Campion NR
98	*Wheatbelt*	*5*	*Central*	*5*	*Cronin*	*CCWA*	*A 36526*	*Lake Cronin NR*
99	*Wheatbelt*	*6*	*Central*	*6*	*Dowerin*	*LGA*	*4244*	
100	*Wheatbelt*	*7*	*Central*	*7*	***Frasers***[6]	*Private*	-	-
101	*Wheatbelt*	*8*	*Central*	*8*	*Goorly*	*UCL*	-	-
102	Wheatbelt	9	Central	9	Hinds	CCWA	A 16305	Lake Hinds NR
103	*Wheatbelt*	*10*	*Central*	*10*	*Mollerin*	*CCWA*	*A 14429*	*Mollerin NR*
104	*Wheatbelt*	*11*	*Central*	*11*	*Mt Marshall 26687*[6]	*CCWA*	*A 26687*	*North Wallambin NR*
105	Wheatbelt	12	Central	12	Ninan	CCWA	A 27026	Lake Ninan NR
106	Wheatbelt	13	Central	13	Noonying	CCWA	A 10313	Noonying NR
107	Wheatbelt	14	Central	14	Red (Bruce Rock)	CCWA	A 16493	Red Lake NR
108	Wheatbelt	15	Central	15	**Walyormouring**	CCWA	A 17186	Walyormouring NR
109	*Wheatbelt*	*16*	*Great Southern*	*1*	*Ace*	*CCWA*	*A 34522*	*Lake Ace NR*
110	Wheatbelt	17	Great Southern	2	**Altham**	CCWA	A 28395	Chinocup NR
111	Wheatbelt	18	Great Southern	3	Anderson	CCWA	A 25914	Anderson Lake NR
112	Wheatbelt	19	Great Southern	4	Atkins Yate	Private	-	-
113	Wheatbelt	20	Great Southern	5	**Bennetts**	CCWA	36445	Dunn Rock NR

Table 2 continued.

No.	DPaW Region	No.	DPaW District	No.	Wetland	Tenure	Reserve No.	Reserve Name
114	*Wheatbelt*	*21*	*Great Southern*	*6*	*Biddy*	*CCWA*	*17617*	*Lake Biddy NR*
115	*Wheatbelt*	*22*	*Great Southern*	*7*	*Bokan*	*CCWA*	*9628*	*Bokan NR*
116	Wheatbelt	23	Great Southern	8	Brown	CCWA	A 24428	Nonalling NR
117	Wheatbelt	24	Great Southern	9	**Bryde**	MWR	28667	
118	*Wheatbelt*	*25*	*Great Southern*	*10*	*Cairlocup*	*CCWA*	*28324*	*Cairlocup NR*
119	Wheatbelt	26	Great Southern	11	Casuarina	CCWA	A 25136	Coblinine NR
120	*Wheatbelt*	*27*	*Great Southern*	*12*	*Coblinine*	*CCWA*	*A 25133*	*Coblinine NR*
121	Wheatbelt	28	Great Southern	13	**Coomelberrup**	CCWA	A 10472	Coomelberrup NR
122	Wheatbelt	29	Great Southern	14	**Corrigin 12900**[6]	CCWA	12900	Paperbark NR
123	Wheatbelt	30	Great Southern	15	**Coyrecup**	CCWA	A 28552	Coyrecup NR
124	Wheatbelt	31	Great Southern	16	Dulbinning	CCWA	A 9617	
125	Wheatbelt	32	Great Southern	17	**Dumbleyung**	CCWA / LGA	26664	Dumbleyung Lake NR
126	Wheatbelt	33	Great Southern	18	Flagstaff	CCWA	A 27609	Flagstaff Lake NR
127	*Wheatbelt*	*34*	*Great Southern*	*19*	*Gnowangerup 26569*	*CCWA*	*A 26569*	
128	*Wheatbelt*	*35*	*Great Southern*	*20*	*Gounter*	*CCWA*	*A 21253*	*Lake Gounter NR*
129	*Wheatbelt*	*36*	*Great Southern*	*21*	*Gundaring*	*CCWA*	*A 24373*	*Gundaring Lake NR*
130	Wheatbelt	37	Great Southern	22	Kent 29020[6]	CCWA	A 29020	Lake Bryde NR
131	*Wheatbelt*	*38*	*Great Southern*	*23*	*Kondinin*	*CCWA*	*A 22519*	*Kondinin Lake NR*
132	*Wheatbelt*	*39*	*Great Southern*	*24*	*Kwobrup*	*Private*	-	-
133	Wheatbelt	40	Great Southern	25	Little White	CCWA	A 26786	Carmody NR
134	Wheatbelt	41	Great Southern	26	Martinup	CCWA	A 17055	Martinup NR
135	Wheatbelt	42	Great Southern	27	Mears	CCWA	A 12398	Lake Mears NR
136	*Wheatbelt*	*43*	*Great Southern*	*28*	*Miripin*	*CCWA*	*A 24912*	*Miripin NR*
137	*Wheatbelt*	*44*	*Great Southern*	*29*	*Murapin*	*CCWA*	*A 17257*	*Murapin NR*
138	Wheatbelt	45	Great Southern	30	Ngopitchup	WRC	2184	
139	*Wheatbelt*	*46*	*Great Southern*	*31*	*Nonalling*	*CCWA*	*A 24428*	*Nonalling NR*
140	*Wheatbelt*	*47*	*Great Southern*	*32*	*Pallarup*	*CCWA*	*A 29860*	*Pallarup NR*
141	Wheatbelt	48	Great Southern	33	**Parkeyerring**	CCWA	A 10733	Parkeyerring NR
142	*Wheatbelt*	*49*	*Great Southern*	*34*	*Queerearrup*	*LGA*	*17255*	
143	Wheatbelt	50	Great Southern	35	Range Road Yate	MWR	29124	
144	Wheatbelt	51	Great Southern	36	**Ronnerup**	CCWA	A 39422	Lake King NR
145a	Wheatbelt	52a	Great Southern	37a	Taarblin North	CCWA	A 9550	Taarblin Lake NR
145b	Wheatbelt	52b	Great Southern	38b	Taarblin South	CCWA	A 9550	Taarblin Lake NR
146	Wheatbelt	53	Great Southern	38	**Toolibin**	CCWA	A 24556	Toolibin NR
147	Wheatbelt	54	Great Southern	39	Varley	CCWA	A 27928	Lake Varley NR
148	*Wheatbelt*	*55*	*Great Southern*	*40*	*Wagin 2088*	*CCWA*	*A 2088*	*Casuarina NR*
149	Wheatbelt	56	Great Southern	41	Walbyring	CCWA	A 14398	Walbyring NR
150	*Wheatbelt*	*57*	*Great Southern*	*42*	*Wardering*	*CCWA*	*A 17258*	*Wardering Lake NR*
151	Wheatbelt	58	Great Southern	43	Warrinup	CCWA	A 1931	Warrenup NR
152	Wheatbelt	59	Great Southern	44	West Arthur 5456	CCWA	A 5456	Dead Mans Swamp NR
153	Wheatbelt	60	Great Southern	45	White (Narrogin)	CCWA	A 21284	Quongunnerunding NR
154	Wheatbelt	61	Great Southern	46	White Water	CCWA	A 24428	Nonalling NR
155	Wheatbelt	62	Great Southern	47	**Yaalup**	CCWA	A 36967	
156	Wheatbelt	63	Great Southern	48	Yealering	LGA	9610	

Notes:

1. Wetlands without official names at the commencement of monitoring are identified by Local Government Authority and Reserve Number, e.g. Albany 26385.
2. CCWA (Conservation Commission of Western Australia); LGA (Local Government Authority); MWR (Minister for Water Resources); UCL (Unallocated Crown Land); WRC (Water & Rivers Commission). DPaW has management responsibility for wetlands vested in CCWA.
3. Entries in the 'Reserve No.' and 'Reserve Name' columns are incomplete and unchecked.
4. Wetlands shown in **bold** are in the group of 25 Intensively Monitored wetlands (see Note 9 of Table 1).
5. In addition to the 103 SWWMP wetlands currently being monitored under the State Salinity Strategy there are 53 SWWMP wetlands that have been monitored at some time in the past, but are not currently being monitored under SWWMP. These 53 are shown above in *italics.*

Table 2 Notes continued.

6. Beverley Lakes is also known as Yenyenning Lakes, Boyup Brook 18239 as Kulicup Swamp; Corrigin 12900 as Paperbark Swamp, Frasers Lake as Maisey's 1 or Maisey's A; Kent 29020 as East Lake Bryde and Mt Marshall 26687 as Wallambin North.
7. Reserves in some instances do not include all of the relevant SWWMP wetland.

Table 3. Number of current and historically-monitored wetlands in each DPaW Region and District.

DPaW Region (Current, *historical*)	DPaW District	Current	*Historical*
Midwest (6, *5*)	Geraldton	0	*1*
	Moora	6	*4*
South Coast (22, *13*)	Albany	11	*7*
	Esperance	11	*6*
South West (*7*, *1*)	Blackwood	4	*0*
	Wellington	3	*1*
Swan (14, *9*)	Perth Hills	3	*1*
	Swan Coastal	11	*8*
Warren (15, *1*)	Donnelly	12	*1*
	Frankland	3	*0*
Wheatbelt (39, *24*)	Central	8	*7*
	Great Southern	31	*17*
Totals (103, *53*)		**103**	***53***

The locations of DPaW Regional and District Headquarters are, in most instances, not obvious from Region or District names and are therefore listed below, for the convenience of readers.

DPaW Region / District	HQ Location
Midwest /	Geraldton
Geraldton	Geraldton
Moora	Jurien Bay
South Coast /	Albany
Albany	Albany
Esperance	Esperance
South West /	Bunbury
Blackwood	Busselton
Wellington	Collie
Swan /	Bentley
Perth Hills	Mundaring
Swan Coastal	Wanneroo
Warren /	Manjimup
Donnelly	Pemberton
Frankland	Walpole
Wheatbelt /	Narrogin
Central	Merredin
Great Southern	Narrogin

Table 4. Ramsar and Directory Sites of south-western Australia, and their SWWMP wetlands.

A. Ramsar Sites (each contains one or more Directory Site).

Ramsar Site	Directory Site	SWWMP wetland
Becher Point Wetlands	Becher Point Wetlands	-
Forrestdale & Thomsons Lakes	Forrestdale Lake	Forrestdale
	Thomsons Lake	Thomsons
Lake Gore	Lake Gore System	Gore
Muir-Byenup System	(southern part of) Byenup Lagoon System	Byenup, Poorginup, Tordit-Gurrup
	Lake Muir	Muir
Peel-Yalgorup System	Yalgorup Lakes System	Clifton
	Lake McLarty System	McLarty, *Murray 24739*
Toolibin Lake	Toolibin Lake	**Toolibin**
Vasse-Wonnerup System	Vasse-Wonnerup Wetland System	- [1]
Lake Warden System	Lake Warden System	Station, Warden, **Wheatfield**
		13 Current *1 Historical*

B. Other Directory Sites (not within Ramsar Sites).

Directory Site	SWWMP wetland
Balicup Lake System	*Camel*
Barraghup Swamp	-
Benger Swamp	-
Bennetts Lake	**Bennetts**
Booragoon Lake	-
Brixton Street Swamps	-
Lake Bryde – East Lake Bryde	**Bryde**, Kent 29020
(northern part of) Byenup Lagoon System	**Noobijup**, Unicup, Yarnup
Cape Leeuwin System	-
Chandala Swamp	Chandala
Chittering-Needonga Lakes	*Chittering*
Coyrecup Lake	**Coyrecup**
Lake Cronin	*Cronin*
Doggerup Creek System	-
Dumbleyung Lake	**Dumbleyung**
Dunn Rock Gnamma Holes	-
Ellen Brook Swamps System	*Ellen Brook, Twin Swamps NW*
Gibbs Road Swamp System	Gibbs
Gingilup-Jasper Wetland System	Gingilup, Jasper, Wilson
Lake Grace System	**Altham**
Guraga Lake	Guraga
Herdsman Lake	-
Hutt Lagoon System	-
Joondalup Lake	Joondalup
Karakin Lakes	*Karakin*
Kondinin Samphire Marsh	-
Lancelin Defence Training Area (Cwlth)	-
Lake Logue-Indoon System	**Logue**
Maringup Lake	Maringup

Directory Site	SWWMP wetland
McCarley's Swamp (Ludlow Swamp)	-
Loch McNess System	-
Moates Lake System	Moates, *Angove*, *Gardner*
Mortijinup Lake System	Mortijinup
Mount Soho Swamps	-
Owingup Swamp System	Boat Harbour 1, Owingup
Palmer Barracks, Guildford (Cwlth)	-
Paperbark Swamp	**Corrigin 12900**
Perth Airport Woodland Swamps (Cwlth)	-
Pink Lake	-
Lake Pleasant View System	Albany 26385, **Pleasant View**
RAAF Caversham (Cwlth)	-
Rottnest Island Lakes	-
Spectacles Swamp	-
Lake Thetis	-
Wannamal Lakes System	Wannamal
Yealering Lakes System	Brown, White Water, Yealering, *Nonalling*
Yellilup Yate Swamp System	Yellilup
Yorkrakine Rock Pools	-
	30 Current 9 Historical

The 'Directory' is 'A Directory of Important Wetlands in Australia', a cooperative project of the State, Territory and Commonwealth Governments. Three editions have been published, in 1993, 1996 and 2001. The Directory continues to be added to and updated from time to time (e.g. by Elscot *et al.* 2009). It is accessible online at http://www.environment.gov.au.

Nine south-west Western Australian Directory Sites are not listed in Tables 4A or 4B, because they are essentially riverine or estuarine and are not monitored under, or as an adjunct to, SWWMP. They are Peel-Harvey Estuary (part of Peel-Yalgorup Ramsar Site), Avon River Valley, Blackwood River (Lower Reaches) and Tributaries, Broke Inlet System, Culham Lake System, Fitzgerald Inlet System, Murchison River (Lower Reaches), Oyster Harbour and Swan-Canning Estuary.

Wetlands shown in *italics* have been monitored in the past under SWWMP, but not currently.

Wetlands shown in **bold** are in the group of 25 Intensively Monitored wetlands (see Note 9 of Table 1).

[1] The authors have maintained continuous water level recorders on the Vasse and Wonnerup estuaries since 1994, as an adjunct to SWWMP.

Table 5. Natural Diversity Recovery Catchments and their SWWMP wetlands (as at Nov 2013).

Natural Diversity Recovery Catchment	DPaW Region	DPaW District	SWWMP-monitored wetlands
Lake Bryde	Wheatbelt	Great Southern	**Bryde**, Kent 29020[2]
Buntine-Marchagee[1]	Wheatbelt	Central	-
Drummond[1]	Swan	Perth Hills	-
Esperance Lakes[1]	South Coast	Esperance	Shark, Station, Warden, **Wheatfield**
Muir-Unicup[1]	Warren	Donnelly	Byenup, Muir, **Noobijup**, Poorginup, Tordit-Gurrup, Unicup, Yarnup, *Red (Manjimup)*[4]
Toolibin Lake	Wheatbelt	Great Southern	Dulbinning, Taarblin[3], **Toolibin**, Walbyring
			17 Current *1 Historical*

Notes:

1. Since Nov 2013, Buntine-Marchagee, Esperance Lakes and Muir-Unicup have lost NDRC status and the future of the Drummond NDRC is uncertain.
2. Kent 29020 is also known as East Lake Bryde
3. Taarblin has two basins, north and south. Both are monitored.
4. *Red (Manjimup)* has been monitored in the past under SWWMP, but is not currently.
5. Most of the wetlands listed above, and some others (non-SWWMP wetlands) not listed, are also monitored under Recovery Catchment programs. Nonetheless it is considered important to continue the twice-yearly routine monitoring under SWWMP, which in all cases pre-dates the establishment of the Natural Diversity Recovery Catchments and their programs.
6. Wetlands shown in **bold** are in the group of 25 Intensively Monitored wetlands (see Note 9 of Table 1).

Table 6. Bathymetrically-mapped SWWMP wetlands.

All SWWMP wetlands known by the authors to have been bathymetrically-mapped are listed in the Table below, together with the years of mapping, methods employed, products and custodians / sources.

No.	Wetland	Custodian / Source	Year of Mapping	Products	Methods / Comment
1	**Ardath** [1]	DPaW	2004	Paper map. Digital data. D-V calc. [4]	RTK [5]
2	Beverley [2]	DPaW	2002/3	Paper map. Digital data. D-V calc.	RTK
3	**Bryde**	DPaW	2002	Paper map. Digital data. D-V calc.	RTK
4	Byenup	DPaW	2009	Digital data. Maps in preparation.	RTK by boat, amphibious vehicle (Argo) & walking.
4	Byenup	DPaW	2013	Digital data. D-V calc. D-SA calc.	LIDAR & RTK
5	Clifton	DoW		Not seen.	Mapping referred to by Knott *et al*. (2003).
6	**Campion**	DPaW	2004/6/7	Paper map. Digital data. D-V calc.	RTK
7	**Coyrecup**	DPaW	2001	Paper map. Digital data. D-V calc. D-SA calc.[4]	RTK at 100m intervals on 9 E-W transects 300m apart.
	Dulbinning	-	-	-	See Water Authority file 00617SW for inflow & outflow channel and some lakebed elevns.
8	**Dumbleyung**	DPaW	1998/01	Paper map. Digital data. D-V calc. D-SA calc.	RTK of bed at 100m intervals on 8 E-W transects 1km apart; Photogrammetry of shore. Correction of outflow elevation in 2002.
9	Forrestdale	DoW		Paper map.	Metropolitan Water Board Special Plan 81C, FB 11318, Stadia Book 11319. Arnold (1990d) pp 356, 357, 359, 360.
10	Gore	DPaW	2003	Paper map. Digital data. D-V calc.	Boat-based RTK and echo-sounding.
11	Hinds	DPaW	2000/1	Paper & PDF maps. Digital data. D-V calc.	
12	Jandabup	DoW		Paper map. 1:5,000.	MWB Special Plan 115, File 763107/74, Stadia L.B. 11650. Arnold (1990a) pp 60, 61, 66.
13	Jasper				Depth transects are shown in Dortch (1996).
14	Joondalup	DoW		Paper map. 1:5,000.	MWB Special Plan 117B, File 763107/74, Stadia L.B. 11651. Arnold (1990b) pp 104, 110-112.
15	Kent 29020 [2]	DPaW	2002	Paper map. Digital data. D-V calc.	RTK
16	Mears	DPaW	2003	Paper map. Digital data. D-V calc.	RTK
17	*Mollerin* [3]	*DPaW*	*2004*	*Paper map. Digital data*	*Photogrammetry and RTK ground truthing.*
18	*Mt Marshall 26687* [2]	*DPaW*	*2004*	*Paper map. Digital data. D-V calc.*	*RTK*
19	Muir	DPaW	2013	Digital data. D-V calc. D-SA calc.	LIDAR
20	Ninan	DPaW	2000	Paper & PDF maps. Digital data. D-V calc.	Boat-based RTK and echo-sounding.
21	**Noobijup**	DPaW	2013	Digital data. D-V calc.	LIDAR
22	Poorginup	DPaW	2013	Digital data. D-V calc.	LIDAR
23	Powell	DoW	2003?		
24	*Red (Manjimup)*	*PPaW*	*2013*	*Digital data. D-V calc. D-SA calc.*	*LIDAR*
25	Shark	DPaW	2003	Paper map. Digital data. D-V calc.	Boat-based RTK.
26	Station	DPaW	2002	Paper map. Digital data. D-V calc.	RTK
27a	Taarblin North	DPaW	2004	Paper & PDF maps. Digital data. D-V calc.	RTK
28	Thomsons			Paper maps.	See Arnold (1990c) pp 266, 267, 269, 270. Davis *et al*. (2001).
29	**Toolibin**	DoW		Scanned copy of paper map, '609 009 PWD WA 54732', with spot heights and 0.5mAHD contours	Also see Water Authority file 00617SW for inflow & outflow channel and W bank elevns.
30	Tordit-Gurrup	DPaW	2011	Paper map. Digital data.	RTK by amphibious vehicle (Argo) & walking.
30	Tordit-Gurrup	DPaW	2013	Digital data. D-V calc. D-SA calc.	LIDAR & RTK
31	**Towerrinning**	Froend & McComb (1991)	1986	≈1:25,000 paper map (<A4); 0.5m contours to –2.5m, shoreline = 0.0m	Weighted graduated rope; ≈50m intervals on 7 transects (4 E-W, 3 N-S) ≈500m apart.
31	**Towerrinning**	JDA (2012)	2012	Digital & paper maps in JDA (2012).	Spot heights, cross sections & invert levels surveyed by JBA Surveys in Feb 2012.

Table 6 continued.

No.	Wetland	Custodian / Source	Year of Mapping	Products	Methods / Comment
32	Unicup	DPaW	2013	Digital data. D-V calc. D-SA calc.	LIDAR & RTK
33	Walbyring	-	-	-	See DoW (Water Authority) file 00617SW for inflow channel elevations.
34	Warden	DPaW	2002	Paper map. Digital data. D-V calc.	Boat-based RTK and echo-sounding.
35	**Wheatfield**	DPaW	2002	Paper map. Digital data. D-V calc.	Boat-based RTK.
36	Yarnup	DPaW	2013	Digital data. D-V calc.	LIDAR
37	Yeagarup	DPaW	2014	Digital map (rectified orthophoto).	Boat-based survey with weighted, graduated survey line and hand-held GPS.
38	Yeagarup South	DPaW	2014	Digital map (rectified orthophoto).	Boat-based survey with weighted, graduated survey line and hand-held GPS.
39	**Yealering**	JDA (2012)	2012	Digital & paper maps in JDA (2012).	Spot heights, cross sections & invert levels surveyed by JBA Surveys in Feb 2012.

Notes:

1. Wetlands shown in **bold** are in the group of 25 Intensively Monitored wetlands (see Note 9 of Table 1).
2. Beverley Lakes is also known as Yenyenning Lakes, Kent 29020 as East Lake Bryde and Mt Marshall 26687 as Wallambin North.
3. Wetlands shown in *italics* have been monitored in the past under SWWMP, but not currently.
4. 'D-V calc.' and 'D-SA calc.' are Depth to Volume and Depth to Surface Area calculators, derived from the bathymetry.
5. 'RTK' refers to collecting 3-dimensional position (point) data using the Real-Time Kinematic Differential Global Positioning System (RTK DGPS).
6. SWWMP personnel have participated in mapping several non-SWWMP wetlands, these being Bokarup, Brown (connected to Campion), Cowcowing, Quallilup, and other wetlands (in addition to Station, Warden and Wheatfield) in the Lake Warden System, namely Ewans, Mullet, Windabout and Woody.

Source references

Arnold, J.M. (1990a). *Jenny Arnold's Wetlands Resource Book. Chapters 5-6: Wetlands of the Northern and Eastern Gnangara Mound and Eastern Wanneroo Wetlands.* Bulletin 266. Environmental Protection Authority and Water Authority of Western Australia, Perth.

Arnold, J.M. (1990b). *Jenny Arnold's Wetlands Resource Book. Chapter 7: Wanneroo Linear Lakes.* Bulletin 266. Environmental Protection Authority and Water Authority of Western Australia, Perth.

Arnold, J.M. (1990c). *Jenny Arnold's Wetlands Resource Book. Chapters 9-11: East Beeliar Wetlands. Wetlands of the South West Corridor and of the Rockingham Plain.* Bulletin 266. Environmental Protection Authority and Water Authority of Western Australia, Perth.

Arnold, J.M. (1990d). *Jenny Arnold's Wetlands Resource Book. Chapters 12-15: East Beeliar Wetlands. Wetlands of the Eastern Coastal Plain and of the Inner Central Suburban Area. Wetlands of the Rivers and Estuaries and of the Serpentine Region.* Bulletin 266. Environmental Protection Authority and the Water Authority of Western Australia, Perth.

Davis, J., Froend, R., Hamilton, D., Horwitz, P., McComb, A., Oldham, C. & Thomas, D. (2001). *Environmental Water Requirements to Maintain Wetlands of National and International Importance.* Environmental Flows Initiative Technical Report No. 1. Environment Australia, Canberra.

Dortch, C.E. (1996). *Prehistory down under: Archaeological investigations of submerged Aboriginal sites at Lake Jasper, Western Australia.* Antiquity 70:116-123.

Froend, R.H. & McComb, A.J. (1991). *An account of the decline of Lake Towerrinning, a wheatbelt wetland.* J. Roy. Soc. West. Aust. 74:123-28.

JDA (2012). *Living lakes Project Stage 1: Part 2 Report. Feasability study of Lakes Towerrinning, Ewlyamartup and Yealering.* Report by JDA Consulting Hydrologists with Land Assessment Pty Ltd, Woodgis Environmental Assessment and Management and Advanced Choice Economics Pty Ltd for the WA Department og Regional Development and Lands. 231pp.

Knott, B., Bruce, L., Lane, J., Konishi, Y. & Burke, C. (2003). *Is the salinity of Lake Clifton (Yalgorup National Park) increasing?* J. Roy. Soc. West. Aust. 86:119-122.

Table 7. SWWMP wetlands for which aerial oblique photography is available. High-resolution, low altitude, aerial oblique photographs of the following SWWMP wetlands were captured by DEC during 2008-2012. Requests for these photographs should be directed to jim.lane@dpaw.wa.gov.au. A small charge for supply may be required.

No.	Wetland Name[1]	Code	Tenure[2]	Local Government Authority	Date of Photography
1	*Ace*[3]	*ACE*	*CCWA*	*Lake Grace*	*17 May 2009*
2	Albany 26385[4]	ALB1	CCWA	Albany	21 May 2008
3	Albany 27157	ALB2	CCWA	Albany	21 May 2008, 28 May 2011
4	**Altham**[5]	ALTH	CCWA	Kent	17 May 2009
5	Anderson	ANDE	CCWA	Tambellup	21 May 2008
6	*Angove*	*ANGO*	*CCWA*	*Albany*	*21 May 2008*
7	**Ardath**	ARDA	CCWA	Bruce Rock	07 June 2010
8	Atkins Yate	ATKI	Private	Lake Grace	17 May 2009
9	Bambun	BAMB	CCWA	Gingin	06 June 2010
10	**Bennetts**	BENN	CCWA	Lake Grace	17 May 2009
11	Beverley[6]	BEVE	CCWA / LGA	Beverley / Brookton / Quairading	07 June 2010
12	*Biddy*	*BIDD*	*CCWA*	*Lake Grace*	*26 May 2010*
13	***Blue Gum***	*BLUE*	*Private*	*Moora*	*07 June 2010*
14	Boat Harbour 1	BOA1	CCWA	Denmark	26 May 2008, 27 May 2011
15	*Bokan*	*BOKA*	*CCWA*	*Narrogin*	*26 May 2010*
16	**Boyup Brook 18239**[6]	BOYU	CCWA	Boyup Brook	19 May 2008
17	Broadwater	BROA	CCWA	Busselton	6, 11 & 12 May 2011
18	Brown	BROW	CCWA	Corrigin	07 June 2010
19	*Bruce Rock 30969*	*BRUC*	*CCWA*	*Bruce Rock*	*26 May 2012*
20	**Bryde**	BRYD	CCWA	Kent	17 May 2009
21	Byenup	BYEN	CCWA	Manjimup	24 May 2008, 11 May 2011
22	*Cairlocup*	*CAIR*	*CCWA*	*Kent*	*17 May 2009*
23	*Camel*	*CAME*	*CCWA*	*Cranbrook*	*21 May 2008*
24	**Campion**	**CAMP**	**CCWA**	**Nungarin / Merredin**	**26 May 2012**
25	*Capamaura*	*CAPA*	*CCWA*	*Carnamah*	*07 June 2010*
26	Casuarina	CASU	CCWA	Katanning	17 May 2009
27	Chandala	CHAN	CCWA	Chittering	06 June 2010
28	*Chittering*	*CHIT*	*CCWA*	*Chittering*	*06 June 2010*
29	Clifton	CLIF	CCWA	Mandurah / Waroona	29 May 2011
30	*Coblinine*	*COBL*	*CCWA*	*Dumbleyung*	*17 May 2009*
31	Collets Road	COLL	CCWA	Jerramungup	16 May 2009
32	**Coomalbidgup**	CMBG	LGA	Esperance	16 May 2009
33	**Coomelberrup**	COOM	CCWA	Dumbleyung	17 May 2009
34	**Corrigin 12900**[6]	CORR	CCWA	Corrigin	07 June 2010
35	**Coyrecup**	COYR	CCWA	Katanning	17 May 2009
36	Crackers	CRAC	CCWA	Dandaragan	07 June 2010
37	*Cranbrook 25812*	*CRAN*	*CCWA*	*Cranbrook*	*21 May 2008*
38	*Cronin*	*CRON*	*CCWA*	*Kondinin*	*26 May 2010*
39	Davies	DAVI	CCWA	Augusta-Margaret River	19 May 2008, 11 May 2011
40	Dobaderry	DOBA	CCWA	Beverley	07 June 2010
41	*Dowerin*	*DOWE*	*LGA*	*Dowerin*	*27 May 2012*
42	Dulbinning	DULB	CCWA	Wickepin	26 May 2010
43	**Dumbleyung**	DUMB	CCWA / LGA	Dumbleyung / Wagin	17 May 2009, 26 May 2010
44	*Dundas 33113*	*DUND*	*CCWA*	*Dundas*	*16 May 2009*

Table 7 continued.

No.	Wetland Name[1]	Code	Tenure[2]	Local Government Authority	Date of Photography
45	**Eganu**	EGAN	CCWA	Coorow	07 June 2010
46	Egret	EGRE	CCWA	Harvey	19 May 2008
47	*Ellen Brook*	*ELLE*	*CCWA*	*Swan*	*06 June 2010*
48	Eneminga	ENEM	CCWA	Dandaragan	07 June 2010
49	Esperance 26410	ESP1	CCWA	Esperance	16 May 2009
50	*Esperance 27768*	*ESP2*	*CCWA*	*Esperance*	*16 May 2009*
51	*Esperance 27985*	*ESP3*	*CCWA*	*Esperance*	*16 May 2009*
52	*Esperance 32128*	*ESP4*	*CCWA*	*Esperance*	*16 May 2009*
53	*Esperance 32776*	*ESP5*	*CCWA*	*Esperance*	*16 May 2009*
54	Flagstaff	FLAG	CCWA	Woodanilling	17 May 2009
55	Forrestdale	FORR	CCWA	Armadale	06 June 2010
56	***Frasers***	***FRAS***	***Private***	***Dowerin***	***27 May 2012***
57	*Gardner*	*GARD*	*CCWA*	*Albany*	*21 May 2008*
58	Gibbs	GIBB	CCWA	Armadale	06 June 2010
59	*Gingin 31241*	*GING*	*CCWA*	*Gingin*	*06 June 2010*
60	*Gnowangerup 26264*	*GNO1*	*CCWA*	*Gnowangerup*	*21 May 2008*
61	*Gnowangerup 26569*	*GNO2*	*CCWA*	*Gnowangerup*	*17 May 2009*
62	**Goonaping**	GOON	CCWA	Beverley	07 June 2010
63	*Goorly*	*GOOR*	*UCL*	*Dalwallinu*	*27 May 2012*
64	Gore	GORE	CCWA	Esperance	16 May 2009
65	*Gounter*	*GOUN*	*CCWA*	*Kondinin*	*26 May 2010*
66	*Gundaring*	*GUND*	*CCWA*	*Wagin*	*17 May 2009*
67	Guraga	GURA	LGA	Dandaragan	07 June 2010
68	Harvey 12632	HARV	CCWA	Harvey	19 May 2008
69	*Hebitons*	*HEBI*	*Private*	*Mullewa*	*27 May 2012*
70	Hinds	HIND	CCWA	Wongan-Ballidu	27 May 2012
71	Jandabup	JAND	CCWA	Wanneroo	06 June 2010
72	Jasper	JASP	CCWA	Nannup	20 May 2008
73	Jerdacuttup	JERD	CCWA	Ravensthorpe	16 May 2009
74	Joondalup	JOON	CCWA	Joondalup	06 June 2010
75	*Karakin*	*KARA*	*WRC*	*Gingin*	*06 June 2010*
76	Kent 29020[6]	KENT	CCWA	Kent	17 May 2009
77	*Kondinin*	*KOND*	*CCWA*	*Kondinin*	*07 June 2010*
78	*Kwobrup*	*KWOB*	*Private*	*Kent*	*17 May 2009*
79	Kwornicup	KWOR	CCWA	Plantagenet	21 May 2008
80	Little White	LITT	CCWA	Narrogin	26 May 2010
81	**Logue**	**LOGU**	**CCWA**	**Carnamah**	**27 May 2012**
82	Maringup	MARI	CCWA	Manjimup	20 May 2008, 11 & 28 May 2011
83	Martinup	MART	CCWA	Woodanilling	11 May 2011
84	McLarty	MCLA	CCWA	Murray	21 May 2008
85	Mears	MEAR	CCWA	Brookton	07 June 2010, 26 May 2012
86	Mettler	METT	CCWA	Albany	21 May 2008
87	*Miripin*	*MIRI*	*CCWA*	*Woodanilling*	*17 May 2009*
88	Moates	MOAT	CCWA	Albany	21 May 2008
89	*Mollerin*	*MOLL*	*CCWA*	*Koorda*	*26 May 2012*
90	Mortijinup	MORT	CCWA	Esperance	16 May 2009

Table 7 continued.

No.	Wetland Name[1]	Code	Tenure[2]	Local Government Authority	Date of Photography
91	Mount Le Grand	MLGR	CCWA	Esperance	16 May 2009
92	*Mt Marshall 26687*	*MTMA*	*CCWA*	*Mt Marshall*	*26 May 2012*
93	Muir	MUIR	CCWA	Manjimup	20 & 24 May 2008
94	*Mungala*	*MUNG*	*CCWA*	*Gingin*	*06 June 2010*
95	*Murapin*	*MURA*	*CCWA*	*Woodanilling*	*17 May 2009*
96	*Murray 24739*	*MURR*	*CCWA*	*Murray*	*21 May 2008*
97	*Nambung*	*NAMB*	*CCWA*	*Gingin*	*06 June 2010*
98	Ngopitchup	NGOP	WRC	Broomehill	24 May 2008
99	Ninan	NINA	CCWA	Wongan-Ballidu	27 May 2012
100	Nine Mile	NINE	CCWA	Murray	19 May 2008
101	*Nonalling*	*NONA*	*CCWA*	*Corrigin*	*07 June 2010*
102	**Noobijup**	NOOB	CCWA	Cranbrook	24 May 2008
103	Noonying	NOON	CCWA	Tammin	27 May 2012
104	North Parriup	NPAR	CCWA	Ravensthorpe	16 May 2009
105	Owingup	OWIN	CCWA	Denmark	20 May 2008
106	Pabelup South	PABE	CCWA	Jerramungup	16 May 2009
107	*Pallarup*	*PALL*	*CCWA*	*Lake Grace*	*17 May 2009*
108	Parkeyerring	PARK	CCWA	Wagin	11 May 2011
109	Pillenorup	PILL	CCWA	Plantagenet	21 May 2008, 28 May 2011
110	*Pinjarrega*	*PINJ*	*CCWA*	*Coorow*	*07 June 2010*
111	*Plantagenet 25386*	*PLAN*	*CCWA*	*Plantagenet*	*21 May 2008*
112	**Pleasant View**	PLEA	CCWA	Albany	21 May 2008, 28 May 2011
113	Poorginup	POOR	CCWA	Manjimup	20 May 2008
114	Powell	POWE	CCWA	Albany	21 May 2008, 28 May 2011
115	*Queerearrup*	*QUEE*	*LGA*	*Woodanilling*	*17 May 2009*
116	Range Road Yate	RANG	MWR	Kent	17 May 2009
117	Red (Bruce Rock)	REDB	CCWA	Bruce Rock	07 June 2010
118	*Red (Manjimup)*	*REDM*	*UCL*	*Manjimup*	*24 May 2008*
119	**Ronnerup**	RONN	CCWA	Lake Grace	17 May 2009
120	Shark	SHAR	CCWA	Esperance	16 May 2009
121	*Shaster*	*SHAS*	*CCWA*	*Ravensthorpe*	*16 May 2009*
122	Station	STAT	CCWA	Esperance	16 May 2009
123	*Streets*	*STRE*	*Private*	*Moora*	*07 June 2010*
124a	Taarblin North[7]	TAAN	CCWA	Narrogin	26 May 2010
124b	Taarblin South[7]	TAAR	CCWA	Narrogin	26 May 2010
125	Thomsons	THOM	CCWA	Cockburn	06 June 2010
126	**Toolibin**	TOOL	CCWA	Wickepin	26 May 2010, 07 Jun 2010
127	Tordit-Gurrup	TORD	CCWA	Manjimup	20 May 2008 (limited), 11 (E) & 28 (W) May 2011
128	**Towerrinning**	TOWE	CCWA	West Arthur	24 May 2008
129	*Twin Swamps N-W*	*TWIN*	*CCWA*	*Swan*	*06 June 2010*
130	Unicup	UNIC	CCWA	Cranbrook	11, 27 & 28 May 2011
131	Varley	VARL	CCWA	Kulin	26 May 2010
132	*Wagin 2088*	*WAGI*	*CCWA*	*Wagin*	*17 May 2009*
133	Walbyring	WALB	CCWA	Wickepin	26 May 2010, 07 Jun 2010
134	*Wallering*	*WALL*	*CCWA*	*Gingin*	*06 June 2010*
135	**Walyormouring**	**WALY**	**CCWA**	**Goomalling**	**27 May 2012**

Table 7 continued.

No.	Wetland Name[1]	Code	Tenure[2]	Local Government Authority	Date of Photography
136	Wannamal	WANN	CCWA	Gingin	06 June 2010
137	Warden	WARD	CCWA	Esperance	16 May 2009
138	*Wardering*	*WARG*	*CCWA*	*Woodanilling*	*11 May 2011*
139	Warrinup	WARR	CCWA	Cranbrook	24 May 2008
140	West Arthur 5456	WEST	CCWA	West Arthur	11 & 27 May 2011
141	**Wheatfield**	WHEA	CCWA	Esperance	16 May 2009
142	*White (Albany)*	*WHIA*	*CCWA*	*Albany*	*21 May 2008*
143	White (Narrogin)	WHIN	CCWA	Narrogin	26 May 2010, 07 Jun 2010
144	White Water	WHIW	CCWA	Corrigin	07 June 2010
145	*Wild Horse*	*WILD*	*CCWA*	*West Arthur*	*19 May 2008*
146	Wilson	WILS	CCWA	Manjimup	20 May 2008
147	**Yaalup**	YAAL	CCWA	Kent	17 May 2009
148	Yarnup	YARN	CCWA	Cranbrook	24 May 2008, 27 May 2011
149	Yarra Yarra	YARR	CCWA	Carnamah	26 May 2012
150	Yealering	YEAL	LGA	Wickepin	07 June 2010
151	Yellilup	YELL	Private	Jerramungup	21 May 2008, 28 May 2011
152	Yurine	YURI	CCWA	Gingin	06 June 2010

Notes:

1. Wetlands without official names at the commencement of monitoring are identified by Local Government Authority and Reserve Number (e.g. Albany 26385).
2. CCWA (Conservation Commission of Western Australia); LGA (Local Government Authority); MWR (Minister for Water Resources); UCL (Unallocated Crown Land), WRC (Water & Rivers Commission). DPaW has management responsibility for wetlands vested in CCWA.
3. The SWWMP wetlands shown in *italics* have been monitored under SWWMP at various times in the past, but are not currently monitored, not at least under SWWMP.
4. Wetlands not shown in italics are 'current' SWWMP wetlands being routinely monitored by the authors for surface water depth, salinity, pH and (until 2007) nutrients, under the State Salinity Strategy. These include the Intensively Monitored wetlands shown in bold.
5. Wetlands shown in **bold** are SWWMP wetlands that have been Intensively Monitored by other DPaW scientific staff for potential changes in plant and animal communities, shallow groundwater levels and detailed water chemistry under the State Salinity Strategy. They are a subset of the 'current' wetlands.
6. Beverley Lakes is also known as Yenyenning Lakes; Boyup Brook 18239 as Kulicup Swamp; Corrigin 12900 as Paperbark Swamp and Kent 29020 as East Lake Bryde.
7. Taarblin North and Taarblin South refer to the northern and southern basins respectively of one wetland (Taarblin).
8. The only SWWMP wetlands not yet photographed are Big Boom (Esperance), Gingilup (Nannup), Yeagarup (Manjimup) and Yeagarup South (Manjimup). These wetlands have only recently been added to SWWMP (Yeagarup and Yeagarup South in 2011, Big Boom and Gingilup in 2012).

Table 8. Number of SWWMP wetlands with 1, 2, 3, etc. years of September and/or[1] November depth, pH and salinity data as at November 2013.

	No. of currently monitored wetlands			No. of historically monitored wetlands		
Number of years of Sep and/or[1] Nov data at Nov 2013	**With Depth data**	**With pH data**	**With Salinity data**	**With Depth data**	**With pH data**	**With Salinity data**
0					2	2
1		1	1		4	2
2	2	2	2	1	4	4
3	2	2	2	5	10	7
4				4	12	5
5				9	4	9
6		1	1	10		5
7		2	1	4	2	3
8		1	2		3	1
9					5	4
10		3		2	4	
11	1	3	3	4	2	6
12	1	1		2		1
13	4	3	2	11		3
14	7	6	7			
15	4	2	5			
16		1				
17		1	1			
18	3					
19	1	5	1			
20	2	6	8		1	
21	4	1	1			1
22	4	8	3	1		
23	1	3	4			
24		3	5			
25	2	3	4			
26	1	2	2			
27	1	2	2			
28	3	7	4			
29	5	6	4			
30	9	4	5			
31		10	1			
32	5	11				
33	4	3	12			
34	13		7			
35	23		11			
36	1		2			
Total Wetlands	103	103	103	53	53	53

SUMMARY

	No. of currently monitored wetlands			No. of historically monitored wetlands		
Number of years of Sep and/or[1] Nov data at Nov 2013	**With Depth data**	**With pH data**	**With Salinity data**	**With Depth data**	**With pH data**	**With Salinity data**
≥ 10	99	94	94	20	7	11
≥ 20	78	69	75	1	1	1
≥ 30	55	28	38	0	0	0

Notes:

1. The objective is to monitor all SWWMP wetlands in both September *and* November each year. However, on occasions, circumstances may prevent data collection at one or a few wetlands in either Sep or Nov (rarely at same wetland in both months) of a particular year.
2. More wetlands have 10+, 20+, 30+ years of depth data than salinity (or pH) data because in most years some wetlands are dry in September and/or November.
3. Fewer wetlands have 10+, 20+, 30+ years of pH data than salinity data because routine pH monitoring began several years after depth and salinity monitoring.
4. Taarblin North is not included in this Table. It has been monitored for a shorter period than Taarblin South, which is included. They are two connected basins of the same wetland (Lake Taarblin).

APPENDICES

APPENDIX 1. Reports, publications and databases (to 2013) in which use is made of SWWMP data.

Adeney, J.A. (2001). *Cyanobacterial issues in the Lake Powell / Torbay Inlet drainage system.* CSIRO Land and Water, Perth, Technical Report 44/01.

ANCA (1993). *A Directory of Important Wetlands in Australia. [First edition]*. Australian Nature Conservation Agency, Canberra. 719pp.

ANCA (1996). *A Directory of Important Wetlands in Australia, Second edition.* Australian Nature Conservation Agency, Canberra. 964pp.

Bari, M.A. & Ruprecht, J.K. (2003). *The salt and water balance modelling of Dumbleyung Lake, Western Australia,* In: *Hydro 2003*, Proceedings of 28th National Hydrology and Water Resources Symposium, 10-14 November 2003, Wollongong, NSW. The Institution of Engineers, Australia.

Bartle, J., Graham, G., Lane, J. & Moore, S. (1987). *Forrestdale Lake Nature Reserve: management plan, 1987-1992.* WA Department of Conservation & Land Management, Management Plan 3. 122pp.

Bennelongia (2008a). *Waterbird monitoring of the Lake Warden and Lake Gore wetland systemes, October 2007*. Report 2008/18 prepared by Bennelongia Environmental Consultants for SCRIPT and WA Dept. of Environment & Conservation. 27pp.

Bennelongia (2008b). *Waterbird monitoring of the Lake Warden and Lake Gore wetland systemes, February 2008*. Report 2008/26 prepared by Bennelongia Environmental Consultants for Esperance Regional Forum. 29pp.

Bennelongia (2009). *Waterbird monitoring of the Lake Warden and Lake Gore wetland systemes,Novmber 2008*. Report 2009/64 prepared by Bennelongia Environmental Consultants for Esperance Regional Forum Inc. 25pp.

Brock, M.A. & Lane, J.A.K. (1983). *The aquatic macrophyte flora of saline wetlands in Western Australia in relation to salinity and permanence.* Hydrobiologia 105:63-76.

Cake, J. (1998). *A compilation of historical water level data for wetlands in the Perth metropolitan area.* Unpublished report for WA Department of Conservation & Land Management.

Cale, D.J. (2008). *Wetland survey of the Lake Bryde natural diversity recovery catchment: waterbirds, aquatic invertebrates and water chemistry*. WA Department of Environment & Conservation. 40pp.

Cale, D.J., Halse, S.A. & Walker, C.D. (2004). *Wetland monitoring in the Wheatbelt of south-west Western Australia: site descriptions, waterbird, aquatic invertebrate and groundwater data.* Conservation Science, W. Aust. 5(1):20-135.

Cale, D., Lyons, M., McCormick, C., Pinder, A. & Walker, C. (2010). *State Salinity Strategy wetland biodiversity monitoring report: Lake Eganu 1998 to 2007.* WA Department of Environment & Conservation. 40pp.

Cale, D.J., McCormick, C., Lyons, M.N. & Pinder, A.M. (2011) *State Salinity Strategy wetland biodiversity monitoring report: Lake Wheatfield 1997 to 2009*. WA Department of Environment & Conservation report. 62pp.

Clarke, A.G. & Lane, J.A.K. (2003). *A waterbird census of selected wetlands along the coastal margins of the Esperance District, Feb.-Mar. 2003: report.* Department of Conservation & Land Management, Kensington, WA. 38 p.

CALM (2000). *Wetlands nominated by the Government of Western Australia for inclusion on the List of Wetlands of International Importance.* Nominating document prepared by WA Department of Conservation & Land Management, November 2000.

CALM (2003). *Information Sheet on Ramsar Wetlands (RIS): Updated RIS's for the 'Forrestdale & Thomsons Lakes', 'Lake Gore', 'Muir-Byenup System', 'Peel-Yalgorup System', 'Toolibin Lake', 'Lake Warden System' Ramsar Sites.* http://www.naturebase.net/pdf/national_parks/wetlands/fact_sheets/lake_gore1.doc

Clarke, A., Lane, J. & Jaensch, R. (2011). *Surveys of waterbirds in selected wetlands of south-western Australia in spring-summer 2009-10, with further assessment of changes in habitat and waterbird usage over 2-3 decades.* WA Department of Environment & Conservation report. 101pp.

Conservation Commission of Western Australia (2009). *Yalgorup National Park Management Plan 1995-2005. Performance Assessment Report.* CRMPPA 02/08. 33+pp.

Davies, C.G. & McSweeney, S. (2012). *Pre-Development Variable Density Groundwater Modelling Report- Preston Beach Town Site Strategy.* Prepared for Preston Beach Development Joint Venture Pty Ltd.

Davies, S. (2010). *An investigation of the cause and effects of increased salinity in a freshwater coastal wetland: Lake Davies, Western Australia.* Report submitted for unit ENV421 Environmental Science Project for Degree of Bachelor of Environmental Science, Murdoch University, May 2010.

Davis, J.A., McGuire, M., Halse, S.A., Hamilton, D., Horwitz, P., McComb, A.J., Froend, R.H., Lyons, M. & Sim, L. (2003). *What happens when you add salt?: predicting impacts of secondary salinisation on shallow aquatic ecosystems using an alternative states model.* Australian Journal of Botany 51:715–724.

DEC (2009). *WetlandBase* (an online State wetlands database). [www.dec.wa.gov.au/management-and-protection/wetlands/wetland-base/view-wetlandbase-online in June 2009].

DEC (2009). *Ecological Character Description of the Lake Gore Ramsar Site: A Report by the Department of Environment and Conservation.* Prepared by G. Watkins of the WA Dept. of Environment & Conservation. 139pp.

DEC (2009). *Ecological Character Description of the Lake Warden System Ramsar Site: A Report by the Department of Environment and Conservation.* Prepared by G. Watkins of the WA Dept. of Environment & Conservation. 168pp.

DEWHA (2009). *Ramsar Sites.* In *Australian Wetlands Database*, Department of the Environment, Water, Heritage and the Arts, Canberra. [www.environment.gov.au/water/publications/environmental/wetlands/database/ in June 2009].

Doupe, R.G. & Horwitz, P. (1995). *The value of macroinvertebrate assemblages for determining priorities in wetland rehabilitation: a case study from Lake Toolibin, Western Australia*. J. Roy. Soc. West. Aust. 78:33-38.

DoW (2006). *Upper Avon River Recovery Plan: Section 20 - Yealering Lakes*. Report No. RRP 12. Prepared by Viv Read and Associates for WA Department of Water and the Avon Waterways Committee.

Elscot, S.V., Lane, J.A.K., Clarke, A.G. & Muir, W.P. (2009). *Nomination and improved documentation of nationally important wetlands in under-represented IBRA regions in Western Australia*. WA Department of Conservation & Land Management. 77pp.

Environment Australia (2001). *A Directory of Important Wetlands in Australia, Third edition*. Environment Australia, Canberra. [www.environment.gov.au/water/publications/environmental/wetlands/database/ in June 2009].

EPA (2007). *State of the environment report, Western Australia, 2007: Inland waters.* Report by the Environmental Protection Authority of Western Australia. www.soe.wa.gov.au/report/inland-waters/loss-or-degradation-of-wetlands.html

Farrell, C. & Cook, B. 2009. *Ecological Character Description of the Muir-Byenup System Ramsar Site South-west Western Australia: Report prepared for the WA Department of Environment and Conservation*, CENRM085. Centre of Excellence in Natural Resource Management, University of WA.

Froend, R.H. (1986). *Preliminary study of the water quality at Lake Towerrinning.* Report to the Lake Towerrinning Committee, Shire of West Arthur. Department of Botany and Centre for Water Research. University of WA, Nedlands. 28pp.

Froend, R.H., Halse, S.A. & Storey, A.W. (1997). *Planning for the recovery of Lake Toolibin.* Wetlands Ecology and Management 5:73-85.

Froend, R.H. & Loomes, R. (2001). *Relationships between water level, salinity and the emergent and fringing vegetation of Byenup-Muir wetlands.* Report to WA Department of Conservation & Land Management. Edith Cowan University, Centre for Ecosystem Management, 26pp.

Froend, R.H. & McComb, A.J. (1991). *An account of the decline of Lake Towerrinning, a wheatbelt wetland.* J. Roy. Soc. West. Aust. 73(4):123-128.

Froend, R.H. & Storey, A.W. (1996). *Monitoring design and data analysis, Toolibin Lake and catchment. Part 1: Review and analysis of monitoring data.* Report prepared for WA Department of Conservation & Land Management.

Gautam, B., William, D., McSweeney, S. & Davies, C.G. (2012). *Pre-Development Groundwater and Nutrient Modelling Report – Preston Beach Town Site Strategy*. Prepared for the Preston Beach Development Joint Venture Pty Ltd.

George, R. & Bennett, D. (1992). *Lake Towerrinning catchment rediversion and waterway. May 1992 Working Notes. Appendix 2. Submission to NPNCA.* West Arthur Land Conservation District, Towerrinning Catchment Group. West. Aust. Dept. of Agriculture, Division of Resource Management.

George, R. & Bennett, D. (1994). *Lake Towerrinning hydrology.* p.15 in *Lake Towerrinning Landcare Group: Looking forward to a productive future. Information notes for meeting and catchment tour, Duranillin Hall, 22 September 1994.*

Gibson, N. & Keighery, G.J. (2000). *Assessment of the nature conservation values of the Byenup-Muir peat swamp system, south western Australia: flora and vegetation.* Unpublished report for Environment Australia prepared by Department of Conservation & Land Management., Perth [makes significant use of SWWMP photography].

Gibson, N. & Keighery, G.J. (2000). *Flora and vegetation of the Byenup-Muir reserve system, south-west Western Australia*. CALMScience 3(3):323-402.

Gibson, N., Keighery, G.J. & Lane, J.A.K. (2004). *Five years monitoring of the wetlands in the Lake Muir-Unicup system, south-western Australia*. J. Roy. Soc. West. Aust. 87:29-33.

Goodsell, J.T. (1990). *Distribution of waterbird broods relative to wetland salinity and pH in south-western Australia.* Australian Wildlife Research 17:219-229.

Government of Western Australia (1996). *Salinity: a situation statement for Western Australian.* Report to the Minister for Primary Industry and the Minister for the Environment prepared by the Chief Executive Officers of Agriculture Western Australia, the Department of Conservation & Land Management, the Department of Environmental Protection and Water and Rivers Commission, November 1996.

Halse, S.A. (1981). *Faunal assemblages of some saline lakes near Marchagee, Western Australia.* Australian Journal of Marine and Freshwater Research 32:133-142.

Halse, S.A. (1987). *Probable effect of increased salinity on the waterbirds of Lake Toolibin.* Technical Report No.15. WA Department of Conservation & Land Management, Perth.

Halse, S.A. & Jaensch, R.P. (1989*). Breeding seasons of waterbirds in south-western Australia: the importance of rainfall.* Emu 89:232-249.

Halse, S.A., Jaensch, R.P., Munro, D.R. & Pearson, G.B. (1990). *Annual waterfowl counts in south-western Australia – 1988/89.* WA Department of Conservation & Land Management Technical Report No.25. 43pp.

Halse, S.A., Pearson, G.B., McRae, J.M. & Shiel, R.J. (2000). *Monitoring aquatic invertebrates and waterbirds at Toolibin and Walbyring lakes in the Western Australian wheatbelt.* J. Roy. Soc. West. Aust. 83:17-28.

Halse, S.A., Pearson, G.B. & Patrick, G.B. (1993). *Vegetation of depth-gauged wetlands in nature reserves of south-west Western Australia*. Technical Report 30. Department of Conservation & Land Management, Perth.

Halse, S.A., Ruprecht, J.K. & Pinder, A.M. (2003). *Salinisation and prospects for biodiversity in rivers and wetlands of south-west Western Australia.* Australian Journal of Botany 51:673–688.

Halse, S.A., Williams, M.R., Jaensch, R.P. & Lane, J.A.K. (1993). *Wetland characteristics and waterbird use of wetlands in south-western Australia.* Wildlife Research 20:103-126.

Hopkinson, K. (2004). *Wetland conservation at Albany WA: Catchment management of the wetlands of the Two Peoples Bay Nature Reserve.* Report prepared by Green Skills for WA Department of Environment and WA Department of Conservation & Land Management and the Natural Heritage Trust. 22pp., plus appendices.

Jaensch, R.P., Clarke, A.G. & Lane, J.A.K. (2009). *Surveys of waterbirds in selected wetlands of south-western Australia in spring-summer 2008-9, with an assessment of changes to habitat and waterbird usage over 2-3 decades.* Report by Wetlands International - Oceania, Brisbane, to WA Department of Environment & Conservation.

Jaensch, R.P., Vervest, R.M. & Hewish, M.J. (1988). *Waterbirds in nature reserves of south-western Australia 1981-1985: Reserve accounts.* Royal Australasian Ornithologists Union Report 30. 290pp.

JDA (1996). *Lake Bryde LCDC: Feasibility of drainage modifications.* Consultant's report by Jim Davies and Associates, Ref. J262a.

JDA (2002). *Environmental impact assessment of surface water management proposals within Lake Bryde Recovery Catchment: Water and salt balance modelling.* Report by JDA Consulting Hydrologists for Viv Read & Associates, Perth (Appendix 1 of VRA 2002).

JDA (2011). *Living Lakes Project Stage 1: Part 1 Report. Feasibility Study in the Wheatbelt and Adjoining Regions.* Report by JDA Consultant Hydrologists with Advanced Choice Economics Pty Ltd, Land Assessment Pty Ltd and Woodgis Environmental Assessment and Management, for the WA Dept. of Regional Development & Lands. 92+pp.

JDA (2012). *Living lakes Project Stage 1: Part 2 Report. Feasability study of Lakes Towerrinning, Ewlyamartup and Yealering.* Report by JDA Consulting Hydrologists with Land Assessment Pty Ltd, Woodgis Environmental Assessment and Management and Advanced Choice Economics Pty Ltd for the WA Department of Regional Development and Lands. 231pp.

Jones, S., Pinder, A., Sim, L. & Halse, S. (2008). *Evaluating the conservation significance of basin and granite outcrop wetlands within the Avon Natural Resource Management region: Stage one assessment method.* WA Department of Environment and Conservation.

Jones, S.M., Pinder, A.M., Sim, L.L. & Halse, S.A. (2009). *Evaluting the conservation significance of basin wetlands within the Avon Natural Resource Management Region: Stage Three Assessment Method.* WA Dept. of Environment & Conservation. 100pp.

Knott, B., Bruce, L., Lane, J., Konishi, Y. & Burke, C. (2003). *Is the salinity of Lake Clifton (Yalgorup National Park) increasing?* J. Roy. Soc. West. Aust. 86:119-122.

Land Assessment Pty Ltd & Woodgis Environmental Consultants (2102). *Living Lakes Feasibility Study Environmental Report.* Prepared for JDA Consultant Hydrologists on behalf of WA Department og Regional Development & Lands. 107pp.

Landform Research (2003). *Proposed Shark Lake industrial park to provide a land port for the bulk storage of goods for the South East Region, WA. Part 2: Hydrological and geotechnical assessment.* Report prepared for the Shire of Esperance and Esperance Port Authority.

Lane, J.A.K. (1985). *Important aspects of duck hunting in Australia, with particular reference to Western Australia.* In: *Proceedings of the Birds and Man Symposium held in Johannesburg, 10-15 April 1983.* Witwatersrand Bird Club, Johannesburg. pp. 281-307.

Lane, J.A.K. (1986). *1987 duck shooting season – South West and Eucla Land Divisions.* Report for WA Department of Conservation & Land Management, 12pp.

Lane, J.A.K. (1987). *Duck shooting seasons – 1988.* Preliminary report of November 19th, 1987 for WA Department of Conservation & Land Management, 9pp. [A full report was to be presented on November 30th]

Lane, J.A.K. (1989). *Consideration of possible duck shooting seasons in Western Australia in 1990.* Report for WA Department of Conservation & Land Management, 22pp.

Lane, J.A.K. (1994). *The Yenyenning Lakes system: a report on experimental management of outflows at Qualandary crossing from 1985-1990 and recommendations for future management.* Report for WA Department of Conservation & Land Management. 36pp.

Lane, J.A.K., Clarke, A.G., Winchcombe, Y.C., Pearson, G.B., Muir, W.P., Johnson, B.W. & Elscot, S.V. (2009a). *South West Wetlands Monitoring Program Report 1977-2007.* WA Department of Environment & Conservation, Busselton. 331pp.

Lane, J.A.K., Clarke, A.G., Winchcombe, Y.C., Pearson, G.B., Muir, W.P., Johnson, B.W. & Elscot, S.V. (2009b). *South West Wetlands Monitoring Program Report 1977-2008.* WA Department of Environment & Conservation, Busselton. 142pp.

Lane, J.A.K., Clarke, A.G. & Winchcombe, Y.C. (2010). *South West Wetlands Monitoring Program Report 1977-2009.* WA Department of Environment & Conservation, Busselton. 148pp.

Lane, J.A.K., Clarke, A.G. & Winchcombe, Y.C. (2011). *South West Wetlands Monitoring Program Report 1977-2010.* WA Department of Environment & Conservation, Busselton. 156pp.

Lane, J.A.K., Clarke, A.G. & Winchcombe, Y.C. (2013a). *South West Wetlands Monitoring Program Report 1977-2011.* WA Department of Environment & Conservation, Busselton. 158pp.

Lane, J.A.K., Clarke, A.G. & Winchcombe, Y.C. (2013b). *South West Wetlands Monitoring Program Report 1977-2012.* WA Department of Parks & Wildlife, Busselton. 168pp.

Lane, J.A.K., Clarke, A.G. & Winchcombe, Y.C. (2015). *South West Wetlands Monitoring Program Report 1977-2013.* WA Department of Parks & Wildlife, Busselton. 174pp.

Lane, J.A.K., Clarke, A.G. & Winchcombe, Y.C. (in prep.). *South West Wetlands Monitoring Program Report 1977-2014.* WA Department of Parks & Wildlife, Busselton.

Lane, J.A.K. & Munro, D.R. (1981). *1980 review of rainfall and wetlands in the south-west of Western Australia*. WA Department of Fisheries & Wildlife, Report 47. 23pp.

Lane, J.A.K. & Munro, D.R. (1982). *1981 review of rainfall and wetlands in the south-west of Western Australia*. WA Department of Fisheries & Wildlife, Report 56. 38pp.

Lane, J.A.K. & Munro, D.R. (1983). *1982 review of rainfall and wetlands in the south-west of Western Australia*. WA Department of Fisheries & Wildlife, Report 58. 41pp.

Lane, J.A.K. & Munro, D.R. (1983). *1983 review of rainfall and wetlands in the south-west of Western Australia*. Report for WA Department of Fisheries & Wildlife. 20pp.

Lane, J.A.K. & Munro, D.R. (1984). *1984 review of rainfall and wetlands in the south-west of Western Australia*. Report for WA Department of Conservation & Land Management. 23pp.

Lane, J.A.K. & Munro, D.R. (1985). *1985 review of rainfall and wetlands in the south-west of Western Australia*. Report for WA Department of Conservation & Land Management. 19pp.

Lane, J.A.K., Pearson, G.B., Clarke, A.G., Winchcombe, Y.C. & Munro, D.R. (dec.) (2004). *Depths and salinities of wetlands in south-western Australia: 1977-2000.* WA Department of Conservation & Land Management, Busselton. 129pp.

Lizamore, J., Davies, S. & Pinder, A., (….). *Reinstating historical hydrology patterns in a Ramsar listed lake suite: the success story of the Lake Warden wetland system*. Source?

Lizamore, J., Simons, J., Davies, S., Pinder, A. & Vogwill, R. (2013). *Managing and adapting to secondary salinity and altered hydrology in a Ramsar listed lake suite: Lake Warden wetland system case study.* Abstract of paper presented at the WA State Coastal Conference, Balancing communities and coasts, Esperance, 2013. WA Department of Parks & Wildlife. pp.1-2.

Lyons, M.N., Halse, S.A., Gibson, N., Cale, D.J., Lane, J.A.K., Walker, C.D., Mickle, D.A & Froend, R.H. (2007). *Monitoring wetlands in a salinizing landscape: case studies from the wheatbelt region of Western Australia.* Hydrobiologia 591:147–164.

McLernon, C. (1996). N311 *Management of aquatic systems. Assignment 4. Wetland project (final report).* [concerns Lakes Warden and Mullet, Esperance]. Murdoch University, Perth.

McLure, N. & Horwitz, P. (2009). *An investigation of aquatic macroinvertebrate occurrence & water quality at Lake Chandala, Western Australia*. School of Natural Sciences, Edith Cowan University report. 36pp.

McSweeney, S., Davies, C.G., Gautam, B. & Hewitt, S. (2011). *Hydrogeological Conceptualisation Report – Preston Beach Town Site Strategy*. Prepared for Preston Beach Developments Joint Venture Pty Ltd.

New, C.E.S., Smith, R.A., Hearn, R.W. & Wheeler, I.B. (2004). *Groundwater-lake interactions in the Lake Muir – Unicup Recovery Catchment.* 1st National Salinity Engineering Conference, 9-12 November 2004, Perth, Western Australia.

Nowicki, A., Kern, S., Pinder, A. & Daniel, G. (2008). *Resource condition report for significant Western Australian wetland: Lake Guraga. Report of WA Department of Environment & Conservation.* 34pp.

Nowicki, A., Kern, S., Pinder, A. & Daniel, G. (2009). *Resource condition report for significant Western Australian wetland: Coyrecup Lake. Report of WA Department of Environment & Conservation.* 32pp.

Peck, A.J. (2000). *Salt lake hydrology: potential impact of drainage schemes.* Paper presented at *Hydro 2000*, 3rd International Hydrology and Water Resources Symposium, 20-23 November 2000, Perth, Western Australia.

Pickering. R. (2011). *Bitterns in the west*. Page 7 in: *The Bittern Chronicle*, Birds Australia, Issue 3 Sept 2011.

Pickering, R. (2013). *Australasian Bittern in Southwest Australia*. Report on investigations supported principally by Birdlife Western Australia, WA Department of Environment & Conservation and LotteryWest. 120pp.

Pinder, A., Cale, D., Halse, S. & Leung, A. (2012). *Waterbird monitoring of the Warden and Gore wetlands in November 2010 and February 2011*. WA Department of Environment & Conservation. 39+pp.

Pinder, A., Cale, D., Halse, S. & Quinlan, K. (2012). *Waterbird monitoring of the Warden and Gore wetlands in December 2011 and February 2012*. WA Department of Environment & Conservation. 48+pp.

Pinder, A.M., Cale, D.J., Lane, J.A.K. & Lyons, M.N. (2010). *A review of the State Salinity Strategy wetland monitoring program 1996 to 2007*. WA Department of Environment & Conservation.

Pinder, A., Cale, D., Leung, A. & Halse, S. (2010). *Waterbird and invertebrate monitoring of the Warden and Gore wetlands in November 2009 and February 2010*. WA Department of Environment & Conservation. 43+pp..

Pinder, A., Cale, D. & Lizamore, J. (2013) *Restore it and they will come? Hydrology and waterbirds in the Lake Warden wetlands*. W.A.: Department of Parks & Wildlife, 2013. Abstract of paper presented at: WA State Coastal Conference, Balancing communities and coasts, Esperance, 2013.

Pinder, A. & Lizamore, J. (2012). *Change in waterbird communities of the Warden wetlands.* WA South Coast Shorebird Network Newsletter 4, pp.2-3.

Robertson, D. & Massenbauer, T. (2005). *Applying hydrological thresholds to wetland management for waterbirds, using bathymetric surveys and GIS.* MODSIM Conference Proceedings, Melbourne.

Sim, L.L. (2005). *Transitions between ecological regimes in salinising wetlands.* Thesis for the degree of Doctor of Philosophy. School of Environmental Science, Murdoch University, Perth.

Sim, L., Nowicki, A., Pinder, A., Prideaux, C., Cale, D. & Coote, M. (2008). *Trialling a framework and indicators for wetland extent, distribution and condition in Western Australia: final report to the National Land and Water Resource Audit.* WA Department of Environment & Conservation. 81pp.

Smith, M.D., Goater, S.E., Reichwaldt, E.S., Knott, B. & Ghadouani, A. (2010). *Effects of recent increases in salinity and nutrient concentrations on the microbialite community of Lake Clifton (Western Australia): are the thrombolites at risk?* Hydrobiologia 649(1):207-216

Smith, R.A. (2003). *Hydrogeology of the Muir-Unicup catchments.* Water and Rivers Commission, Perth. Salinity and Land Use Impacts Report SLUI 22.

Storey, A.W., Lane, J.A.K. & Davies, P.M. (1997). *Monitoring the ecological character of Australia's wetlands of International importance (Ramsar Convention).* WA Department of Conservation & Land Management, 115 p.

Susac, R., Nowicki, A., Kern, S., Pinder, A. & Daniel, G. (2008). *Resource condition report for a significant Western Australian wetland: Lake Logue.* Report of WA Department of Environment & Conservation. 38pp.

URS (2002). *Feasibility of engineering works to improve water quality in Lake Mears.* Report prepared for WA Department of Conservation & Land Management, Narrogin, by URS Australia Pty Ltd, Perth.

VRA (2002). *Impact assessment of surface water management proposal for the Lake Bryde Recovery Catchment.* Report prepared by Viv Read and Associates for the WA Department of Conservation & Land Management.

Watkins, D. & McNee, S. (1985). *Typha at Lake Forrestdale.* Unpublished report to WA Department of Fisheries & Wildlife. 54pp.

WRC (2002). *Yenyenning Lakes Management Strategy 2002-2012.* Water and Rivers Commission, Water Resource Management Series, No. WRM 32.

WRC & Hopkinson, K. (1999). *Draft recommendations for the management of the Bremer wetlands: Swamp Rd catchment, Gairdner Study Group catchment, Devils Swamp catchment.* Water and Rivers Commission, Albany.

APPENDIX 2. Recreation and SWWMP wetlands.

Wetlands in south-western Australia are used for many forms of recreation including water-based sports such as water-skiing, sailing, sailboarding, canoeing and kayaking and other 'in the water' experiences such as tadpole and macroinvertebrate collecting and waterbird surveys. Many urban wetlands have trails or footpaths on or near their shores and these are enjoyed by walkers, joggers and cyclists. Others have parks, picnic areas and family playgrounds. In both of these urban situations, the lake-side vistas and ambience add enjoyment to the recreational experience. Some wetlands have hides, platforms and walkways for viewing birds and their environments. People enjoy the aesthetics of healthy wetlands and the opportunity to closely observe, and perhaps photograph, the local wildlife.

SWWMP wetlands and recreational access

SWWMP wetlands provide many opportunities for recreational enjoyment of wildlife. Some have easy access and others do not. Below is a list (a-f) of all SWWMP wetlands categorised according to their proximity to Perth, to other major urban centres and to smaller towns and settlements, and according to their ease of access at present.

While reading the list, the following should be noted:

There are hazards (e.g. water, mud, venomous snakes, toxic algae, overpowering odours, possibility of becoming lost) associated with many wetlands and 'easy access' should not be interpreted as low risk. Assignment to access categories (a-f) is based on ease of access to each wetland and not necessarily to each wetland's depth gauge(s). The use of watercraft is generally not permitted on SWWMP wetlands (or other wetlands reserved for conservation or in National Parks) except in a few instances where and when indicated by on-site signage. No privately-owned SWWMP wetlands (*Hebitons, Blue Gum, Streets, Frasers*, Ardath, *Kwobrup*, Atkins Yate and Yellilup) are listed below. Landowners' permission is required to access privately-owned wetlands. SWWMP wetlands on public land but only accessible via private property are included in the 'difficult access' category (f). The wetlands within each category are listed approximately N-S and W-E. Wetlands in italics are '*historical*' and not currently monitored under SWWMP. The approximate location, coordinates and tenure of each wetland can be ascertained from Figure 1 and Table 1 of this report. Tables 2 and 3 may also be helpful.

a) SWWMP wetlands in the Perth metropolitan area are: Joondalup, Thomsons, Forrestdale, Gibb and Jandabup. The first three are easy to access and have some interpretive and other recreational facilities.

b) SWWMP wetlands in or close to other major urban centres[1] are: Egret (Australind), Broadwater (Busselton), Moates, *Angove*, *Gardner*, Powell (Albany) and Warden, Shark, Wheatfield, Station (Esperance). Access is easy to all except Moates, *Angove* and Station.

c) SWWMP wetlands close to smaller rural towns[1] **and settlements**[1] **and easy to access** are: Yarra Yarra (Three Springs), Wannamal (Wannamal), *Nambung* and *Wallering* (Bambun), McLarty (Birchmont), 'Boyup Brook 18239' (Kulicup), Towerrinning (Moodiarrup), Pleasant View, 'Albany 26385' [ALB1], 'Albany 27157' [ALB2] and *White Albany* (Manypeaks), Yealering (Yealering), '*Wagin 2088'* and Parkeyerring (Wagin), *Kondinin* (Kondinin), *Gounter* (Hyden), Jerdacuttup (Hopetoun), Coomalbidgup (Coomalbidgup). **Not readily accessible** are Bambun and *Mungala* (Bambun), Noonying (Tammin) and Mettler (Wellstead).

d) SWWMP wetlands in National Parks and easy to access are: Clifton (Yalgorup NP), Davies (Leeuwin-Naturaliste NP), Yeagarup (D'Entrecasteaux NP). **Not readily accessible** are Jasper, Wilson, Yeagarup South and Maringup (D'Entrecasteaux NP), Pillenorup (Stirling Range NP), Colletts and Pabelup South (Fitzgerald River RNP) and Mount Le Grand (Cape Le Grand NP).

e) Other SWWMP wetlands readily accessible by road (though may involve a short walk): *Goorly*, Yurine, *Chittering*, Hinds, Ninan, Walyormouring, *Dowerin*, *Mollerin*, Campion, *'Bruce Rock 30969'*, Red Bruce Rock, Beverley, Mears, Brown, White Water, Dulbinning, Toolibin, Walbyring, Taarblin, Flagstaff, *Queerearrup*, *Murapin*, Martinup, Dumbleyung, *Coblinine*, Casuarina, Coyrecup, Muir, *Red Manjimup*, Unicup, Yarnup, Noobijup, Warrinup, Kwornicup, Anderson, Altham, Bryde, Range Road, *Biddy*, *Pallarup*, *Cronin*, *'Plantagenet 25386'*, Gore, *'Esperance 27985' [ESP3]* and *'Dundas 33113'*. Several of these wetlands, e.g. Ninan, Walyormouring, Beverley, Mears, Toolibin, Dumbleyung and Muir, have some limited facilities for recreation.

f) Other SWWMP wetlands NOT readily accessible by road (long or difficult walk required): Logue, *Capamaura*, Eganu, *Pinjarrega*, Eneminga, Guraga, Crackers, *Karakin*, *'Gingin 31241'*, Chandala, *Twin Swamps*, *Ellen Brook*, Dobaderry, Goonaping, *'Murray 24739'*, Nine Mile, 'Harvey 12632', Gingilup, Byenup, Tordit-Gurrup, Poorginup, Owingup, 'Boat Harbour 1', *'Mount Marshall 26687'*, 'Corrigin 12900', *Nonalling*, *Bokan*, Little White, White Narrogin, *Gundaring*, Coomelberrup, *Wardering*, *Miripin*, 'West Arthur 5456', *Wild Horse*, Ngopitchup, *'Cranbrook 25812'*, *Camel*, *'Gnowangerup 26264' [GNO1]*, *'Gnowangerup 26569' [GNO2]*, Yaalup, *Cairlocup*, 'Kent 29020', Bennetts, Ronnerup,

[1] Town / settlement name in brackets.

Ace, Varley, Mettler, North Parriup, *Shaster*, 'Esperance 26410' [ESP1], Mortijinup, *'Esperance 27768' [ESP2]*, *'Esperance 32128' [ESP4]*, *'Esperance 32776' [ESP5]* and Big Boom. None of these wetlands have facilities for recreation.

SWWMP wetlands, recreational boating and some other activities
SWWMP wetlands currently approved (Department of Transport website[1], 09/2/2015) for water-skiing are Bennetts, Dumbleyung, *Queerearrup* and Towerrinning. Other SWWMP wetlands (not including privately-owned wetlands) known or understood to have been used for water-skiing in the past are Anderson, Beverley, Bryde, Campion, *Coblinine*, Coyrecup, Forrestdale, Guraga, Hinds, Jasper, *Kondinin*, Mears, Ninan, *Queerearrup*, Unicup, and Yealering. Water-skiing might also have occurred at *'Mt Marshall 26697'*. On Dec 31st 1964, Donald Campbell set a new world water speed record when he piloted his boat, 'Bluebird K7' across the recently full-to-overflowing Lake Dumbleyung at 445 km/hr.

Canoes, kayaks or small dinghies are known or are thought to have been used in recent times at some of the above lakes and on *Angove*, Bambun, Clifton, Gore, *Gundaring*, Joondalup, *Miripin*, Powell, Shark, Toolibin, Walyormouring and Warden. Sailboards and small yachts are thought to have been used on Dumbleyung and Towerrinning. During the 1980s, a small number of permits were issued to allow RAOU[2]-affiliated bird observers to use small craft to survey certain large or deep SWWMP wetlands during an assessment of waterbird use of wetland nature reserves (Jaensch *et al.* 1988).

Swimming may occur at Dumbleyung and *Cronin* and at *Coblinine* where the remains of a wooden diving tower and board were evident a decade or so ago. Horses have been exercised in Parkeyerring. Horse races were apparently conducted on the bed of Red (Bruce Rock) decades ago and some bush-pole structures remain. Fishing for bream has occurred at Clifton and possibly at Wheatfield and marroning at Jasper and Moates. Recreational egg-collecting (now banned) no doubt occurred on some SWWMP wetlands in the past.

Note that some of the above activities are now prohibited and mention here should not be taken to indicate otherwise.

SWWMP wetlands, bird watching and bird studies by volunteers
Except perhaps for duck-shooting (see below), the most geographically extensive recreational use of SWWMP and other wetlands in south-western Australia has been the 1977–81 Atlas of Australian Birds (Blakers *et al.* 1984), the 1981–85 survey of waterbird use of wetland nature reserves (Lane 1981, Jaensch *et al.* 1988), the Great Duck Counts of 1986–88 (Jaensch & Vervest 1988), the 1998–2002 New Atlas of Australian Birds (Barrett *et al.* 2003), the Hooded Plover surveys of the 1990s, the Australasian and Little Bittern surveys of 2007–13 (Pickering 2013) and the waterbird survey efforts of B. & A. Buchanan and possibly others unknown to or not recalled by the authors. The waterbird surveys of R. Garstone (197..?) in the Great Southern and by the WA Field & Game Association prior to 1992 have also been noteworthy. Most notable overall is the fact that a comprehensive assessment by volunteers of the numbers and breeding activity of all waterbird species across the south-west has not been made for three decades, that is, since the 1981–85 survey by members of the former RAOU, now Birdlife Australia.

SWWMP wetlands and recreational duck shooting
Prior to being banned in Western Australia in 1992, recreational duck shooting was undertaken by thousands of licensed shooters. During the last declared season in the south-west (Jan 14th to Feb 11th 1990), the following 40 SWWMP wetlands (and some other wetland reserves) in the conservation estate were declared 'Game Reserves' open for licensed recreational duck shooting: Beverley, Brown, *Bokan*, *Camel*, Campion, *Coblinine*, Coomelberrup, Coyrecup, Dulbinning, Eganu, Eneminga, Flagstaff, Gore, *Gundaring*, Hinds, Jerdacuttup, Martinup, Mears, Muir (part), *Murapin*, Ninan, *Nonalling*, Noobijup, Noonying, Parkeyerring, *Pinjarrega*, *Shaster*, Station, Taarblin, Unicup, *'Wagin 2088'*, Walbyring, Walyormouring, Wannamal (part), Wheatfield, *White (Albany)*, White (Narrogin), White Water, *Wild Horse* and Yurine, Recreational duck shooting may also have been permitted on one or more of several privately-owned SWWMP wetlands.

Throughout the year, all nature reserves not declared to be game reserves and all national parks were closed to shooting. These included a number of SWWMP wetlands In addition, a number of 'waterfowl refuge areas' were declared closed to shooting at all times. These included the following SWWMP wetlands: 'Albany 27157' [ALB2], Anderson, Bambun, Broadwater, *Chittering*, Clifton, 'Corrigin 12900', Crackers, *Coblinine*, Dumbleyung, Egret, Forrestdale, Jandabup, Joondalup, McLarty, Muir (part), *Mungala*, *Murapin*, *'Murray 24739'*, *Nambung*, Powell, Toolibin, Towerrinning, *Wallering*, Wannamal (part), *Wardering* and Yealering.

[1] http://www.transport.wa.gov.au/mediaFiles/marine/MAC-M-WaterSki_InlandWaterDamsLakes3.pdf
[2] Now 'Birdlife Australia'.

APPENDIX 3. 'Waterbird Spectaculars'

The most recent broad-scale survey of all waterbird species, numbers and breeding activity on hundreds of wetlands across the south-west is the 1981–85 survey of waterbird usage of wetland nature reserves (and many other wetlands) in south-western Australia (Lane 1981, Jaensch *et al.* 1988). This survey was a cooperative effort by the WA Department of Fisheries & Wildlife (a predecessor of DPaW) and the Royal Australasian Ornithologists Union (now Birdlife Australia) and was funded by recreational duck-shooting licence fees. The Tables below show where the highest counts were made, which wetlands had the highest numbers of birds per unit area, the water depth and salinity at the time of each highest count, and the most abundant species.

The main purpose of preparing these Tables is to show that, when conditions are suitable, large numbers and densities of waterbirds gather, providing periodic opportunities to witness 'waterbird spectaculars'. They also demonstrate how count, depth and salinity data could be used to predict future events of this nature.

In the first Table, wetlands are listed (ranked) in order of highest count. In the second, the same wetlands are listed in order of count per unit area, i.e. waterbird density.

(A) Ranked by Highest Count

SWWMP Wetland	Highest Count (month & year)	Count Rank	Area (ha)	Count / Area Ratio	Count / Area Rank	Local Authority	Depth (m)	Sal. (ppt)	Single most abundant species in highest count
Dumbleyung	24,839 (Mar85)	**1**	3,968	6.3	28	Dumbl./Wagin	2.75	40	Coot (10,500)
Forrestdale	17,484 (Jan83)	**2**	198	88.3	**5**	Armadale	0.17	11	Uid Ducks (4,500)
Warden	16,919 (Nov82)	**3**	600	28.2	14	Esperance	0.40	166	Banded Stilt (7,000)
Thomsons	14,675 (Mar85)	**4**	239	61.4	**7**	Cockburn	0.33	8	Coot (5,200)
Gore	13,505 (Nov84)	**5**	738	18.3	21	Esperance	1.67	49	Shelduck (7,000)
Mears	10,958 (May82)	**6**	279	39.3	12	Brookton	0.20	95	Banded Stilt (5,200)
Eganu	10,940 (Jan82)	**7**	84	130.2	**3**	Coorow	1.82	18	Grey Teal (4,000)
Pinjarrega	10,311 (Dec81)	**8**	570	18.1	22	Coorow	1.94	27	Shelduck (3,000)
Hinds	9,614 (Oct83)	**9**	1,197	8.0	27	Wong.-Ballidu	1.44	61	Banded Stilt (8,000)
White Narrogin	8,399 (Mar84)	**10**	200	42.0	11	Narrogin	1.22	7	Grey Teal (6,000)
Kwornicup	7,361 (Sep82)	11	219	33.6	13	Plantagenet	0.14	46	Banded Stilt (7,000)
Guraga	7,217 (Mar84)	12	350	20.6	19	Dandaragan	1.52	10	Uid Grebe, Coot (2,000 ea)
Joondalup	6,573 (Mar84)	13	469	14.0	24	Joondalup	2.40	2	Coot (4,436)
Wardering	6,304 (Mar84)	14	43	146.6	**2**	Woodanilling	0.37	29	Grey Teal (4,000)
Broadwater	6,125 (Jan83)	15	63	97.2	**4**	Busselton	-	-	Grey Teal (2,000)
Coyrecup	6,070 (May83)	16	417	14.6	23	Katanning	0.92	13	Grey Teal (2,680)
Chandala	5,202 (Oct83)	17	120	43.4	**9**	Chittering	0.90	1	Straw-n. Ibis (5,000)
McLarty	4,639 (Feb85)	18	200	23.2	15	Murray	-	-	Grey Teal (1,500)
Walyormouring	4,473 (Nov81)	19	≈500	≈8.9	26	Goomalling	0.51	20	Grey Teal, Hardhead (2,000 ea)
Jandabup	4,438 (Mar83)	20	232	19.1	20	Wanneroo	0.34	3	Red-c. Plover (3,000)
Flagstaff	4,336 (Jan85)	21	≈200	≈21.7	16	Woodanilling	0.52	96	Shelduck (2,500)
Taarblin	4,241 (Feb84)	22	985	4.3	29	Narrogin	1.52	3	Grey Teal (3,000)
Ninan	4,178 (Oct82)	23	199	21.0	18	Wong.-Ballidu	0.88	110	Banded Stilt (3,000)
Wannamal	4,158 (Nov84)	24	64	65.0	**6**	Gingin	1.28	8	Coot (3,600)
Coomelberrup	3,459 (Jan83)	25	82	42.2	**10**	Dumbleyung	0.61	39	Grey Teal (1,300)
Beverley (cntrl)	3,423 (Apr84)	26	≈75	≈45.6	**8**	Beverley	0.88	110	Banded Stilt (2,500)
Parkeyerring	3,317 (Jul84)	27	≈300	≈11.1	25	Wagin	1.13	23	Coot (1,800)
White Water	3,204 (Sep82)	28	≈150	≈21.4	17	Corrigin	0.14	56	Banded Stilt (2,880)
Muir	3,012 (Jan85)	29	4600	0.7	30	Manjimup	0.70	58	Shelduck (3,000)
* Shark	2,642 (Mar85)	30	4.5	587.1	**1**	Esperance	1.83	2	Grey Teal (2,000)

- The cutoff for this Table is 3,000 birds. Shark Lake has been added because of its exceptionally high count / area ratio.
- Twenty of the wetlands in this Table are in the inland agricultural area where rainfall is declining and wetlands are filling less frequently than during 1981-85. Waterbird numbers are probably also in decline and 'waterbird spectaculars' less frequent.
- This Table could be usefully updated by addition of (for example) unpublished 1986-1992 RAOU data, the 1986-1988 *Great Duck Counts* (Jaensch & Vervest 1988); 1987-1992 *Annual Waterfowl Counts* (e.g. Halse *et al*. 1995); Esperance District counts (Clarke & Lane 2003); count data from DPaW Recovery Catchments and from intensive monitoring of SWWMP wetlands by Halse, Pinder & Cale, and data from articles appearing in post-1990 issues of *WA Bird Notes*. Lake Muir, for example, supported 51,613 ducks, swans and coots in March 1989 (Halse *et al*. 1990), greatly exceeding the highest count for any wetland in the above Table.

APPENDIX 3 continued.

(B) Ranked by Waterbird Density (Count/Area Ratio)

SWWMP Wetland	Highest Count (month & year)	Count Rank	Area (ha)	Count / Area Ratio	Count / Area Rank	Local Authority	Depth (m)	Sal. (ppt)	Single most abundant species in highest count
* Shark	2,642 (Mar85)	30	4.5	587.1	**1**	Esperance	1.83	2	Grey Teal (2,000)
Wardering	6,304 (Mar84)	14	43	146.6	**2**	Woodanilling	0.37	29	Grey Teal (4,000)
Eganu	10,940 (Jan82)	**7**	84	130.2	**3**	Coorow	1.82	18	Grey Teal (4,000)
Broadwater	6,125 (Jan83)	15	63	97.2	**4**	Busselton	-	-	Grey Teal (2,000)
Forrestdale	17,484 (Jan83)	**2**	198	88.3	**5**	Armadale	0.17	11	Uid Ducks (4,500)
Wannamal	4,158 (Nov84)	24	64	65.0	**6**	Gingin	1.28	8	Coot (3,600)
Thomsons	14,675 (Mar85)	**4**	239	61.4	**7**	Cockburn	0.33	8	Coot (5,200)
Beverley (cntrl)	3,423 (Apr84)	26	≈75	≈45.6	**8**	Beverley	0.88	110	Banded Stilt (2,500)
Chandala	5,202 (Oct83)	17	120	43.4	**9**	Chittering	0.90	1	Straw-n. Ibis (5,000)
Coomelberrup	3,459 (Jan83)	25	82	42.2	**10**	Dumbleyung	0.61	39	Grey Teal (1,300)
White Narrogin	8,399 (Mar84)	**10**	200	42.0	11	Narrogin	1.22	7	Grey Teal (6,000)
Mears	10,958 (May82)	**6**	279	39.3	12	Brookton	0.20	95	Banded Stilt (5,200)
Kwornicup	7,361 (Sep82)	11	219	33.6	13	Plantagenet	0.14	46	Banded Stilt (7,000)
Warden	16,919 (Nov82)	**3**	600	28.2	14	Esperance	0.40	166	Banded Stilt (7,000)
McLarty	4,639 (Feb85)	18	200	23.2	15	Murray	-	-	Grey Teal (1,500)
Flagstaff	4,336 (Jan85)	21	≈200	≈21.7	16	Woodanilling	0.52	96	Shelduck (2,500)
White Water	3,204 (Sep82)	28	≈150	≈21.4	17	Corrigin	0.14	56	Banded Stilt (2,880)
Ninan	4,178 (Oct82)	23	199	21.0	18	Wong.-Ballidu	0.88	110	Banded Stilt (3,000)
Guraga	7,217 (Mar84)	12	350	20.6	19	Dandaragan	1.52	10	Uid Grebe, Coot (2,000 ea)
Jandabup	4,438 (Mar83)	20	232	19.1	20	Wanneroo	0.34	3	Red-c. Plover (3,000)
Gore	13,505 (Nov84)	**5**	738	18.3	21	Esperance	1.67	49	Shelduck (7,000)
Pinjarrega	10,311 (Dec81)	**8**	570	18.1	22	Coorow	1.94	27	Shelduck (3,000)
Coyrecup	6,070 (May83)	16	417	14.6	23	Katanning	0.92	13	Grey Teal (2,680)
Joondalup	6,573 (Mar84)	13	469	14.0	24	Joondalup	2.40	2	Coot (4,436)
Parkeyerring	3,317 (Jul84)	27	≈300	≈11.1	25	Wagin	1.13	23	Coot (1,800)
Walyormouring	4,473 (Nov81)	19	≈500	≈8.9	26	Goomalling	0.51	20	Grey Teal, Hardhead (2,000 ea)
Hinds	9,614 (Oct83)	**9**	1,197	8.0	27	Wong.-Ballidu	1.44	61	Banded Stilt (8,000)
Dumbleyung	24,839 (Mar85)	**1**	3,968	6.3	28	Dumbl./Wagin	2.75	40	Coot (10,500)
Taarblin	4,241 (Feb84)	22	985	4.3	29	Narrogin	1.52	3	Grey Teal (3,000)
Muir	3,012 (Jan85)	29	4600	0.7	30	Manjimup	0.70	58	Shelduck (3,000)

Depths at the time of highest counts being recorded ranged from 2.75m (Dumbleyung) to 0.14m (Kwornicup, White Water) and salinities from 166ppt (Warden) to 1ppt (Chandala). Timing was as follows: Jun-Jul (1 wetland), Aug-Sep (2), Oct-Nov (7), Dec-Jan (7), Feb-Mar (10), Apr-May (3). These data are consistent with authors' (JL, AC) experience that highest numbers are most likely to occur between late spring and early autumn and that the timing at particular wetlands is depth-specific, with salinity primarily affecting species composition rather than the occurrence or otherwise of high numbers.

'Waterbird spectaculars' may also be observed at other, non-SWWMP wetlands in the south-west, such as Peel Inlet at Mandurah and Vasse-Wonnerup at Busselton, where large flocks of migratory and resident species gather each summer. Feeding frenzies involving hundreds of pelicans, egrets, herons, ibis, cormorants and spoonbills may be seen in the lowest reaches of Vasse-Wonnerup in December-January each year (Lane *et al.* 2007). The nesting colony of Black Swans *Cygnus atratus* at the northern end of Wonnerup estuary and the ibis and cormorant colonies on the Vasse estuary floodplain are also sights to be seen.

APPENDIX 4. Threatened species in SWWMP wetlands.

'Wildlife Conservation (Specially Protected Fauna) Notice 2014', issued under Section 14(4) of the 'Wildlife Conservation Act 1950' and gazetted on December 2nd, 2014, declared a number of species of Western Australian fauna *'that is rare or likely to become extinct ... [or] … presumed to be extinct … to be fauna that is in need of special protection'*. Listed below are the species that occur (or, in the case of Lewin's Rail, are presumed to no longer occur) on south-west wetlands.

Mammals

Setonix brachyurus Quokka

Quokkas make extensive use of thick vegetation associated with wetlands. In the northern part of its mainland range the habitat critical to its survival comprises Swamp Peppermint *Taxandria linearifolia* swamps. Further south it occupies a range of forest, woodland and wetland ecotypes (DEC 2013). Habitat critical to survival on the south coast includes swamps, riparian areas, incised gullies and dense coastal heath (de Tores *et al*. 2007).

SWWMP wetlands that lie within the putative boundaries of the various sub-populations (DEC 2013) are as follows: Dobaderry, Goonaping (Northern Jarrah), 'Boat Harbour 1', Davies, Gingilup, Jasper, Maringup, Owingup, Wilson, Yeagarup, Yeagarup South, (Southern Forest), Moates, Gardner, Angove, 'Albany 27175' (South Coast) and Pillenorup (Stirling Range). There are no SWWMP wetlands within the boundaries of the Central Jarrah sub-population.

Birds

Botaurus poiciloptilus Australasian Bittern ('The Bunyip Bird')

Currently, the threatened waterbird species of primary interest on south-west wetlands is the Australasian Bittern, which is considered threatened throughout its range. A substantial effort has been made in recent years by Alan Clarke (co-author of this report), Robyn Pickering and other members of Birdlife Australia to ascertain, through field survey, which wetlands it is now restricted to and its abundance (Pickering 2012, 2013). Since this effort began in 2007, Australasian Bitterns have been recorded at 29 sites, including the following 15 SWWMP wetlands: 'Albany 26385' (ALB1), 'Albany 27157' (ALB2), Big Boom, 'Boat Harbour 1', Byenup, Forrestdale, Gingilup, Maringup, Moates, Owingup, Pleasant View (highest count of survey was 8 birds in April 2012), Poorginup, Thomsons and Tordit-Gurrup. Historically, this bittern has also been recorded on several other SWWMP wetlands, namely Angove, Gardner, Gundaring, Jandabup, McLarty, Muir, Powell, Shark, Toolibin, Towerrinning, Unicup, White (Albany?) and Yarnup (Pickering 2013).

Calidris ferruginea Curlew Sandpiper

Curlew Sandpipers are primarily coastal and estuarine birds, but do make significant use of lake environments in the south-west. The three lakes in the south-west with highest numbers include two SWWMP wetlands: Thomsons (2,500 in Jan 1993) and Forrestdale (2,000 in Jan 1993). These numbers are considered internationally significant (Bamford *et al*. 2008).

Rallus pectoralis clelandi Lewin's Rail

The Lewin's Rail subspecies *clelandi*, which is now *'presumed to be extinct'* is *'Known from four specimens: two from Margaret River, 1907; one from King George's Sound, date unknown; one from Bridgetown, Dec 1931'* (Marchant & Higgins 1993) and was last recorded in 1932, near Bridgetown. There are no records of this species on SWWMP wetlands, although there are a number of SWWMP wetlands within its former range.

Rostratula benghalensis australis Australian Painted Snipe

The Australian Painted Snipe is found mainly in eastern Australia and is rare in Western Australia. There is a record of three birds on SWWMP wetland Bambun in Nov 1986 (Jaensch & Vervest 1987) and the species was *'evidently common in swamps of Swan Coastal Plain last century'* with the *'last breeding record in 1923 (near Moora)'* (Johnstone & Storr 1998).

Six additional shorebird species are listed as 'specially protected', however these make very limited use of wetlands other than estuaries. They are as follows. *Calidris canutus* Red Knot, *Calidris tenuirostris* Great Knot, *Charadrius leschenaultii leschenaultii* Greater Sand Plover (Mongolian), *Charadrius mongolus* Lesser Sand Plover, *Limosa lapponicai* Bar-tailed Godwit and *Numenius madagascariensis* Eastern Curlew.

Reptiles

Pseudemydura umbrina Western Swamp Tortoise

Globally, the Western Swamp Tortoise is restricted to three or four small locations north of Perth, two of which, *Twin Swamps* and *Ellen Brook*, are historical SWWMP wetlands that were monitored under SWWMP between 1979 and 1984.

Water level and water quality monitoring of these wetlands is now undertaken under programs relating specifically to the conservation of the species, rather than under SWWMP.

Frogs

Three frog species of the south-west have been listed as 'specially protected'. These are *Geocrinia alba* White-bellied Frog, *Geocrinia vitellina* Orange-bellied Frog and *Spicospina flammocaerulea* Sunset Frog. Given their non-lentic habitat preferences, none is considered likely to occur in SWWMP wetlands.

Fish

Galaxias truttaceus hesperius Western Trout Minnow

In WA, the Western Trout Minnow *'is found only in the landlocked Goodga and Angove catchments in the vicinity of Two Peoples Bay ... and in one tributary of the Kent River'* (Morgan *et. al.* 2011). It might therefore occur in the following SWWMP wetlands: Angove, Gardner, Moates and perhaps Owingup or 'Boat Harbour 1'.

Nannatherina balstoni Balston's Pygmy Perch

Balston's Pygmy Perch is *'restricted to near-coastal streams, lakes and wetlands between the upper Margaret River and the Goodga Rive (near Albany)'* (Morgan *et al.* 2011). SWWMP wetlands in this geographic area are (from west to east) Davies, Jasper, Wilson, Yeagarup, Yeagarup South, Maringup, Owingup, 'Boat Harbour 1', Powell and Moates. Jaensch (1992) recorded Balston's Pygmy Perch in Maringup, Owingup and 'Boat Harbour 1' in autumn 1992.

The Mud Minnow *Galaxiella munda* has *'a preference for permanent stream habitats rather than ephemeral wetlands'* (Morgan *et al.* 2011) and therefore seems unlikely to occupy any SWWMP wetlands as none are permanent streams.

Threatened Invertebrates, Threatened Flora and Threatened Ecological Communities

Readers are directed to the Department of Parks & Wildlife's website http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities for the official lists of threatened invertebrate fauna, threatened flora and threatened ecological communities. Their occurrence on SWWMP wetlands will perhaps be addressed in future annual SWWMP reports.

GRAPHS

The following graphs of wetland water depth, pH and salinity are arranged in the same order (alphabetical by wetland name) as in Table 1 where coordinates, tenure and location (by Local Government Authority) are provided.

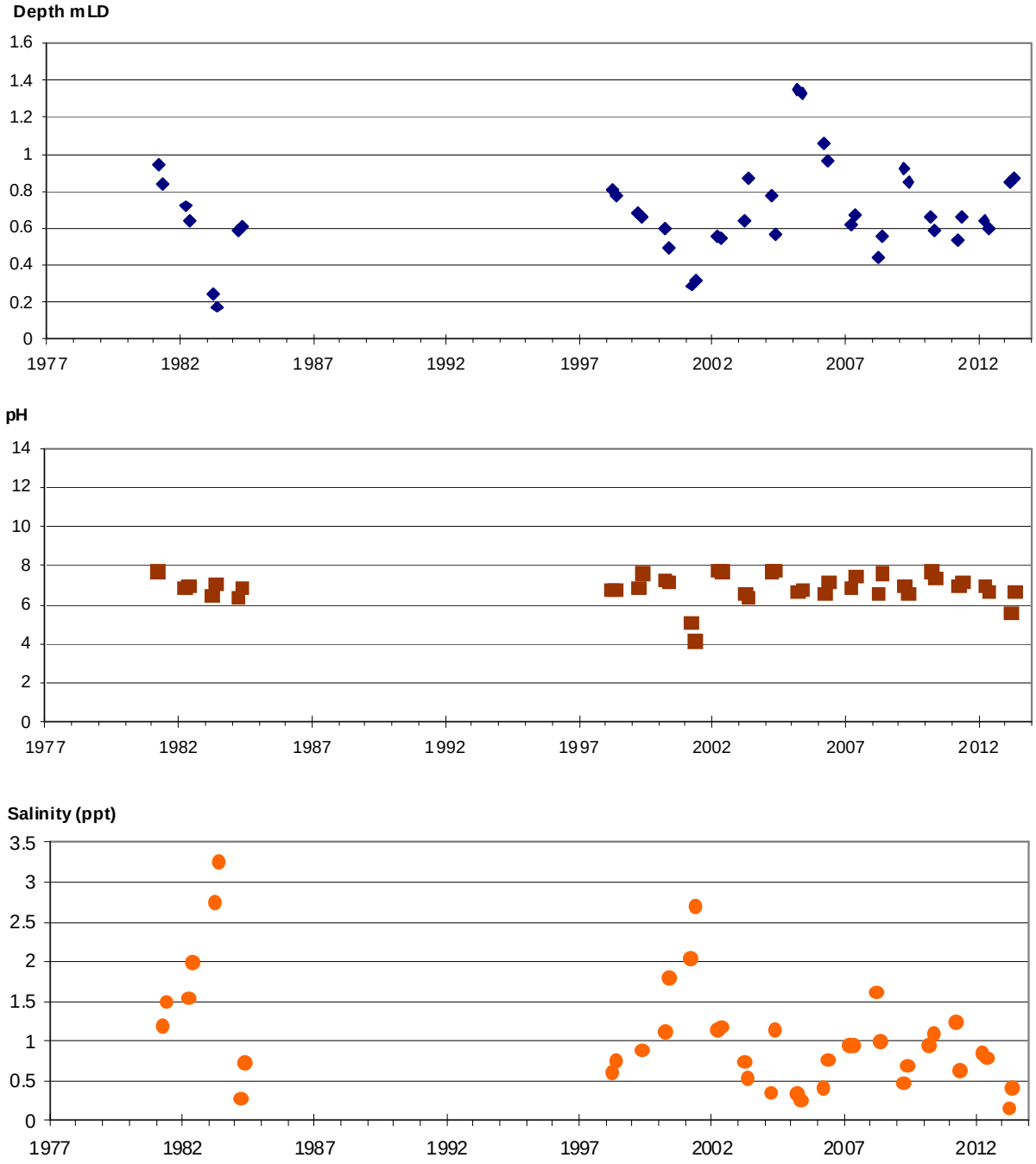
Only routinely-collected September and November data from the 103 SWWMP wetlands currently monitored under the State Salinity Strategy are displayed.

The 25 wetlands Intensively Monitored by DPaW scientific staff for additional biological and physico-chemical attributes (see second-last paragraph of Section 3 and Note 9 of Table 1) are indicated.

Listing as a Wetland of International Importance under the 'Ramsar' *Convention on Wetlands* (Government of Western Australia 1990, 2000; Ramsar Secretariat 2013) and listing in '*A Directory of Important Wetlands in Australia*' (Environment Australia 2001) is indicated where this is the case.

Inclusion in a Natural Diversity Recovery Catchment (Government of Western Australia 1996a; Wallace & Lloyd 2008) is also indicated where applicable.

ALBANY 26385

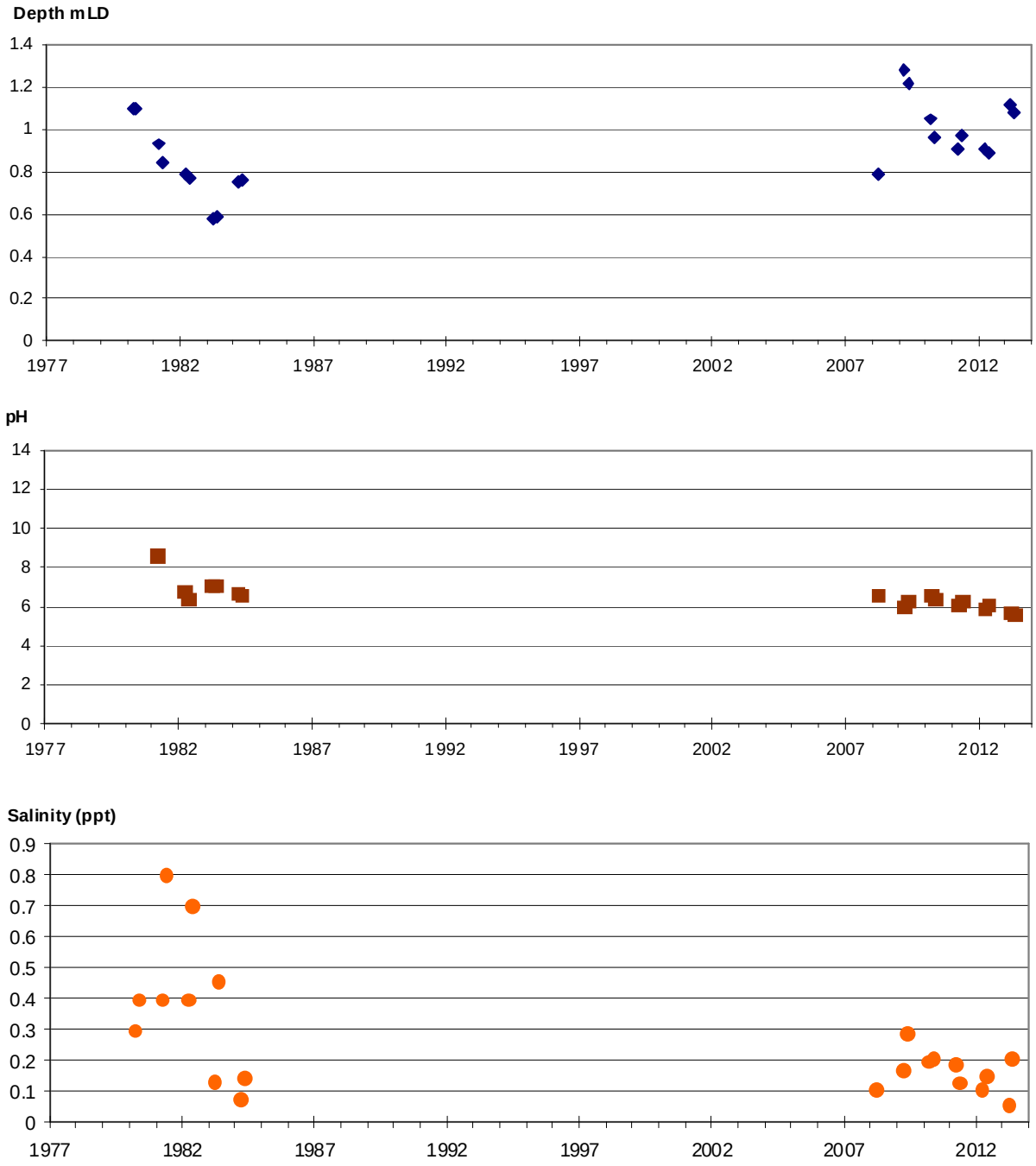


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Albany 26385 is a component of the 'Lake Pleasant View System', which is listed in the 'Directory of Important Wetlands in Australia'.

Albany 26385 is in the Albany District of the South Coast DPaW Region.

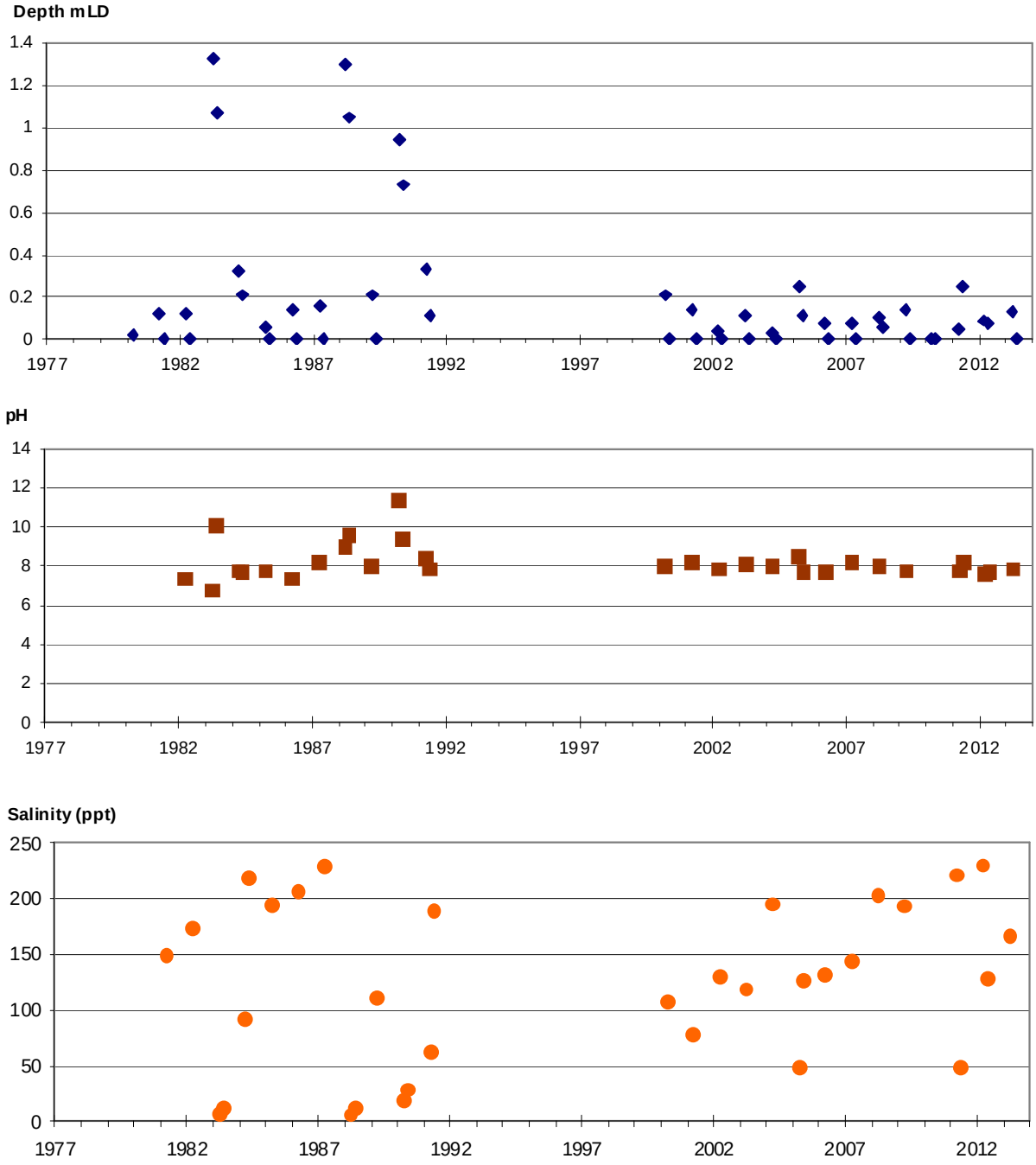
ALBANY 27157



Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Albany 27157 is in the Albany District of the South Coast DPaW Region.

ALTHAM [IM]

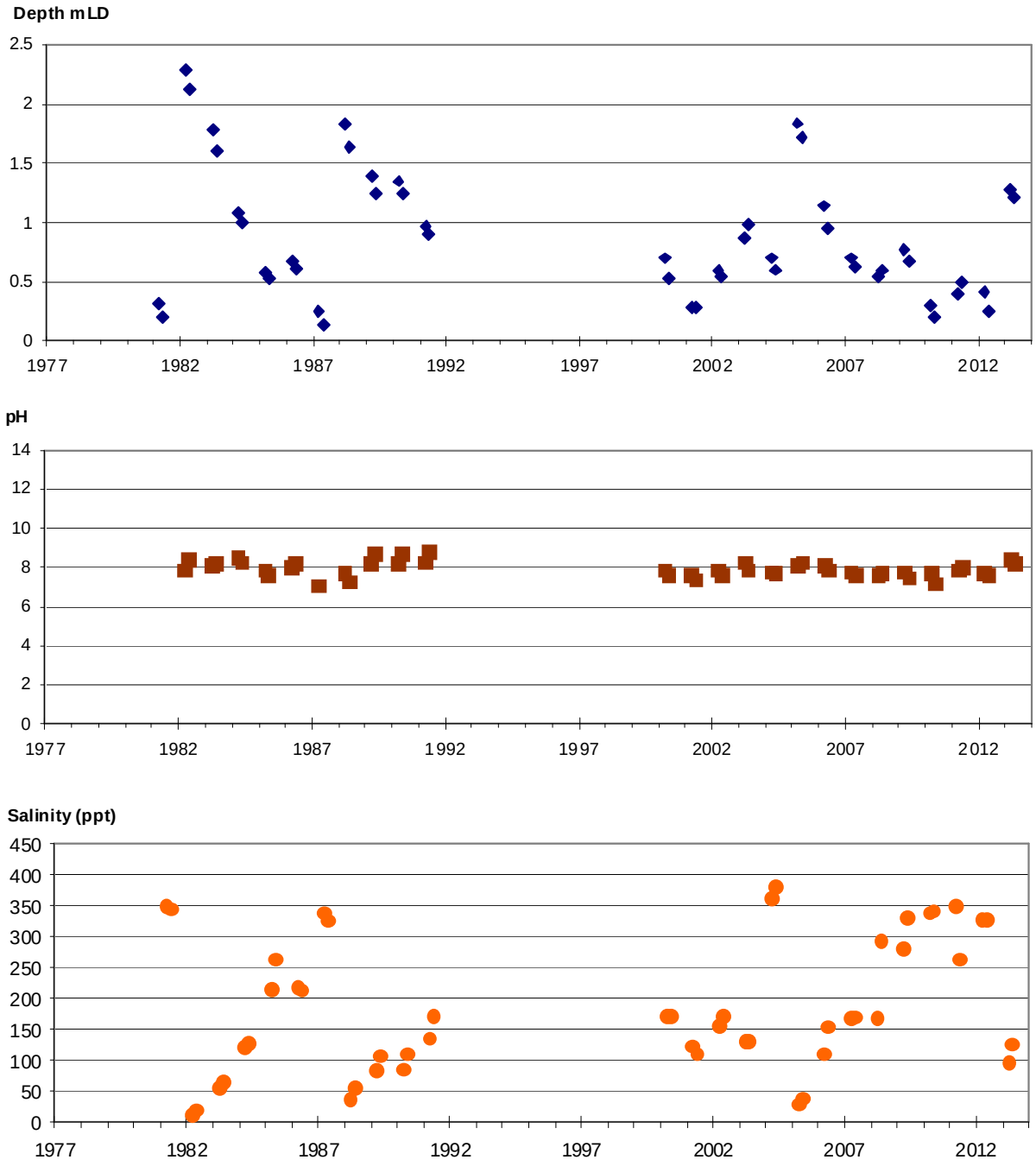


Notes:
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Altham is a component of the 'Lake Grace System', which is listed in the 'Directory of Important Wetlands in Australia'.

Altham is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

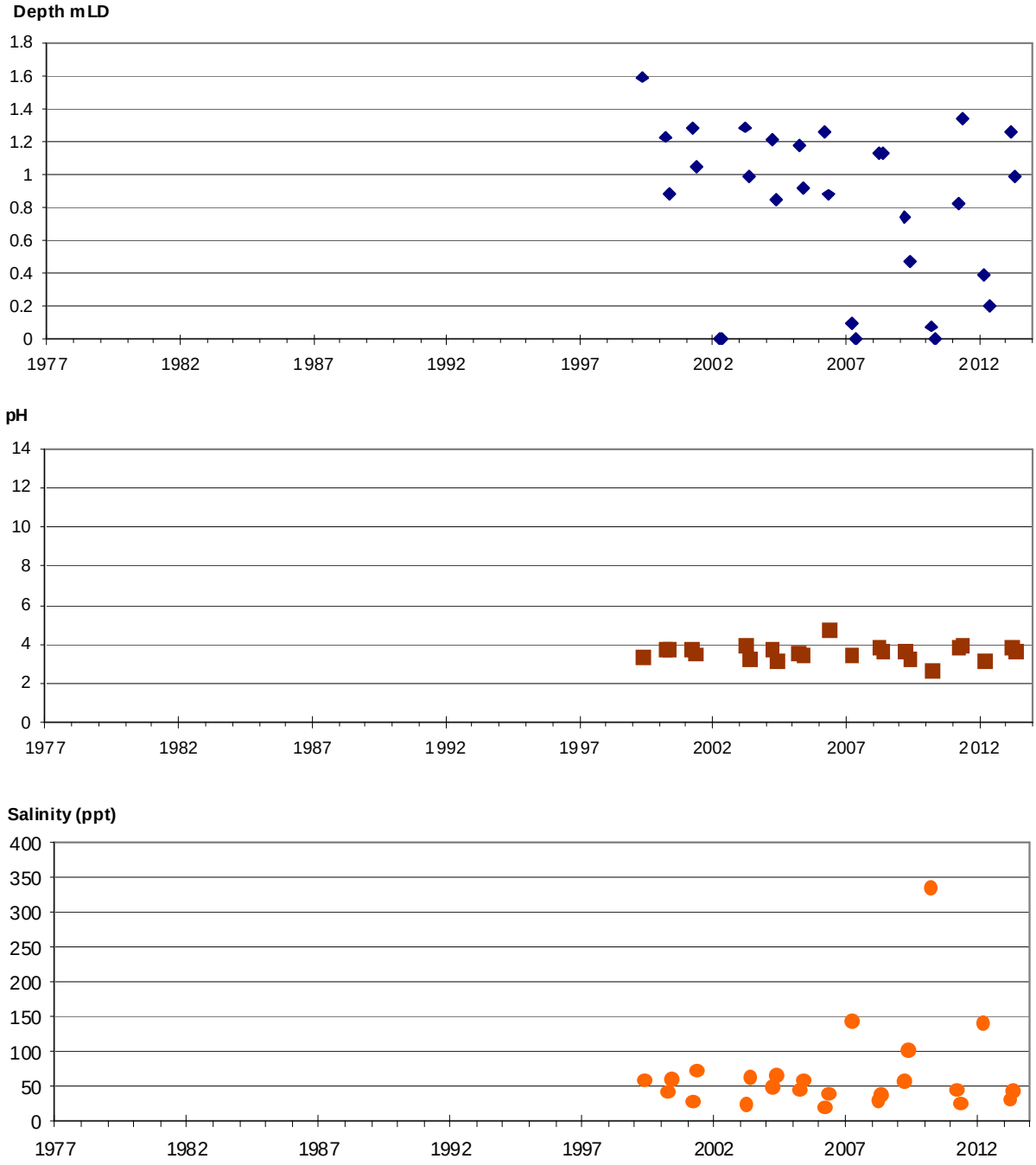
ANDERSON



Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Anderson is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

ARDATH [IM]

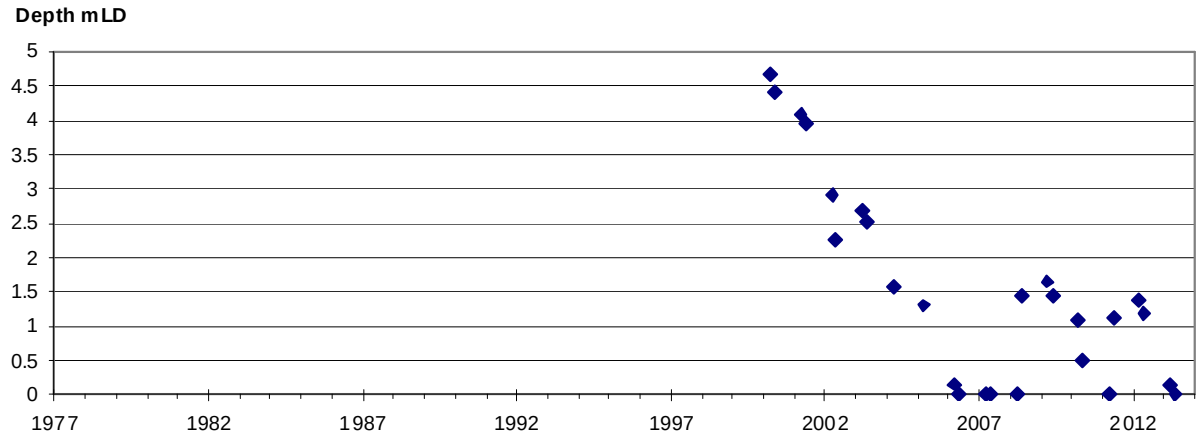


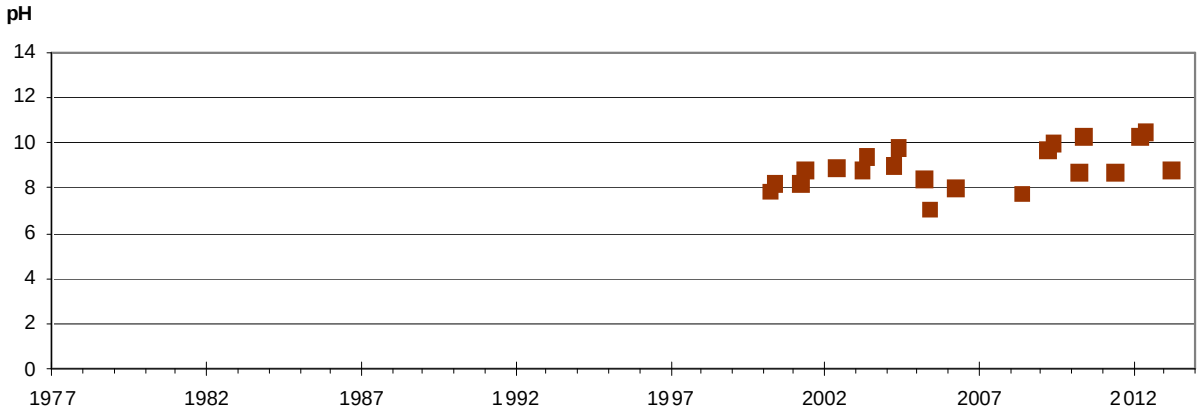
Notes:

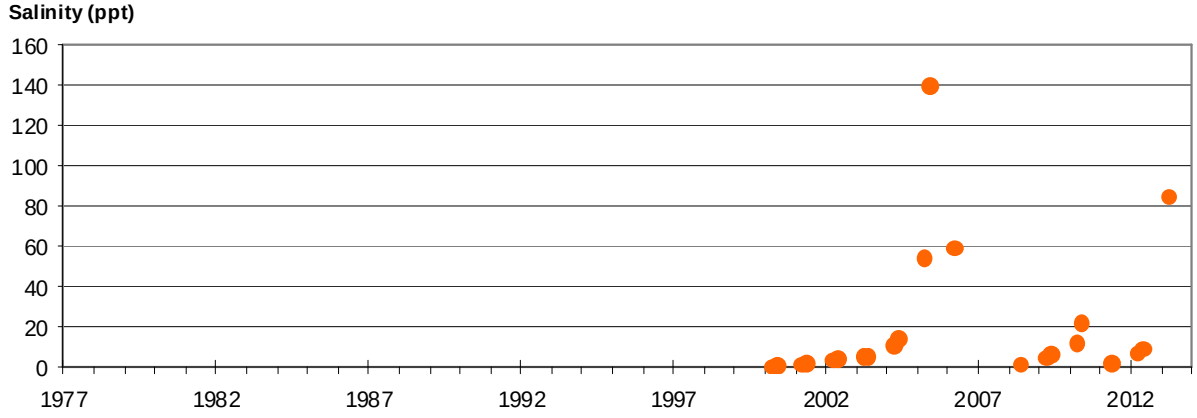
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Ardath is in the Central District (headquartered in Merredin) of the Wheatbelt DPaW Region.

ATKINS YATE



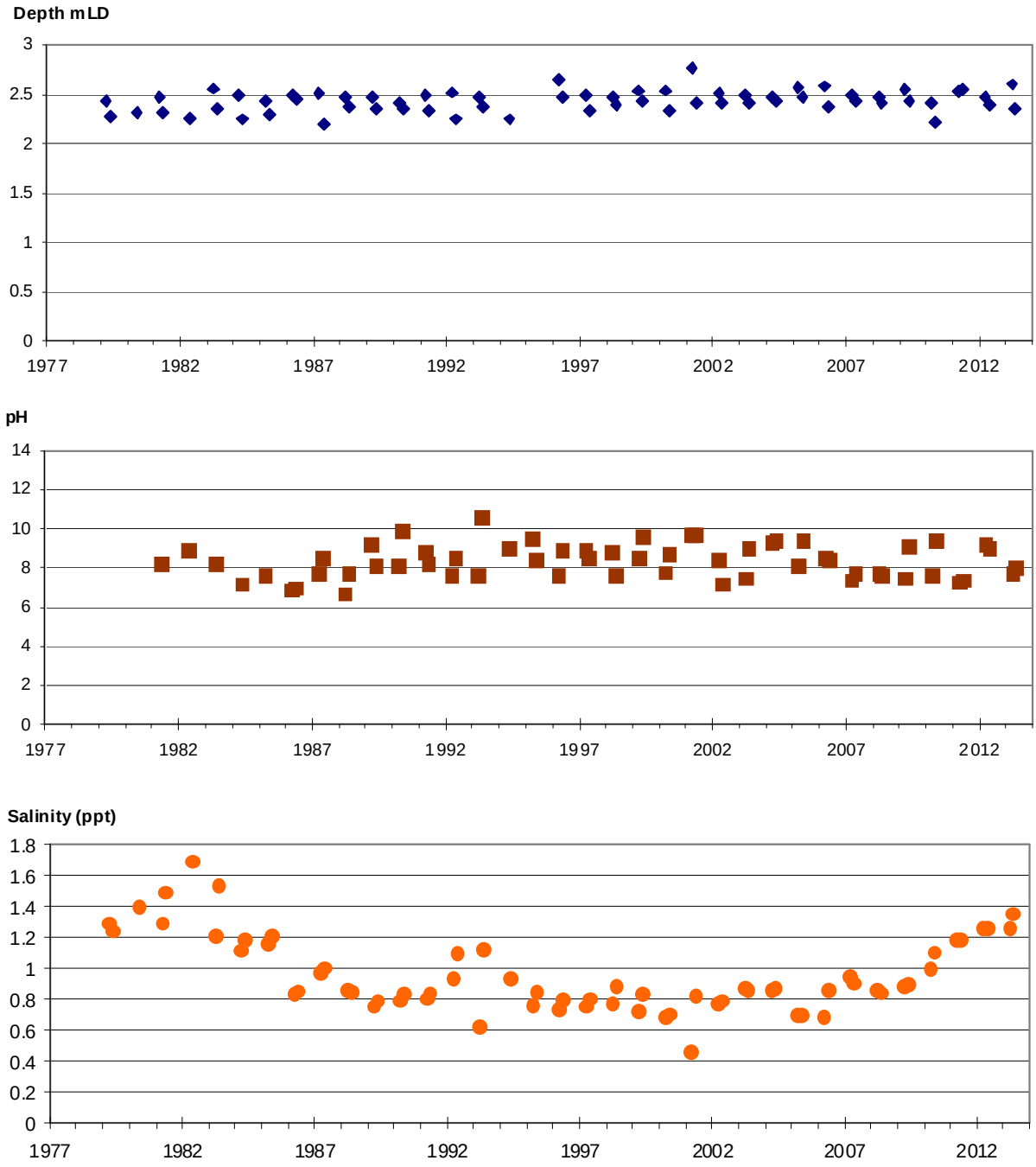




Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Atkins Yate is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

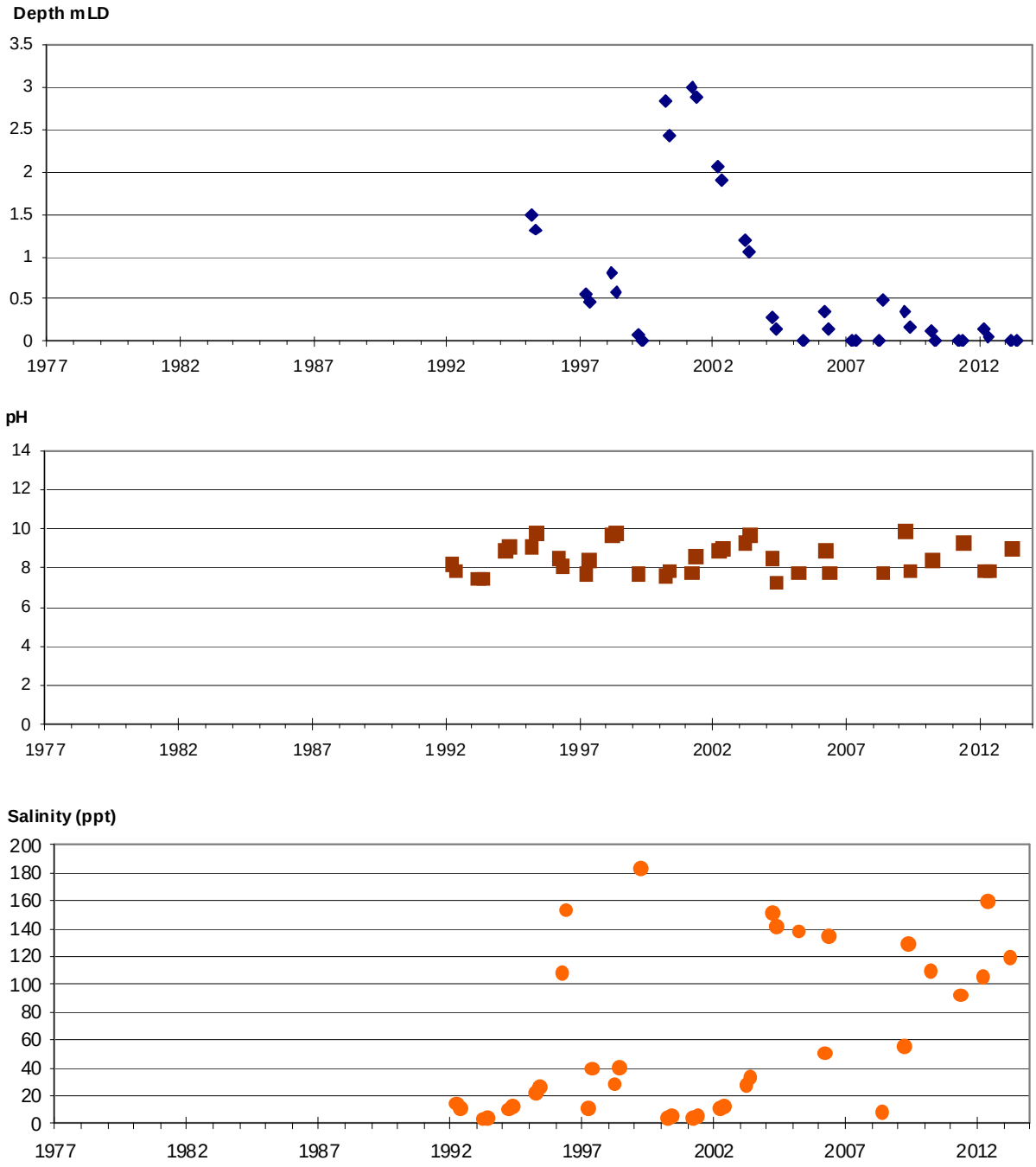
BAMBUN



Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Bambun is in the Swan Coastal District (headquartered in Wanneroo) of the Swan DPaW Region.

BENNETTS [IM]



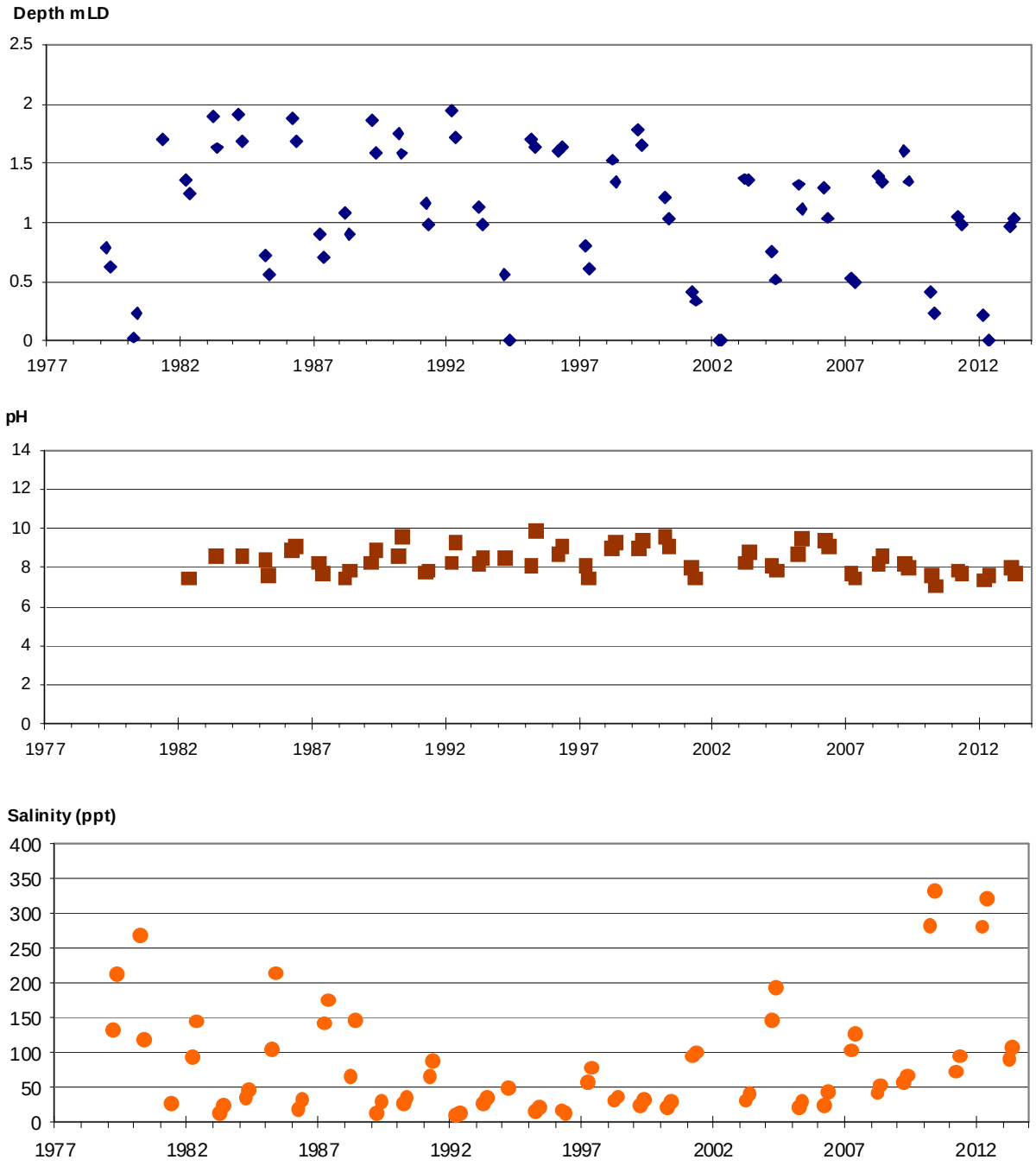
Notes:

1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Bennetts Lake has been nominated for listing in the 'Directory of Important Wetlands in Australia' (Elscot *et al.* 2009).

Bennetts is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

BEVERLEY

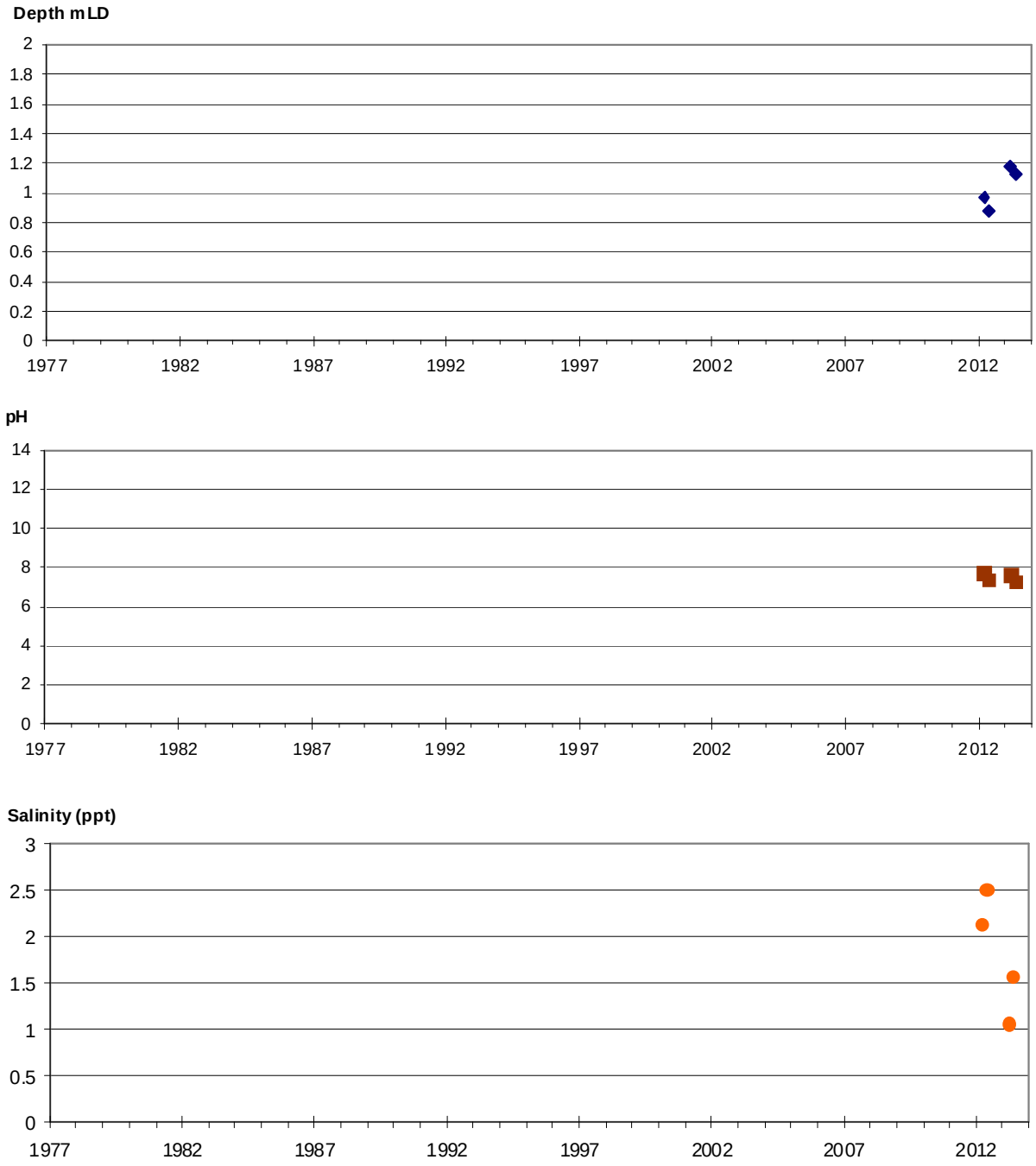


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Beverley Lakes is also known as Yenyenning Lakes.

Beverley is in the Central District (headquartered in Merredin) of the Wheatbelt DPaW Region.

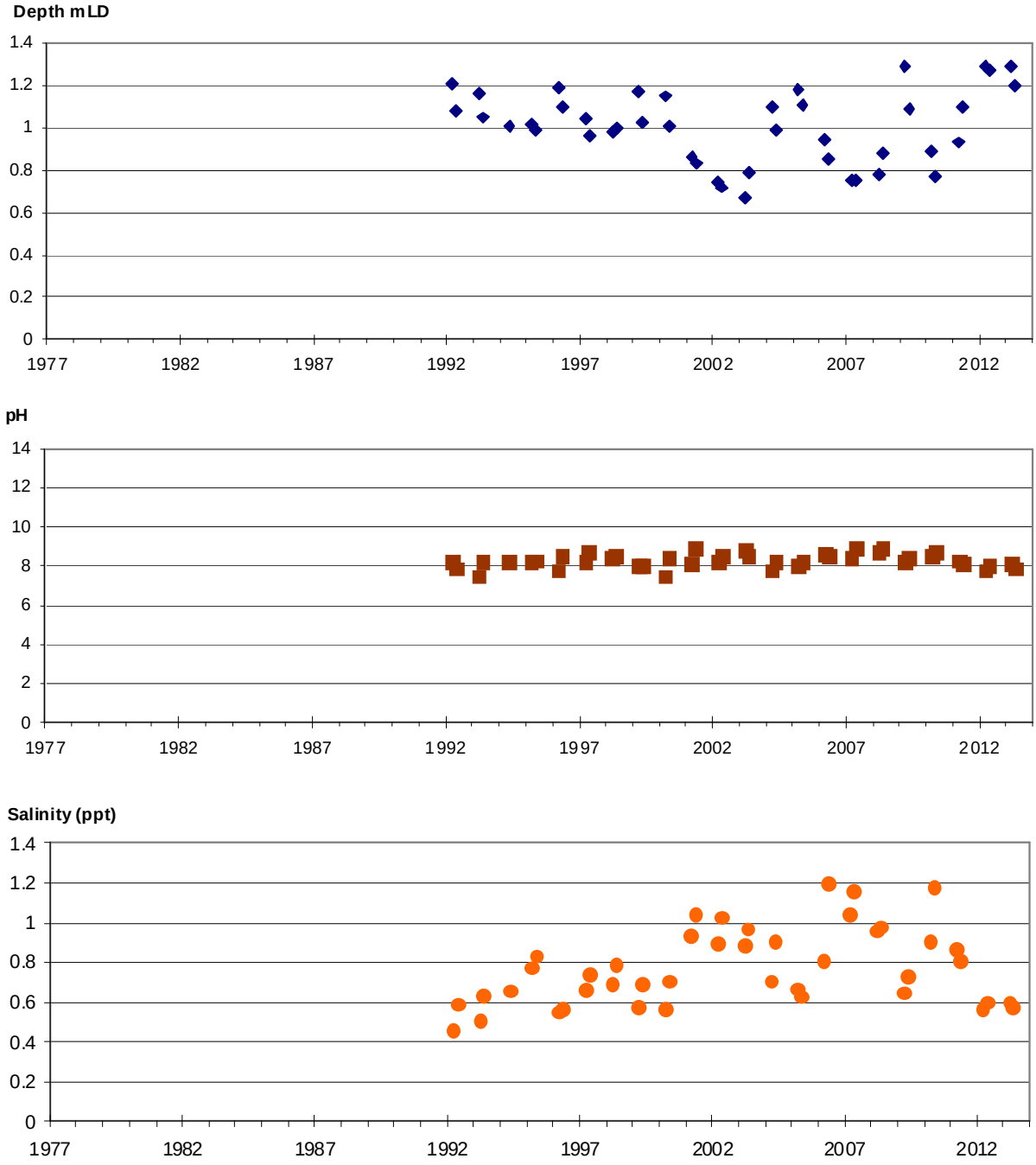
BIG BOOM



Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Big Boom is in the Esperance District of the South Coast DPaW Region.

BOAT HARBOUR 1

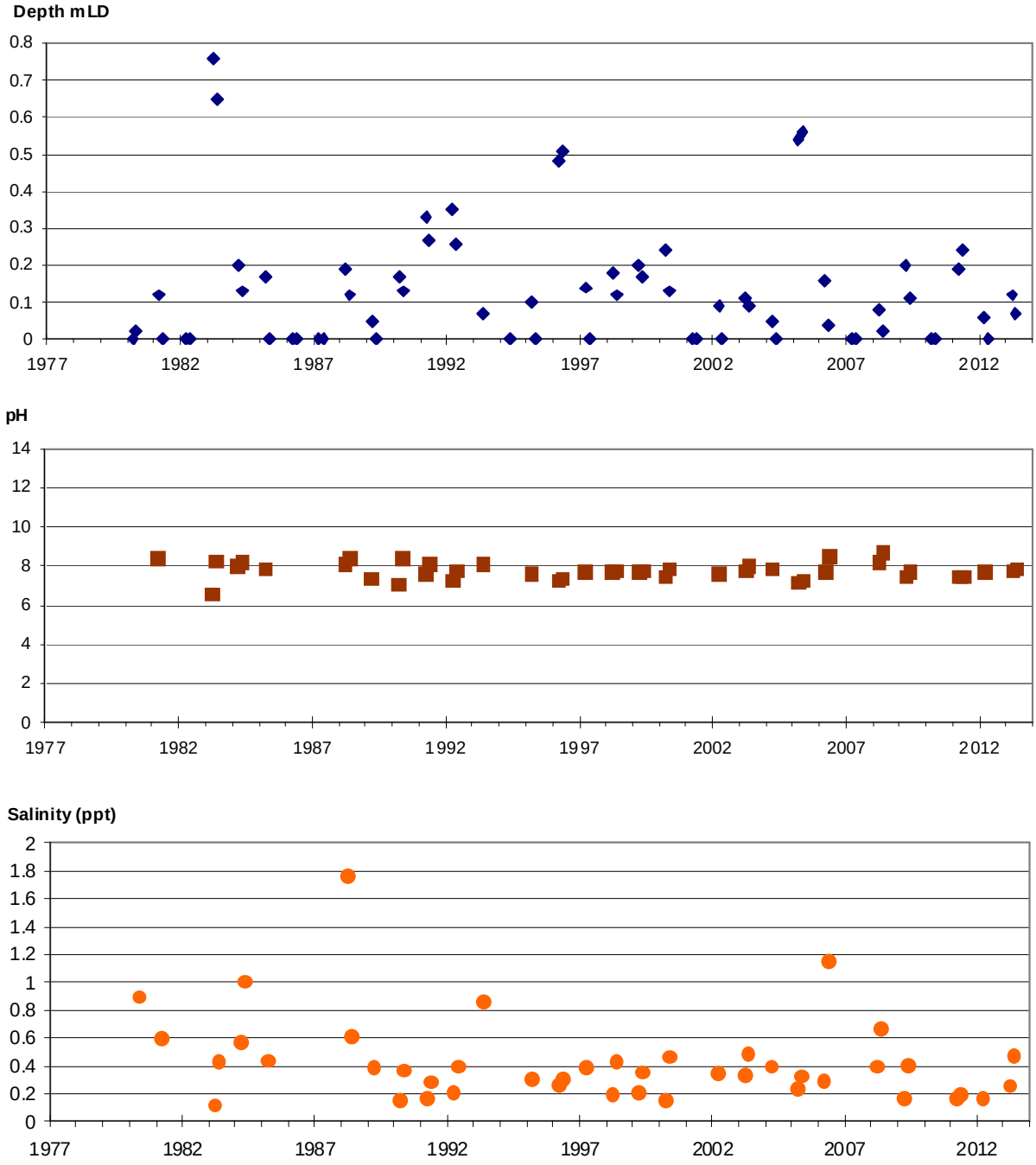


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Boat Harbour 1 is a component of the 'Owingup Swamp System', which is listed in the 'Directory of Important Wetlands in Australia'.

Boat Harbour 1 is in the Frankland District (headquartered in Walpole) of the Warren DPaW Region.

BOYUP BROOK 18239 [IM]



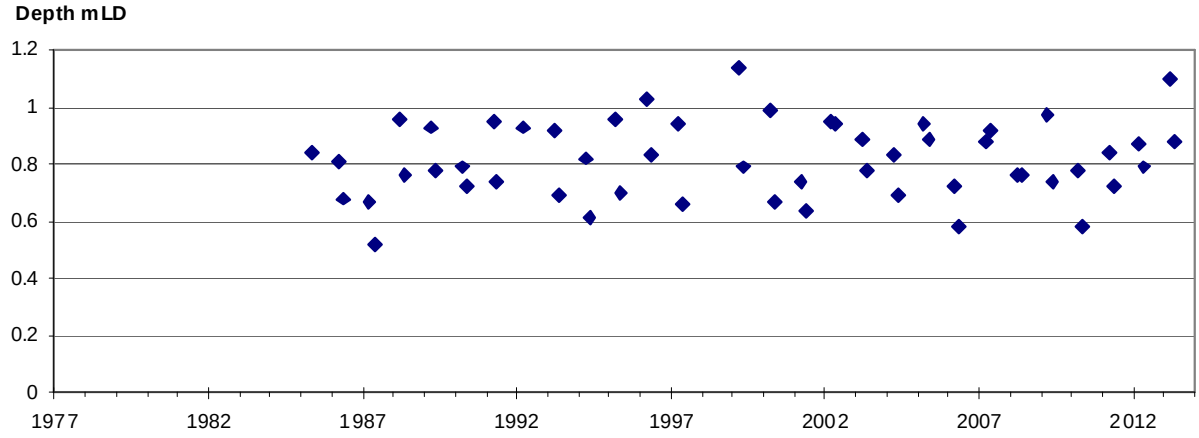
Notes:

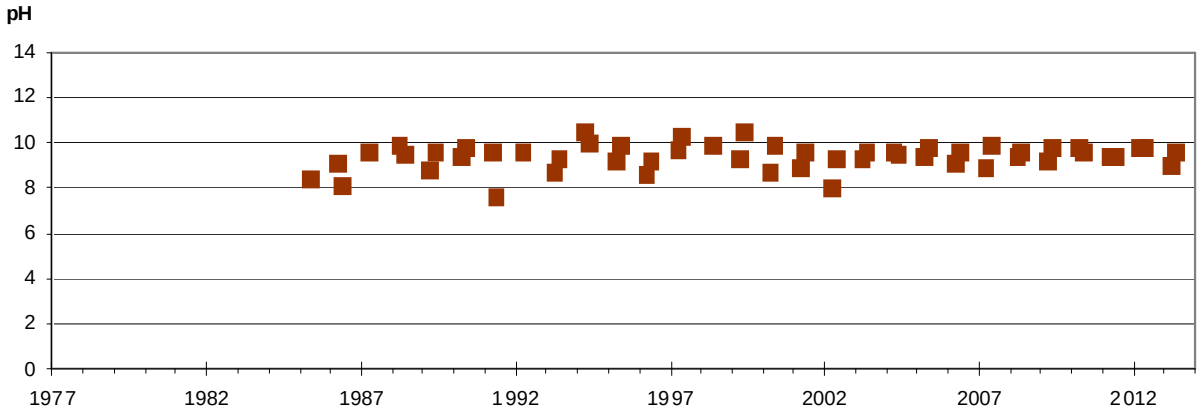
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

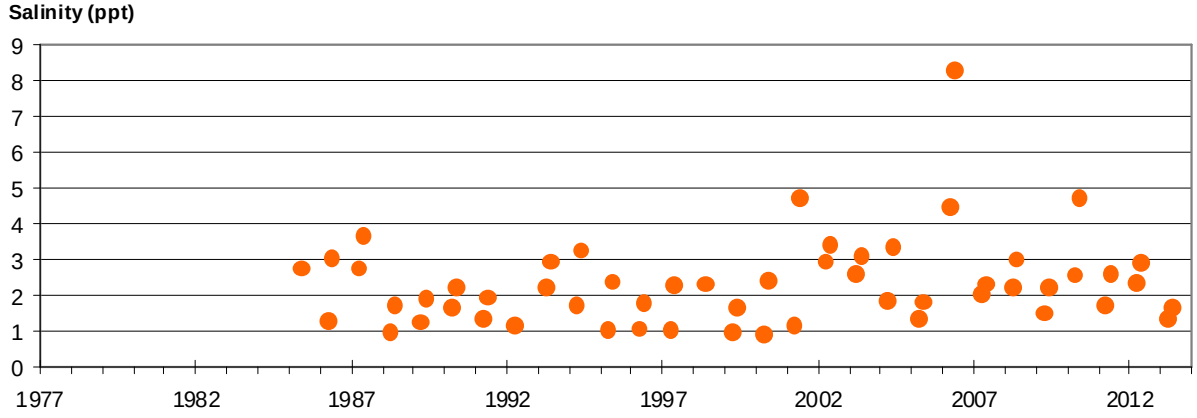
Boyup Brook 18239 is also known as Kulicup Swamp.

Boyup Brook 18239 is in the Blackwood District (headquartered in Busselton) of the South West DPaW Region.

BROADWATER



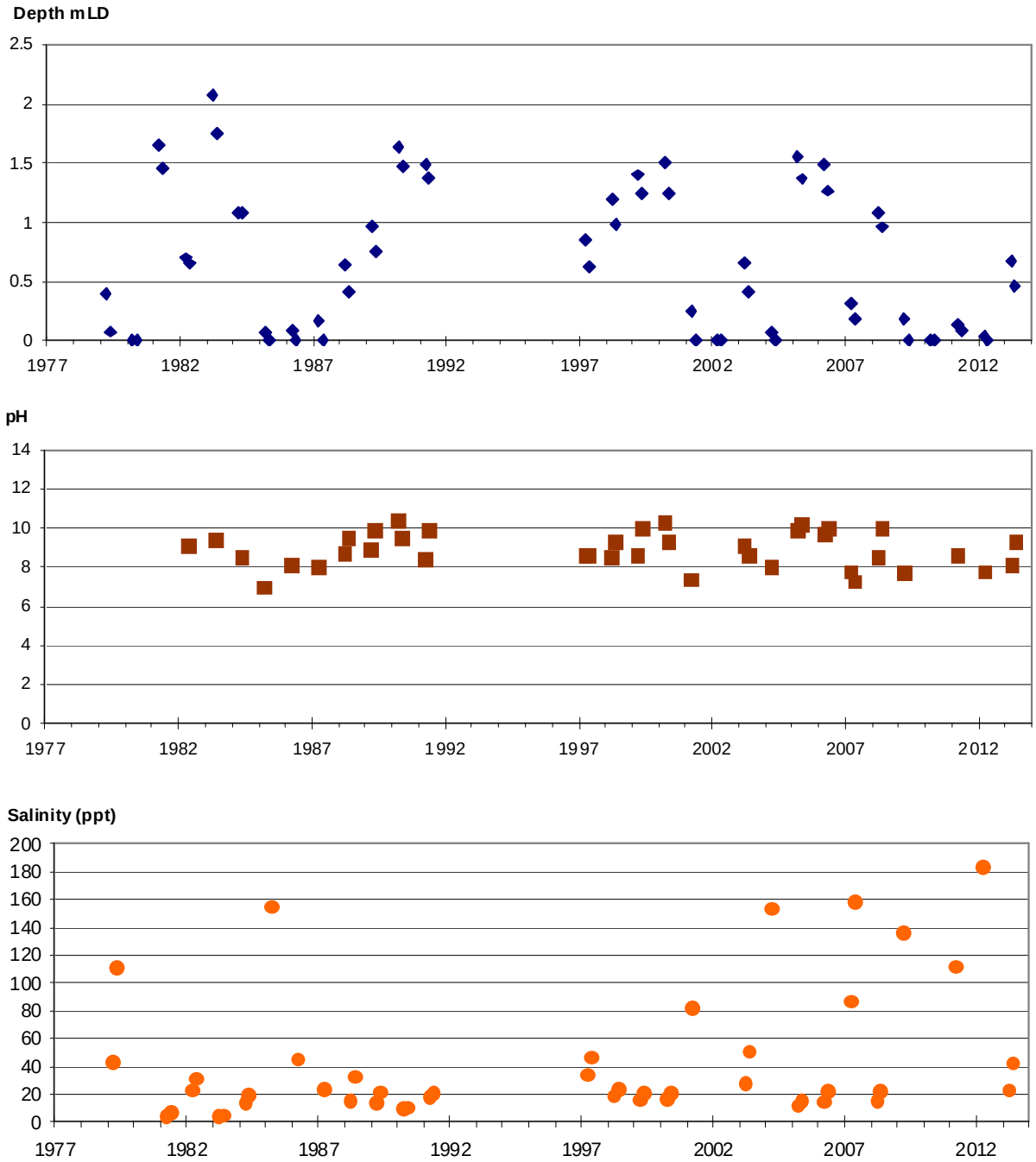




Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Broadwater is in the Blackwood District (headquartered in Busselton) of the South West DPaW Region.

BROWN

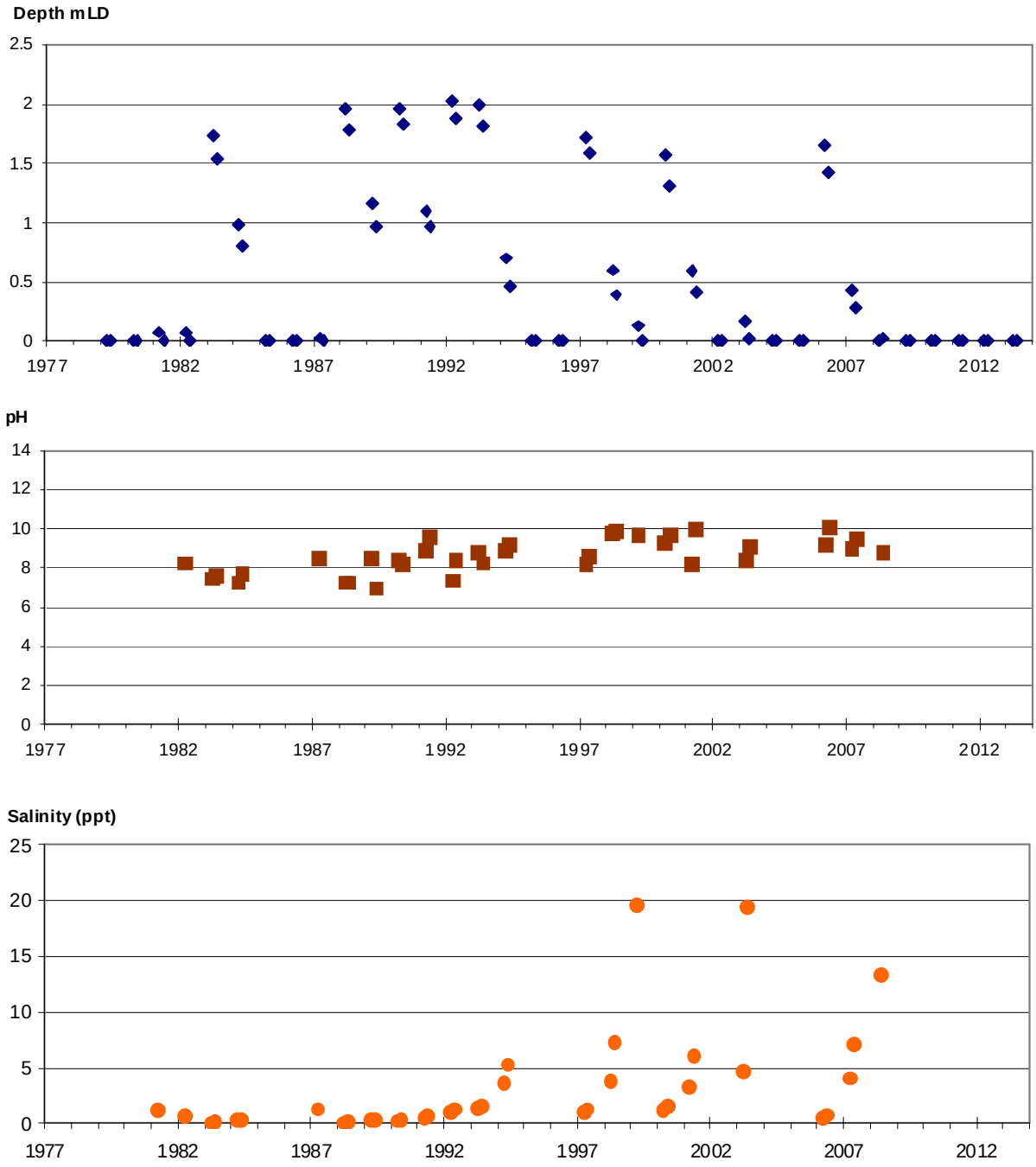


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Brown is a component of the 'Yealering Lakes System', which is listed in the 'Directory of Important Wetlands in Australia'.

Brown is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

BRYDE [IM]

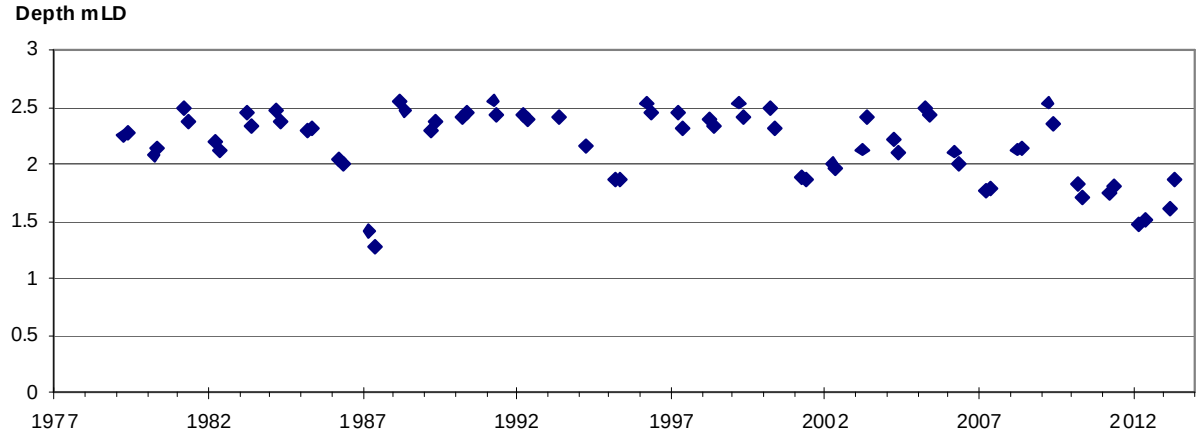


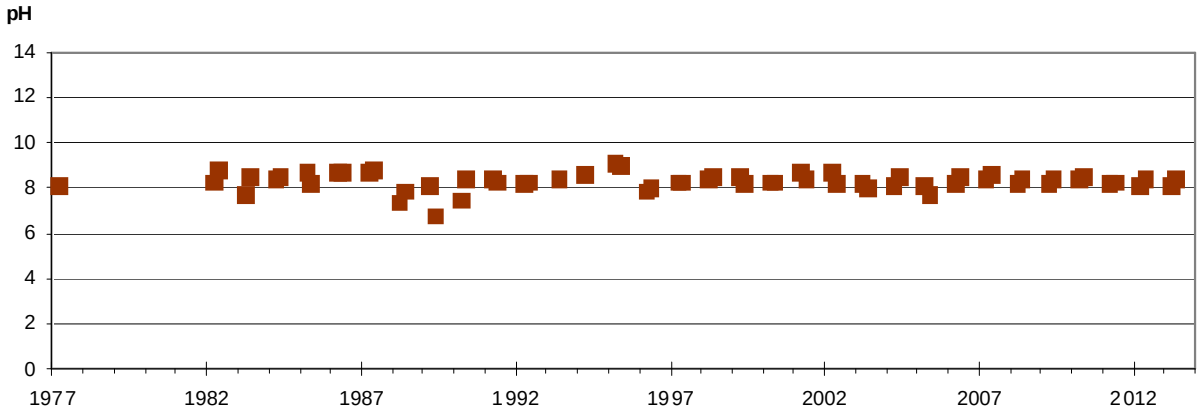
Notes:
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

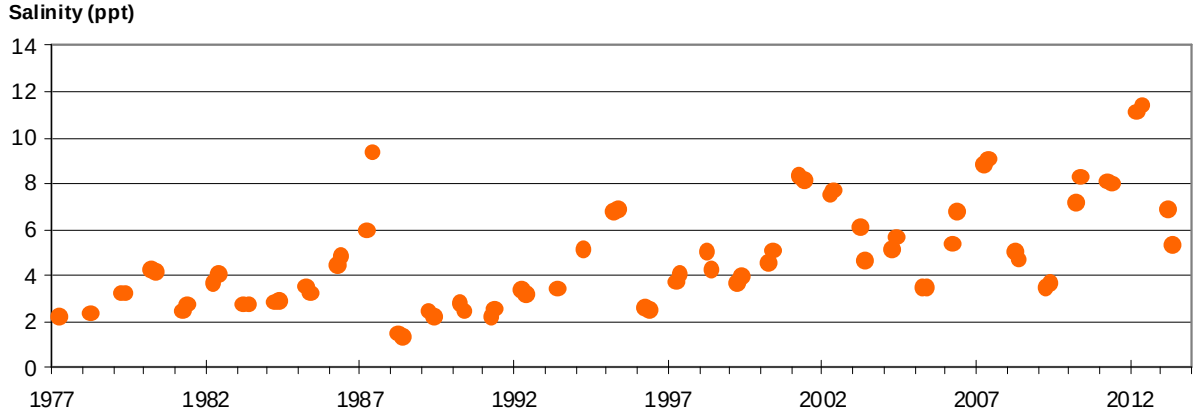
Bryde is part of the 'Lake Bryde – East Lake Bryde System' listed in the 'Directory of Important Wetlands in Australia'.

Bryde is within the Lake Bryde Natural Diversity Recovery Catchment and is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

BYENUP





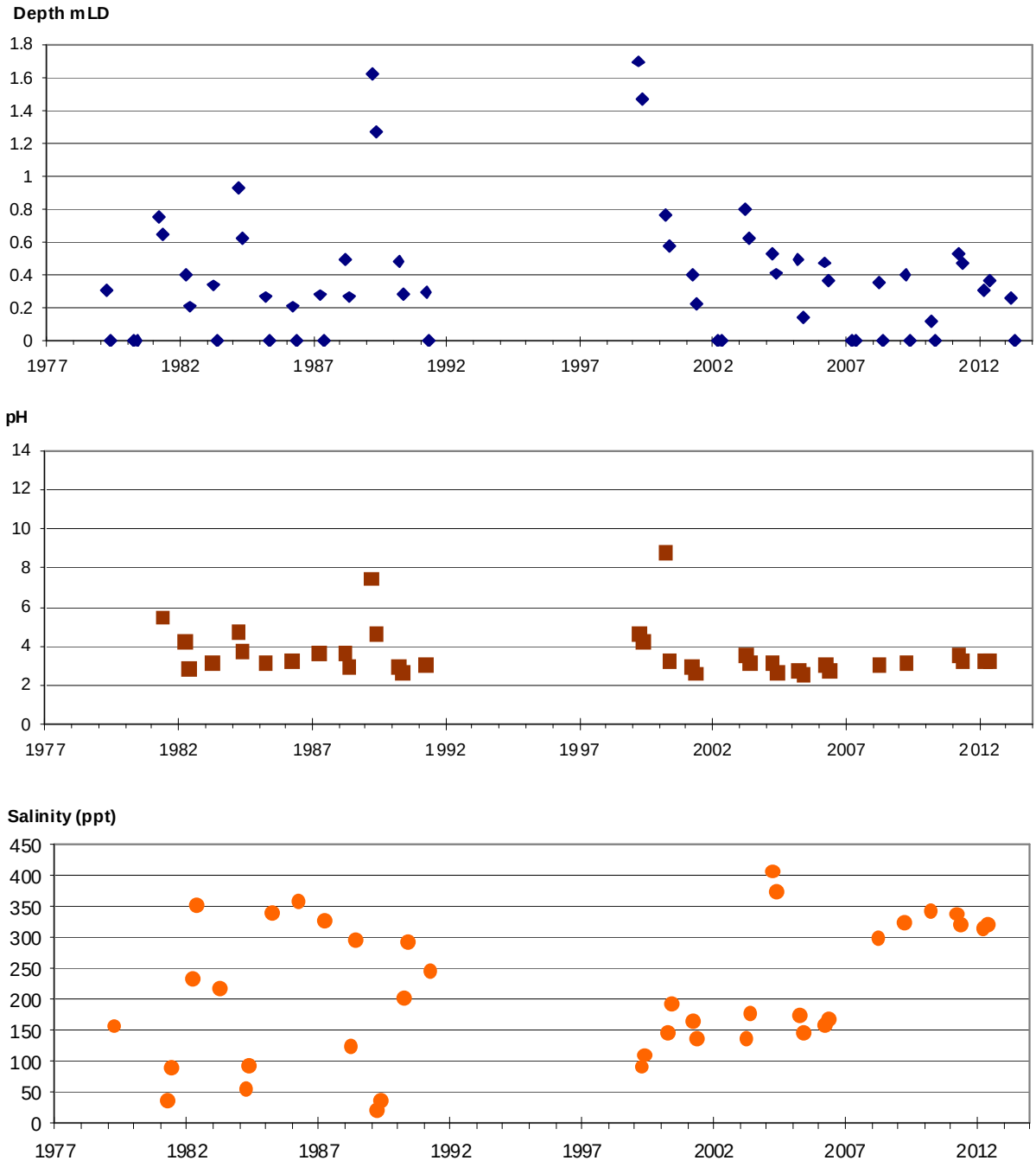


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Byenup is a component of the 'Muir-Byenup System', which is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands, and is also part of the 'Byenup Lagoon System' listed in the 'Directory of Important Wetlands in Australia'.

Byenup is within the former Muir-Unicup Natural Diversity Recovery Catchment and is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

CAMPION [IM]

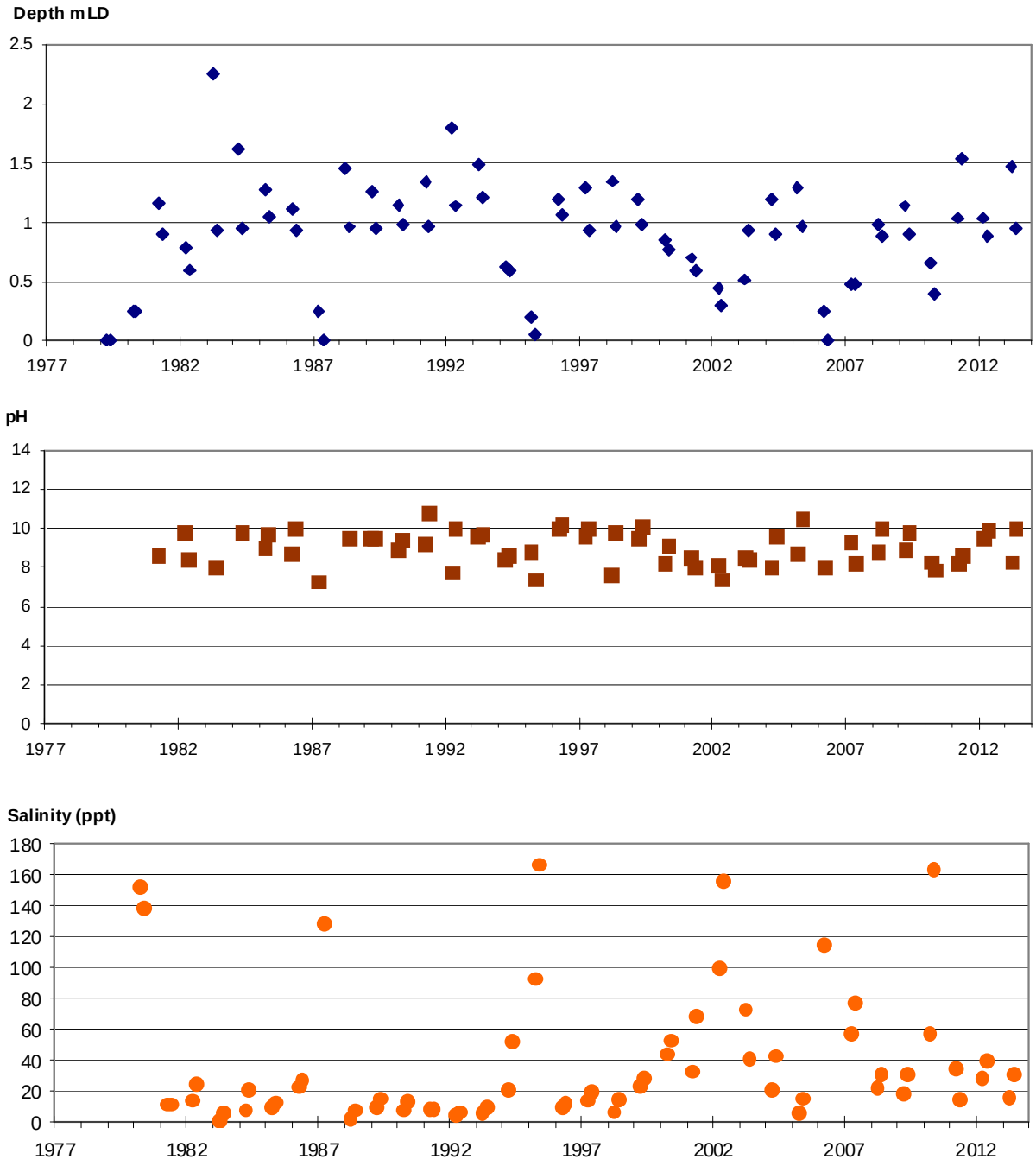


Notes:

1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Campion is in the Central District (headquartered in Merredin) of the Wheatbelt DPaW Region.

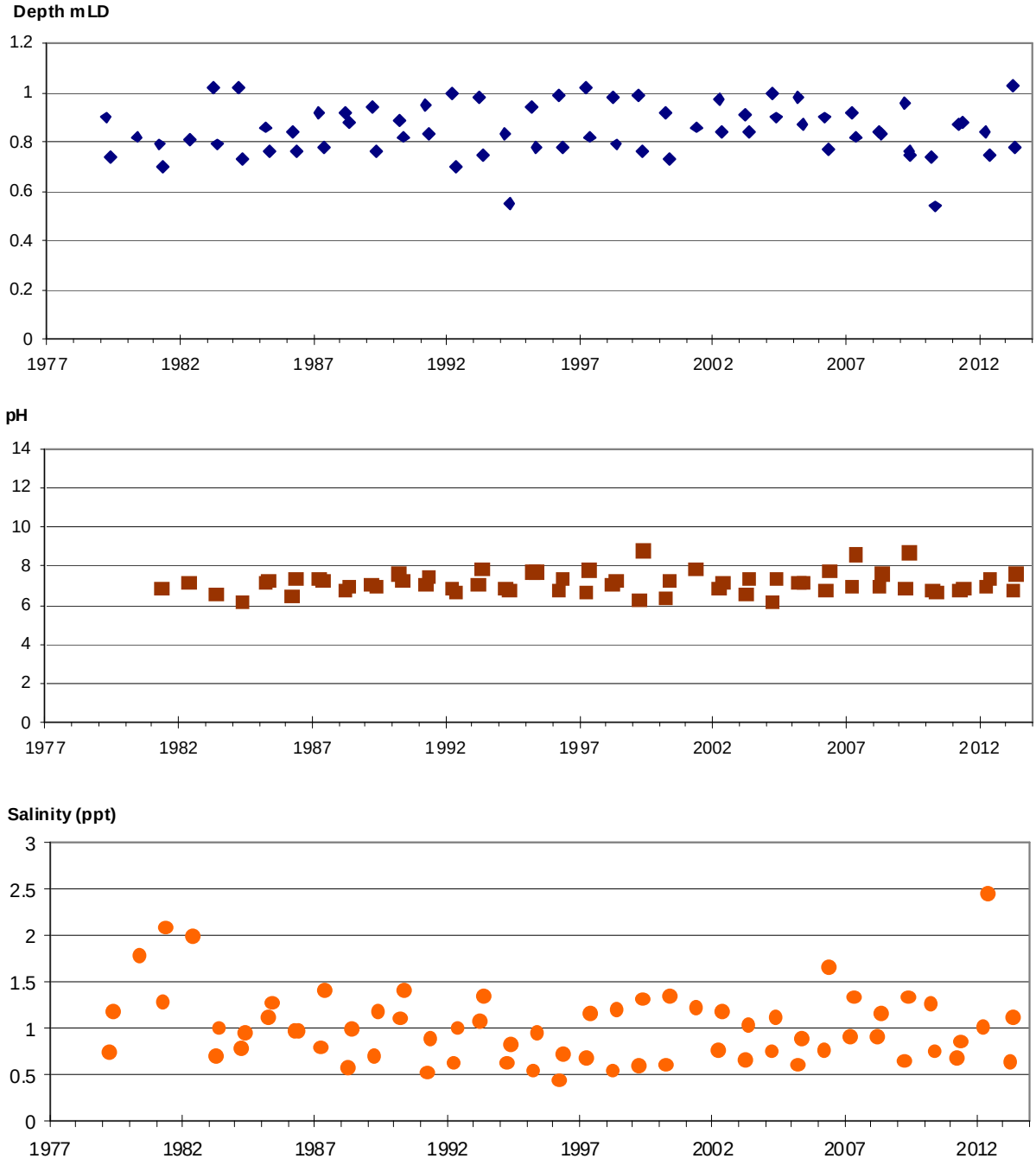
CASUARINA



Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Casuarina is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

CHANDALA

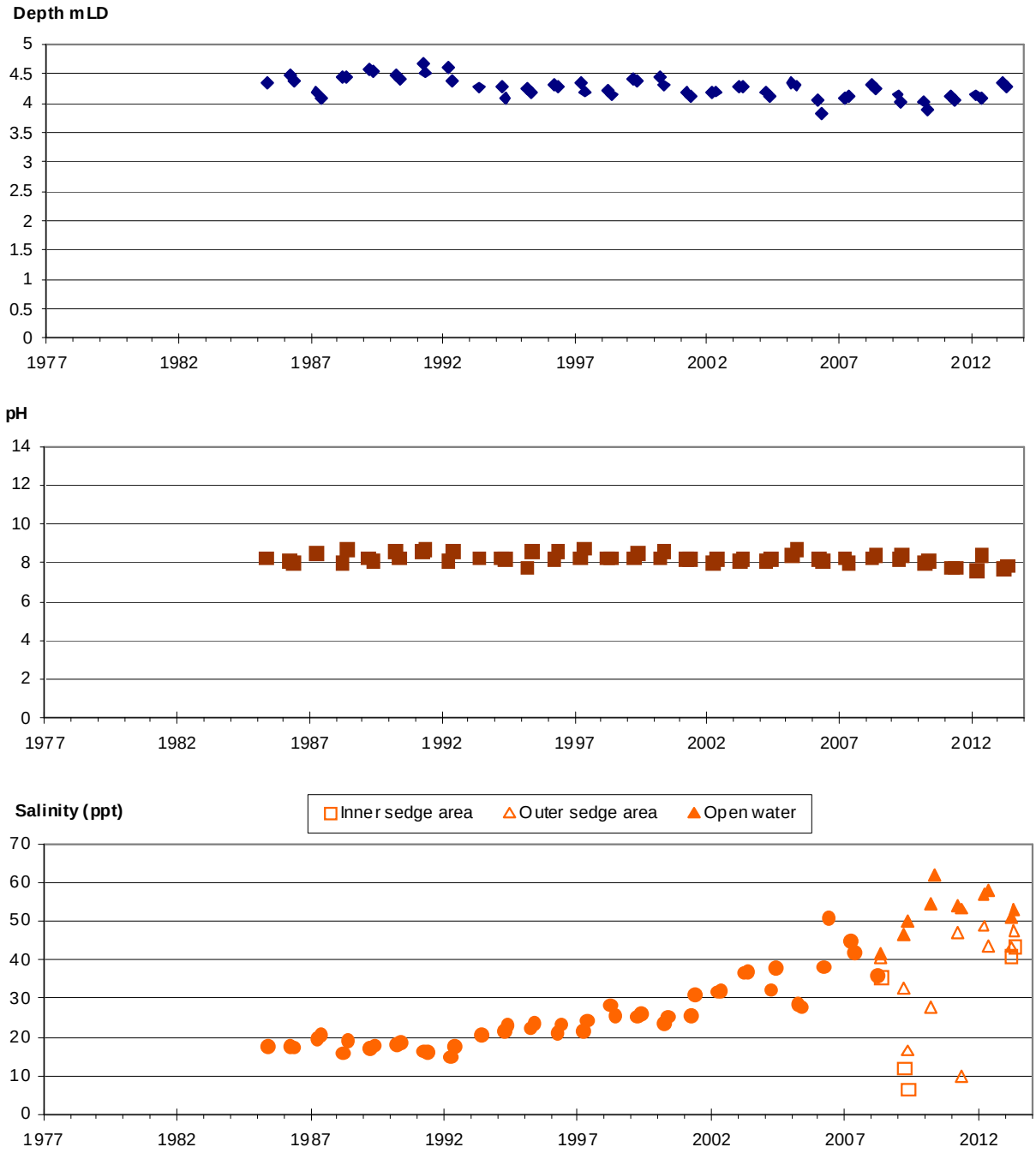


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Chandala Swamp is listed in the 'Directory of Important Wetlands in Australia'.

Chandala is in the Perth Hills District (headquartered in Mundaring) of the Swan DPaW Region.

CLIFTON (with Depth axis 0-5m)



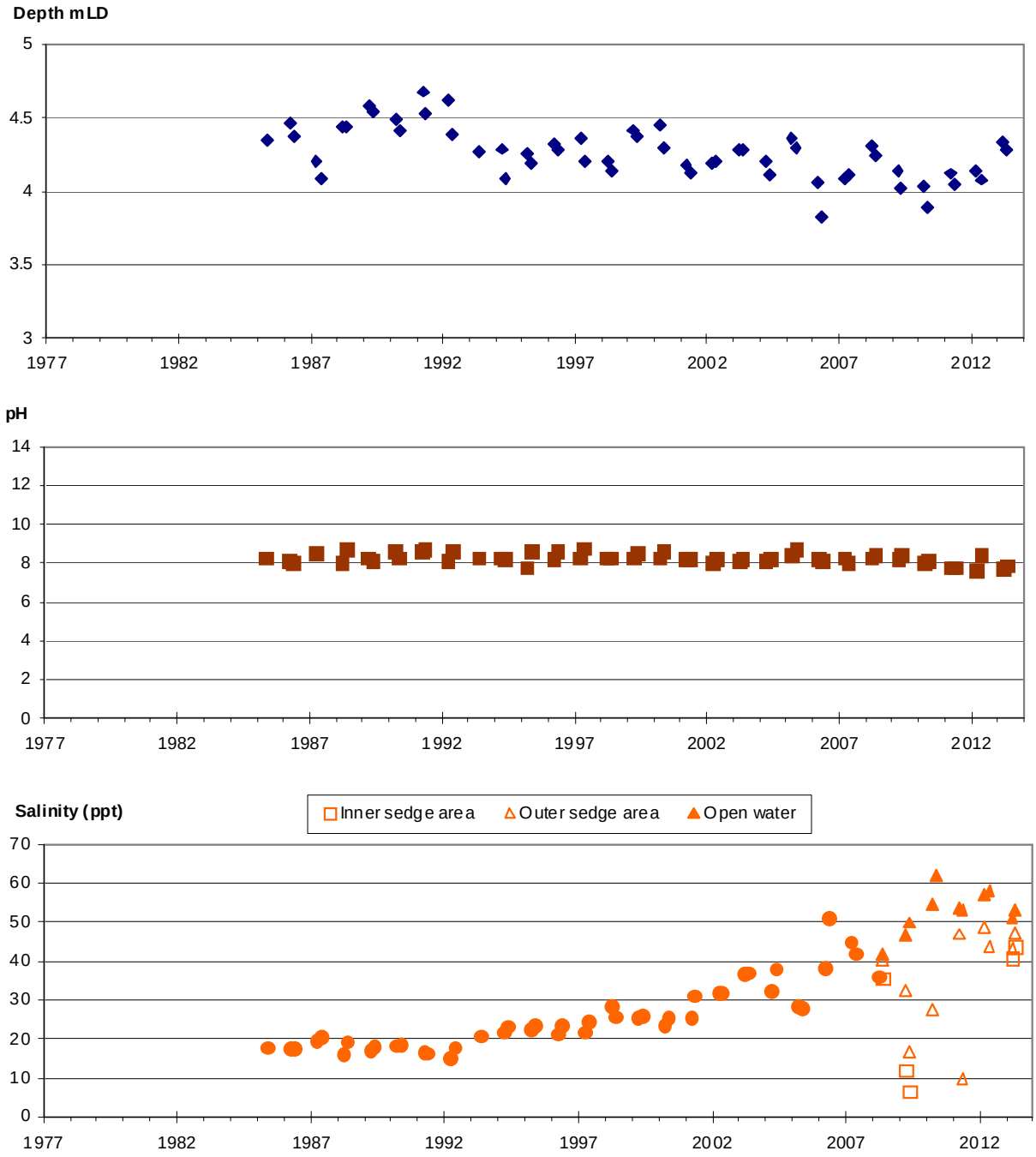
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Clifton is a component of the 'Peel-Yalgorup System', which is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands.

Clifton is also a component of the 'Yalgorup Lakes System', which is listed in the 'Directory of Important Wetlands in Australia'.

Clifton is in the Swan Coastal District (headquartered in Wanneroo) of the Swan DPaW Region.

CLIFTON (with Depth axis 3-5m)



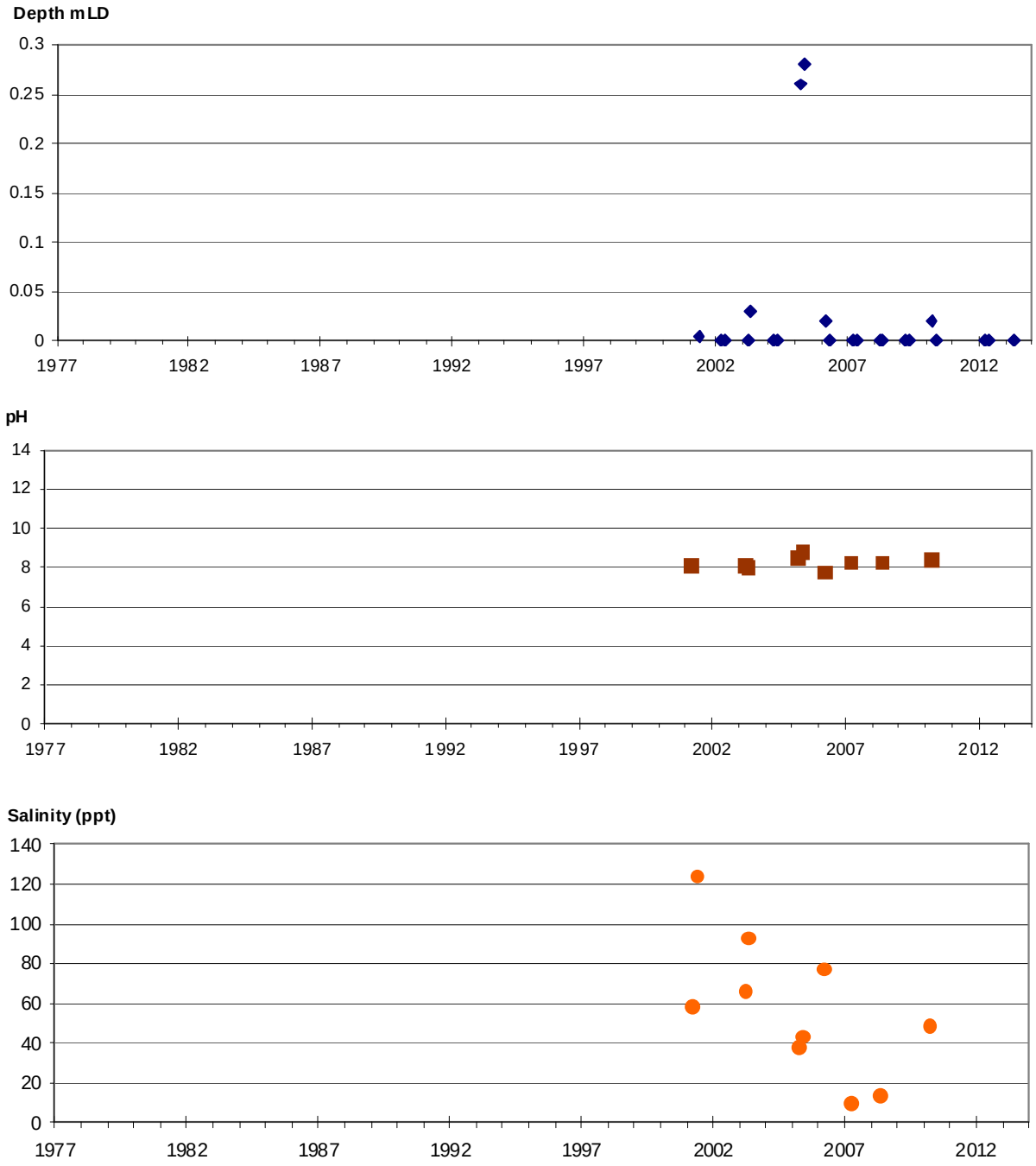
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Clifton is a component of the 'Peel-Yalgorup System', which is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands.

Clifton is also a component of the 'Yalgorup Lakes System', which is listed in the 'Directory of Important Wetlands in Australia'.

Clifton is in the Swan Coastal District (headquartered in Wanneroo) of the Swan DPaW Region.

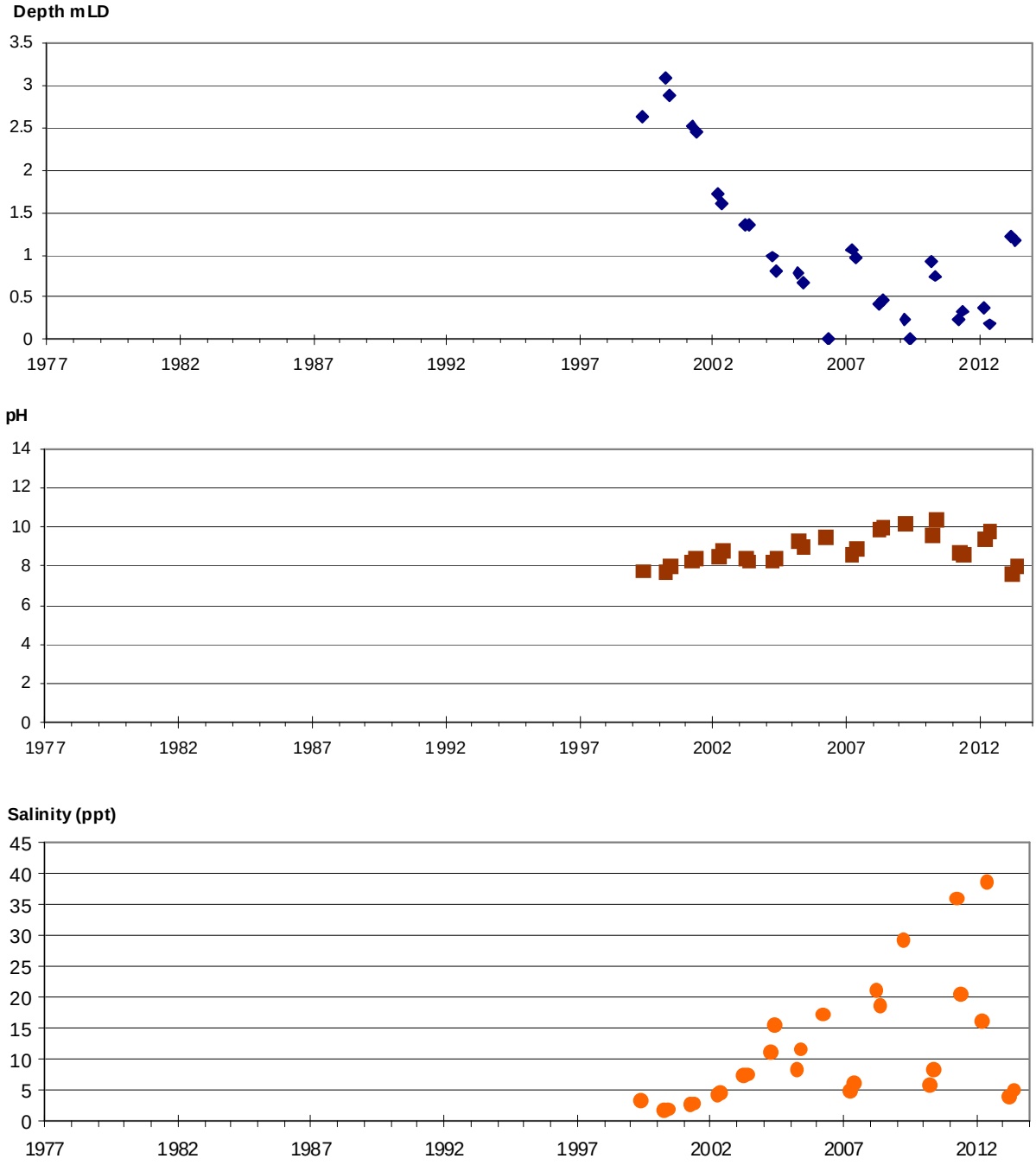
COLLETS ROAD



Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Colletts Road Swamp is in the Albany District of the South Coast DPaW Region

COOMALBIDGUP [IM]

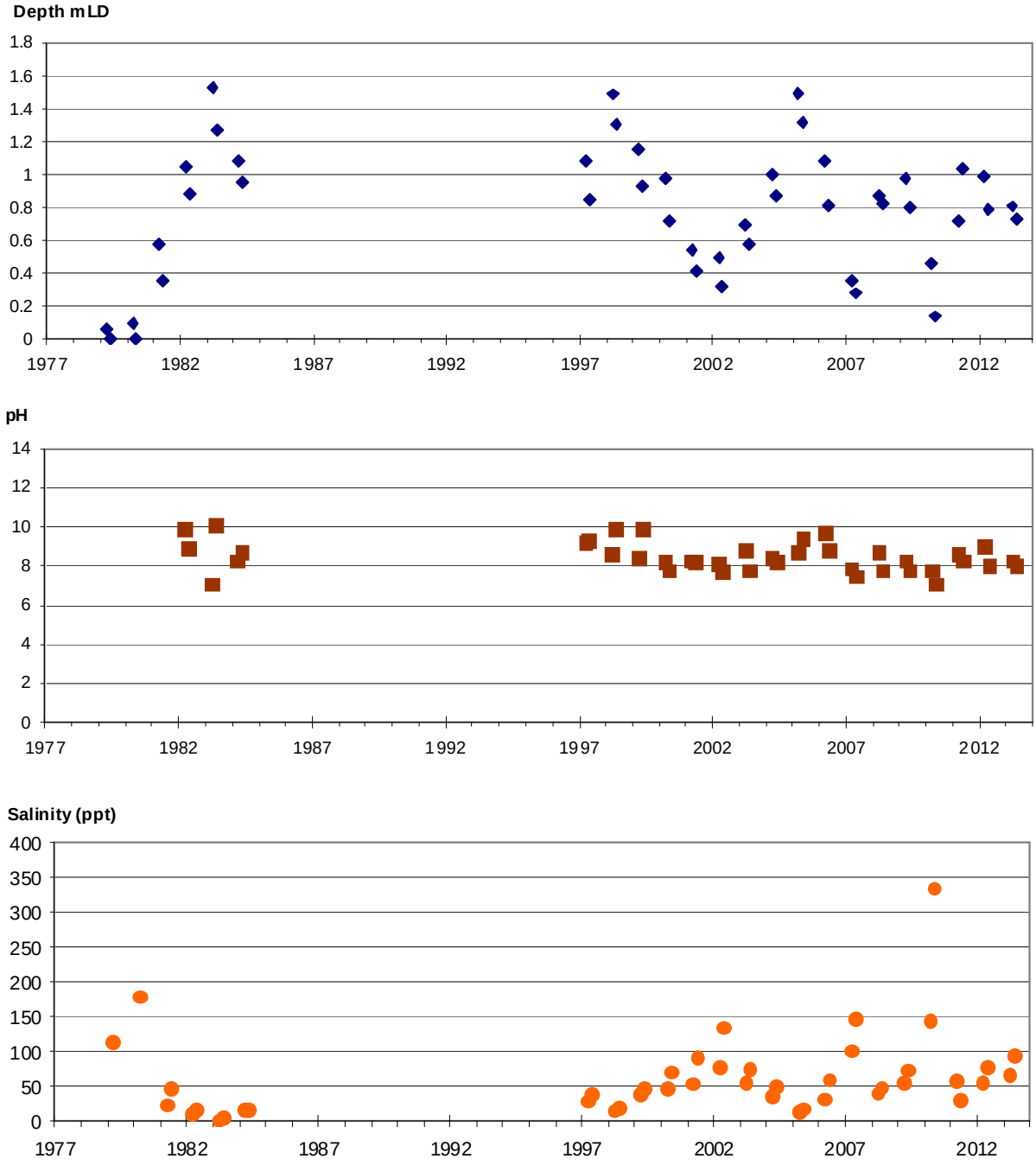


Notes:

1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Coomalbidgup is in the Esperance District of the South Coast DPaW Region.

COOMELBERRUP [IM]

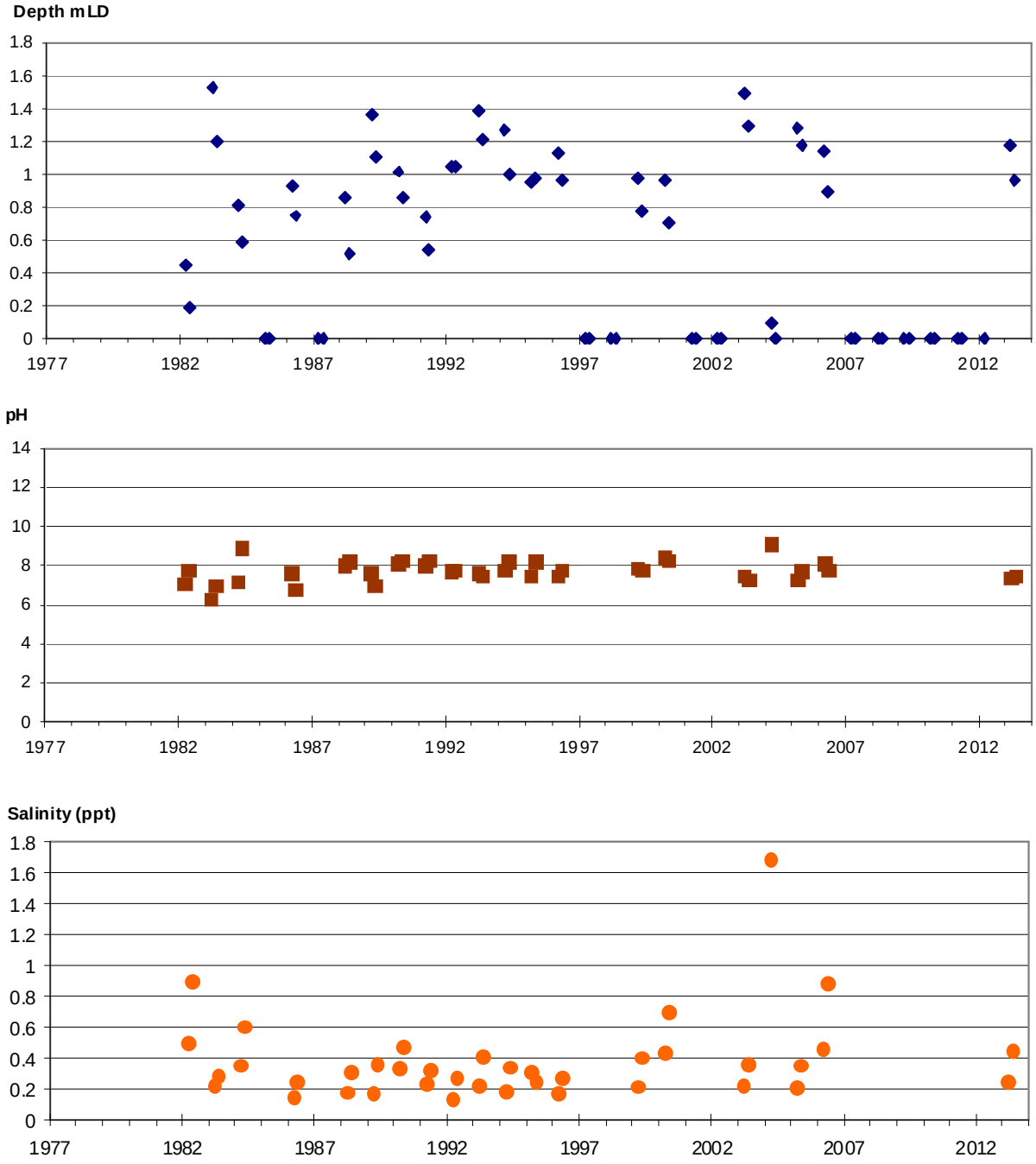


Notes:

1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Coomelberrup is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

CORRIGIN 12900 [IM]

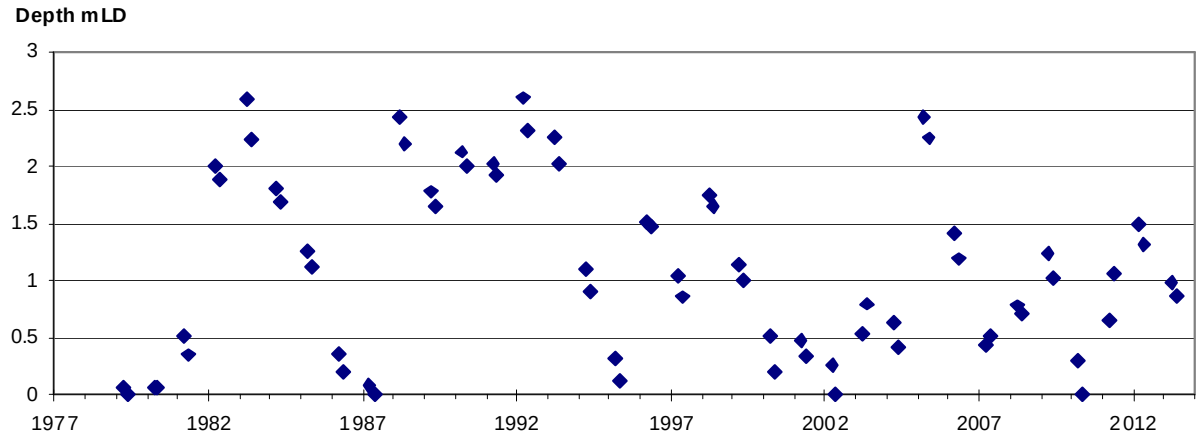


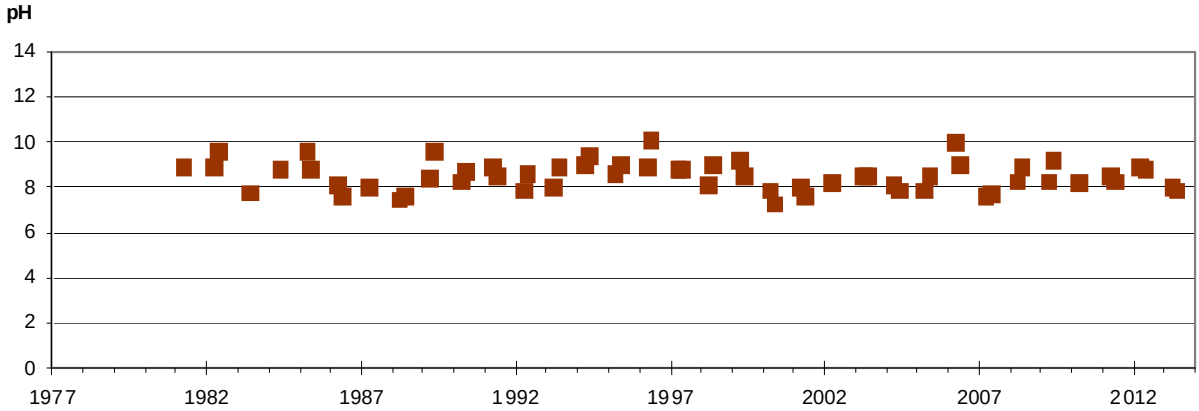
Notes:
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

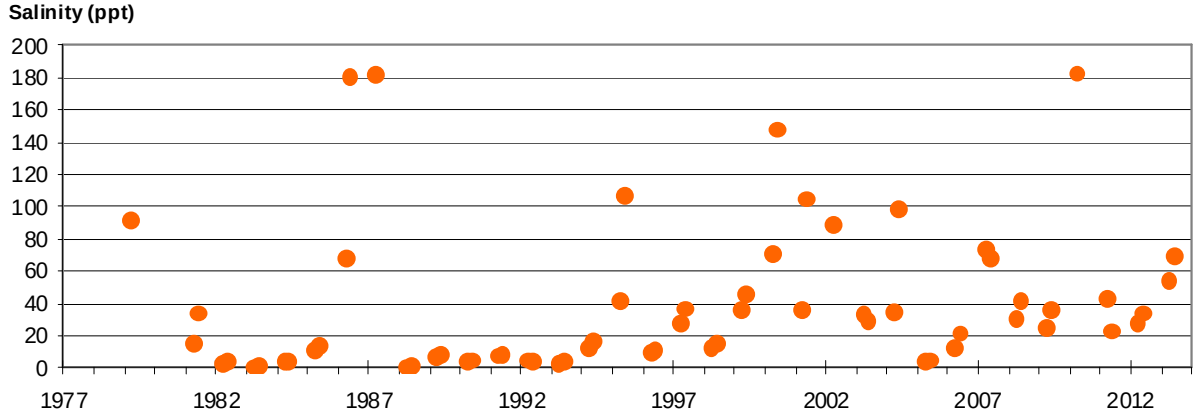
Corrigin 12900 (also known as Paperbark Swamp) has been nominated for listing in the 'Directory of Important Wetlands in Australia' (Elscot et al. 2009).

Corrigin 12900 is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

COYRECUP [IM]







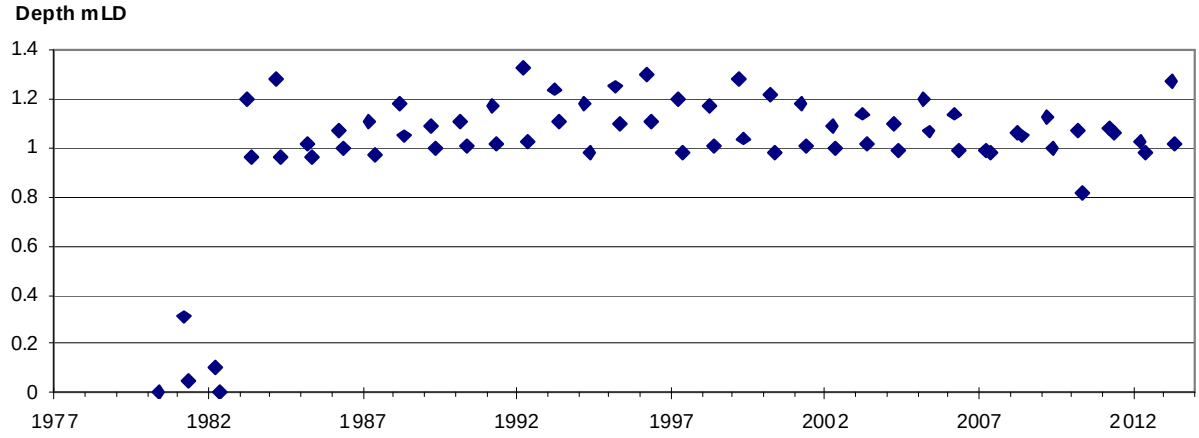
Notes:

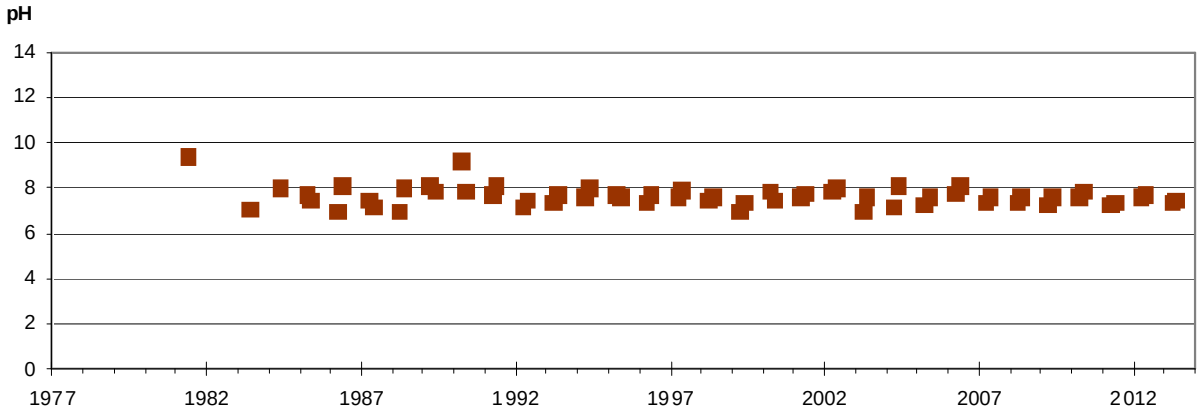
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

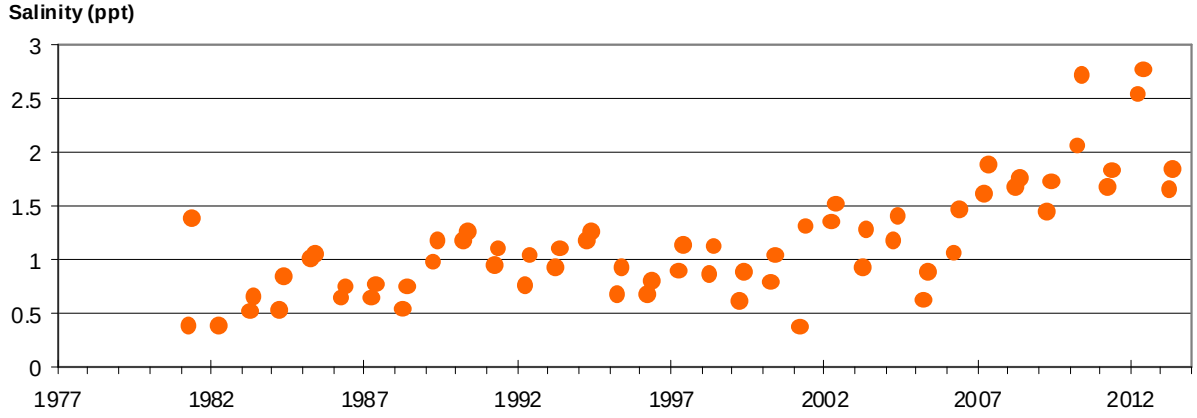
Coyrecup Lake is listed in the 'Directory of Important Wetlands in Australia'.

Coyrecup is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

CRACKERS



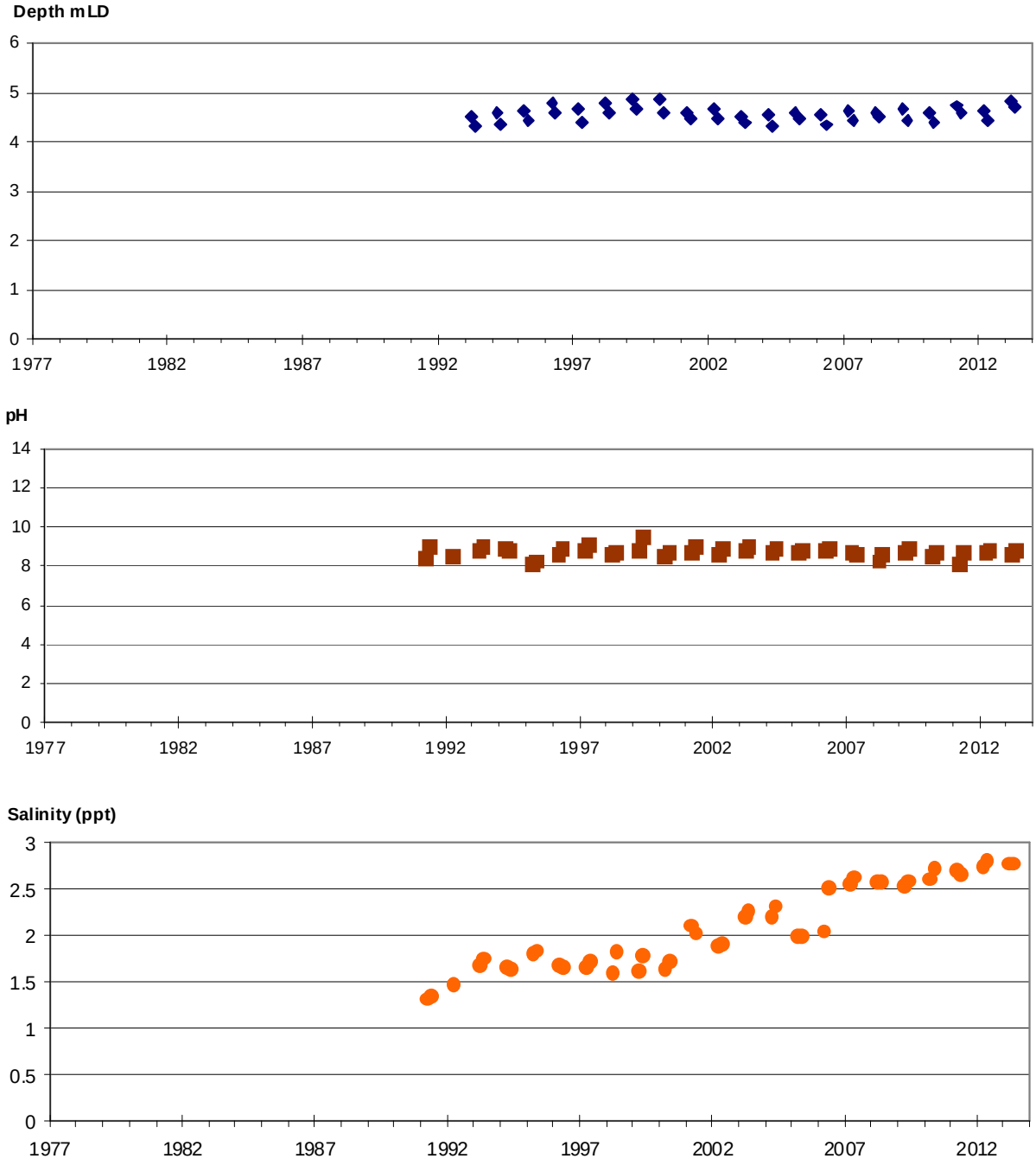




Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Crackers is in the Moora District (headquartered in Jurien Bay) of the Midwest DPaW Region.

DAVIES (with Depth axis 0-6m)

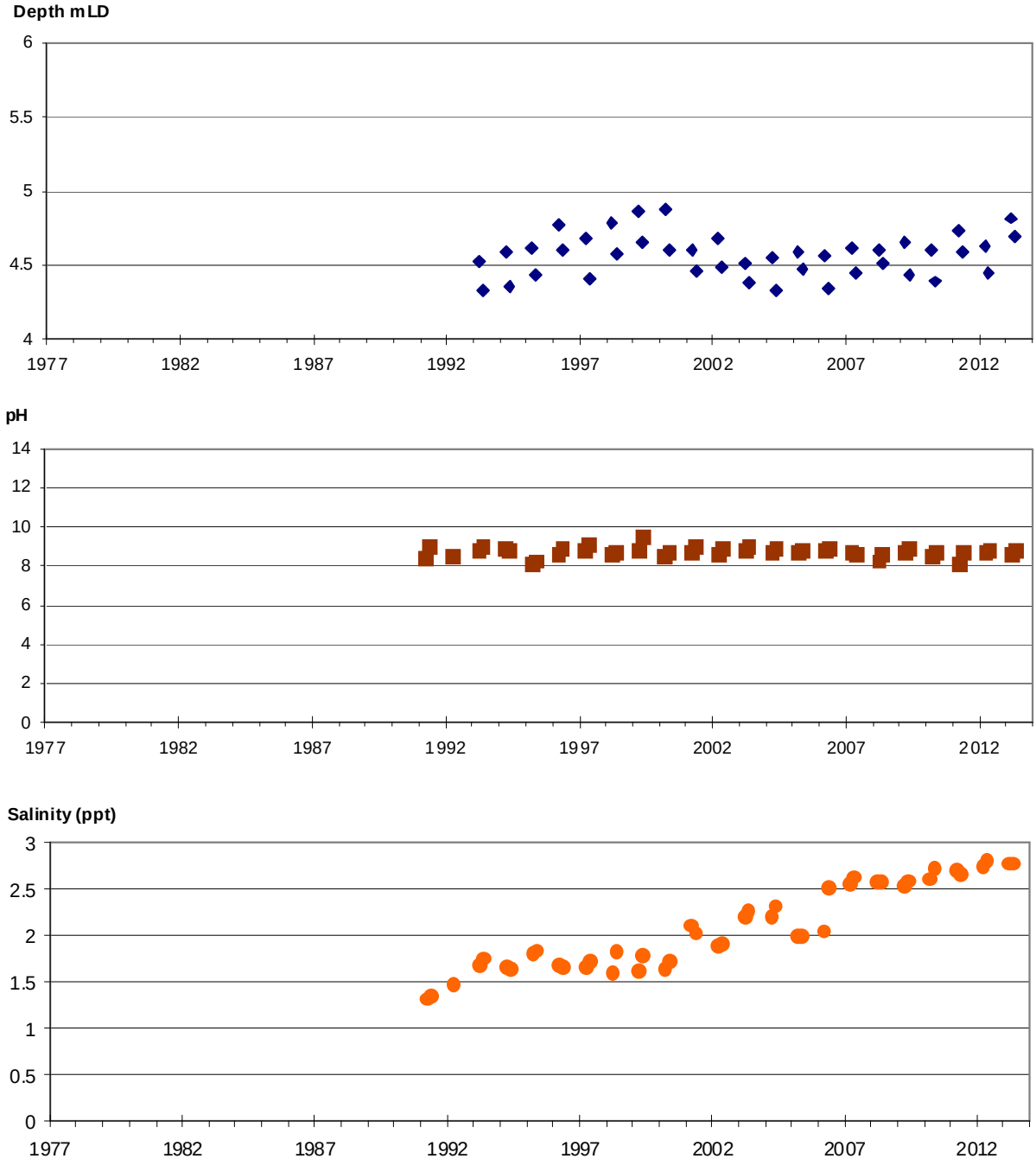


Notes:

1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Davies is in the Blackwood District (headquartered in Busselton) of the South West DPaW Region.

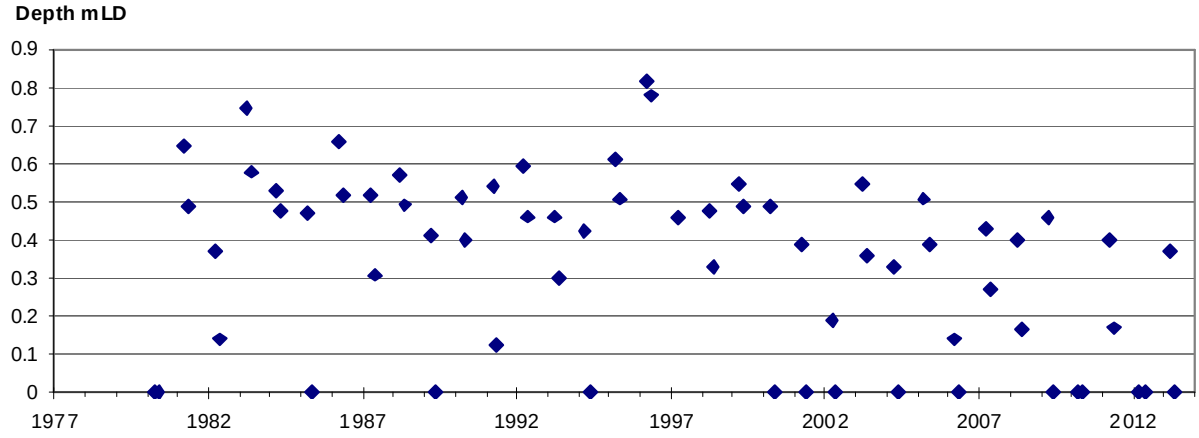
DAVIES (with Depth axis 4-6m)

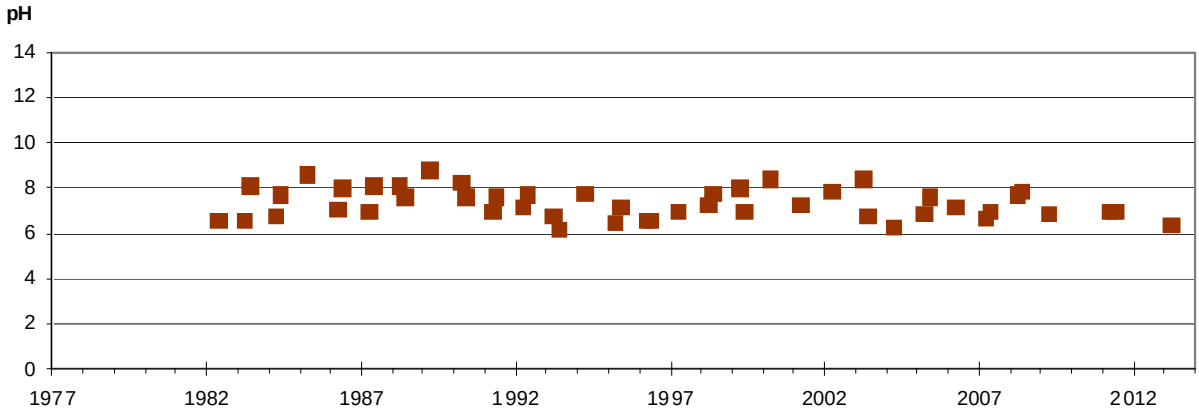


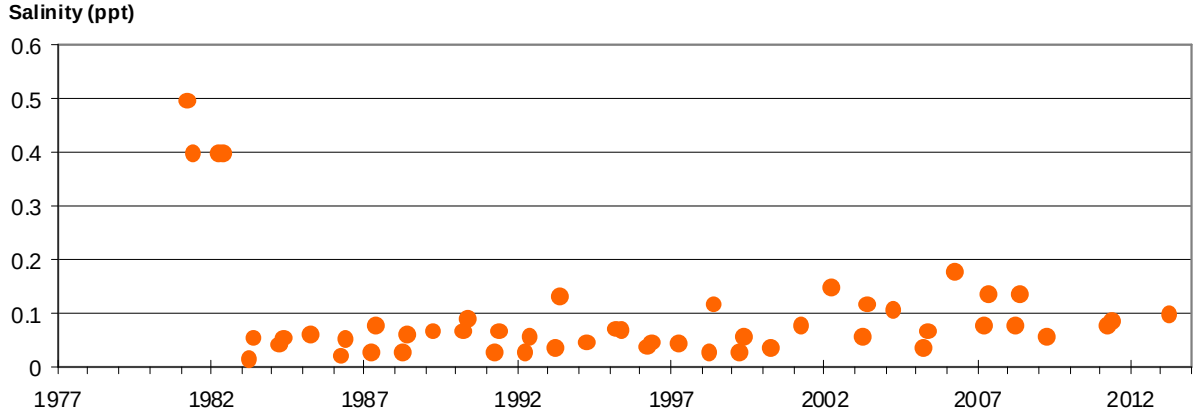
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Davies is in the Blackwood District (headquartered in Busselton) of the South West DPaW Region.

DOBADERRY



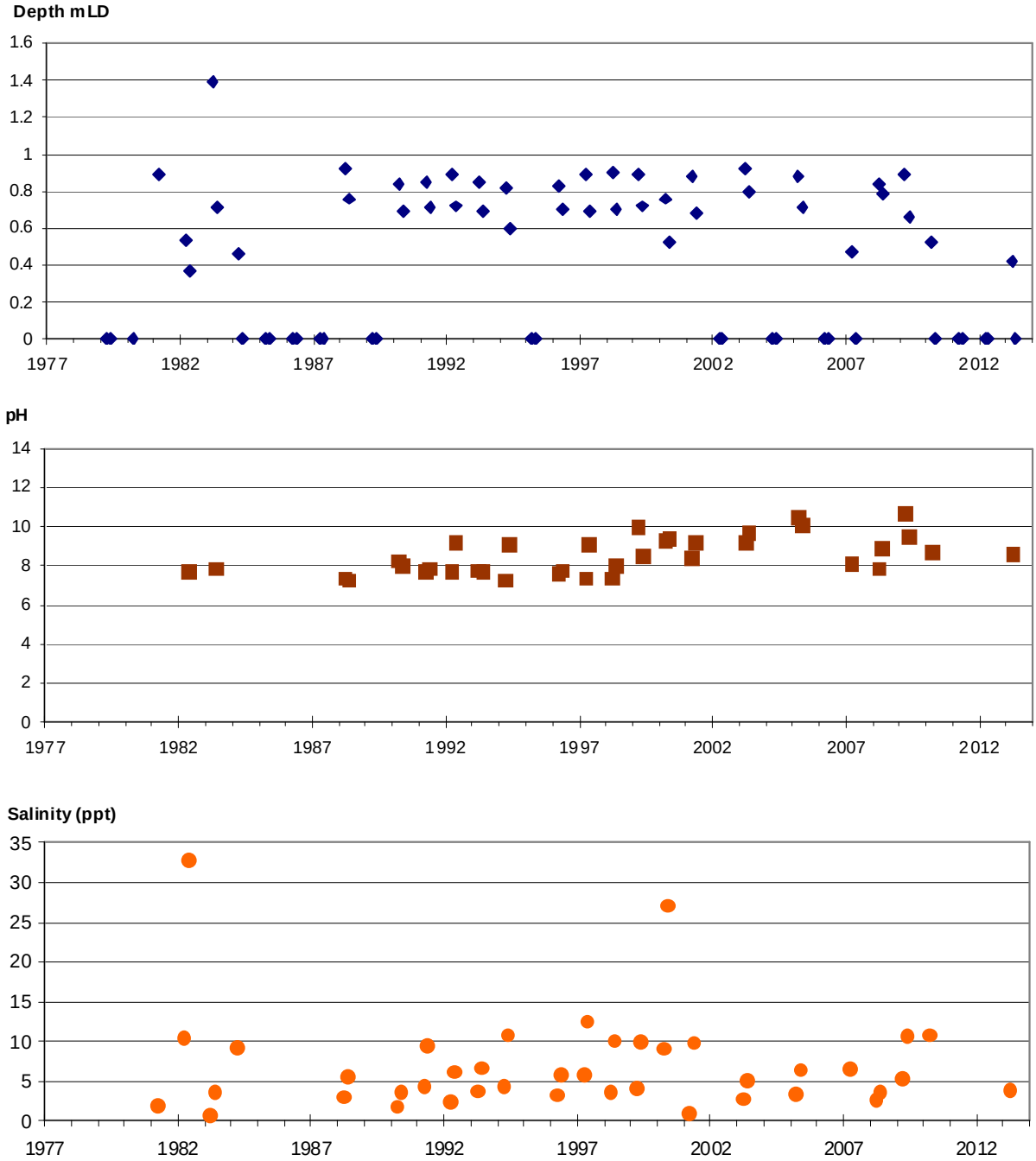




Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Dobaderry is in the Perth Hills District (headquartered in Mundaring) of the Swan DPaW Region.

DULBINNING

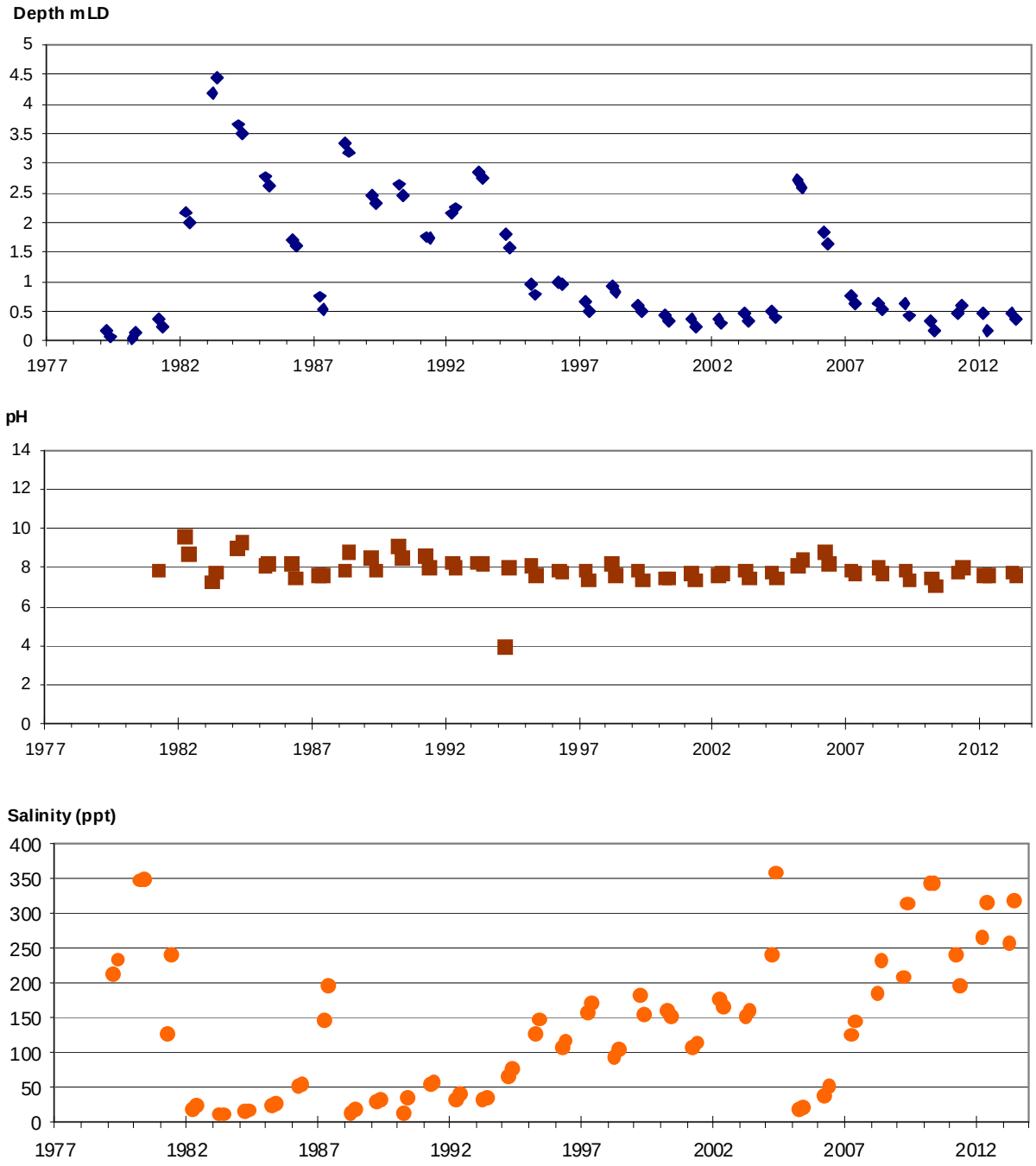


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Dulbinning is within the Toolibin Lake Natural Diversity Recovery Catchment.

Dulbinning is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

DUMBLEYUNG [IM]

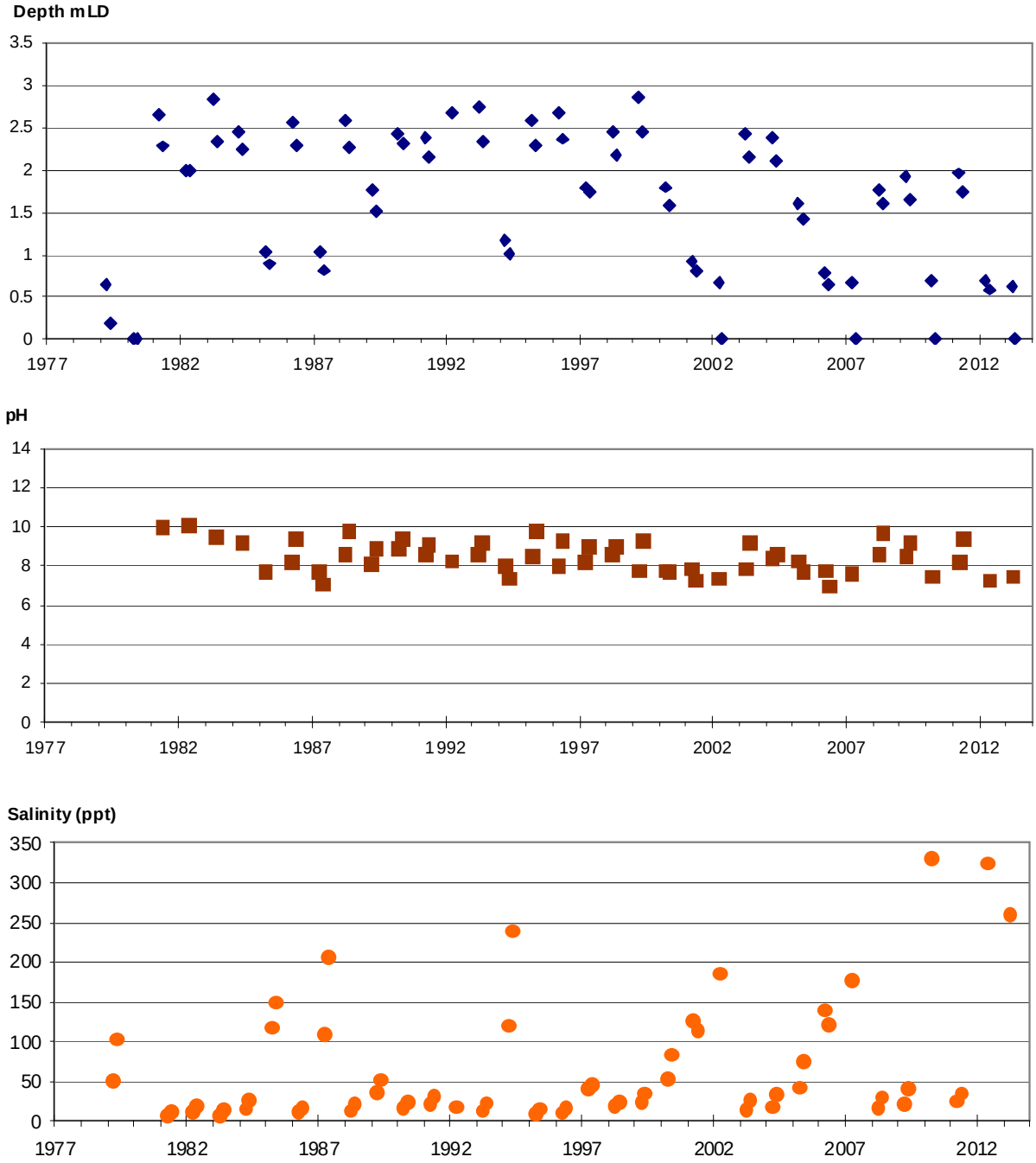


Notes:
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Dumbleyung Lake is listed in the 'Directory of Important Wetlands in Australia'.

Dumbleyung is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

EGANU [IM]

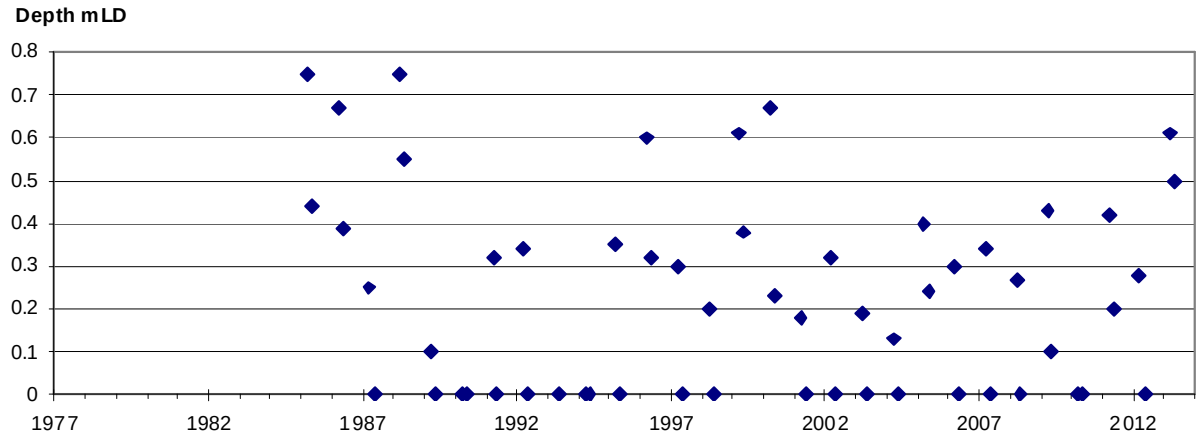


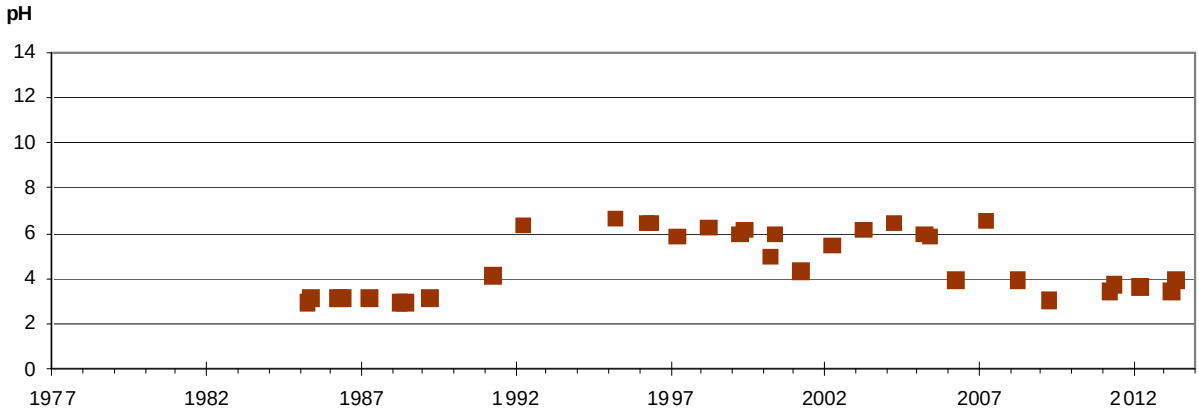
Notes:

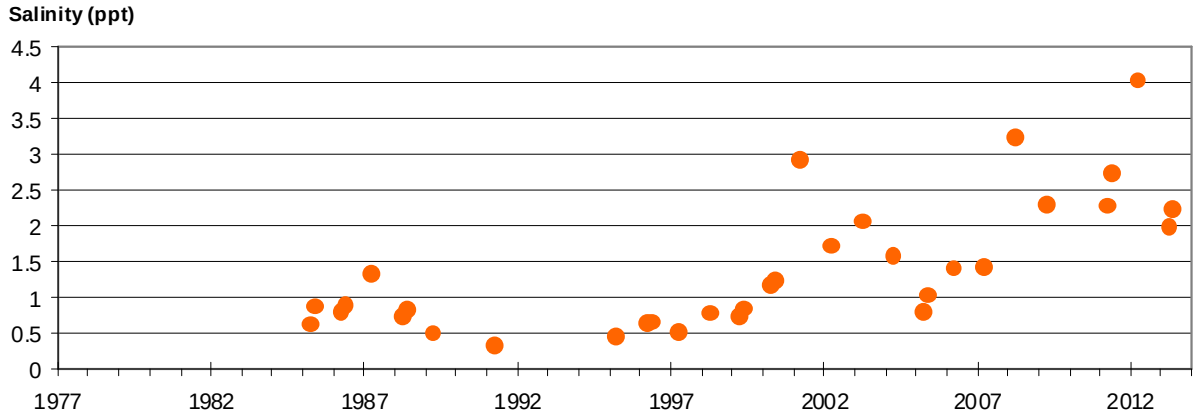
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Eganu is in the Moora District (headquartered in Jurien Bay) of the Midwest DPaW Region.

EGRET



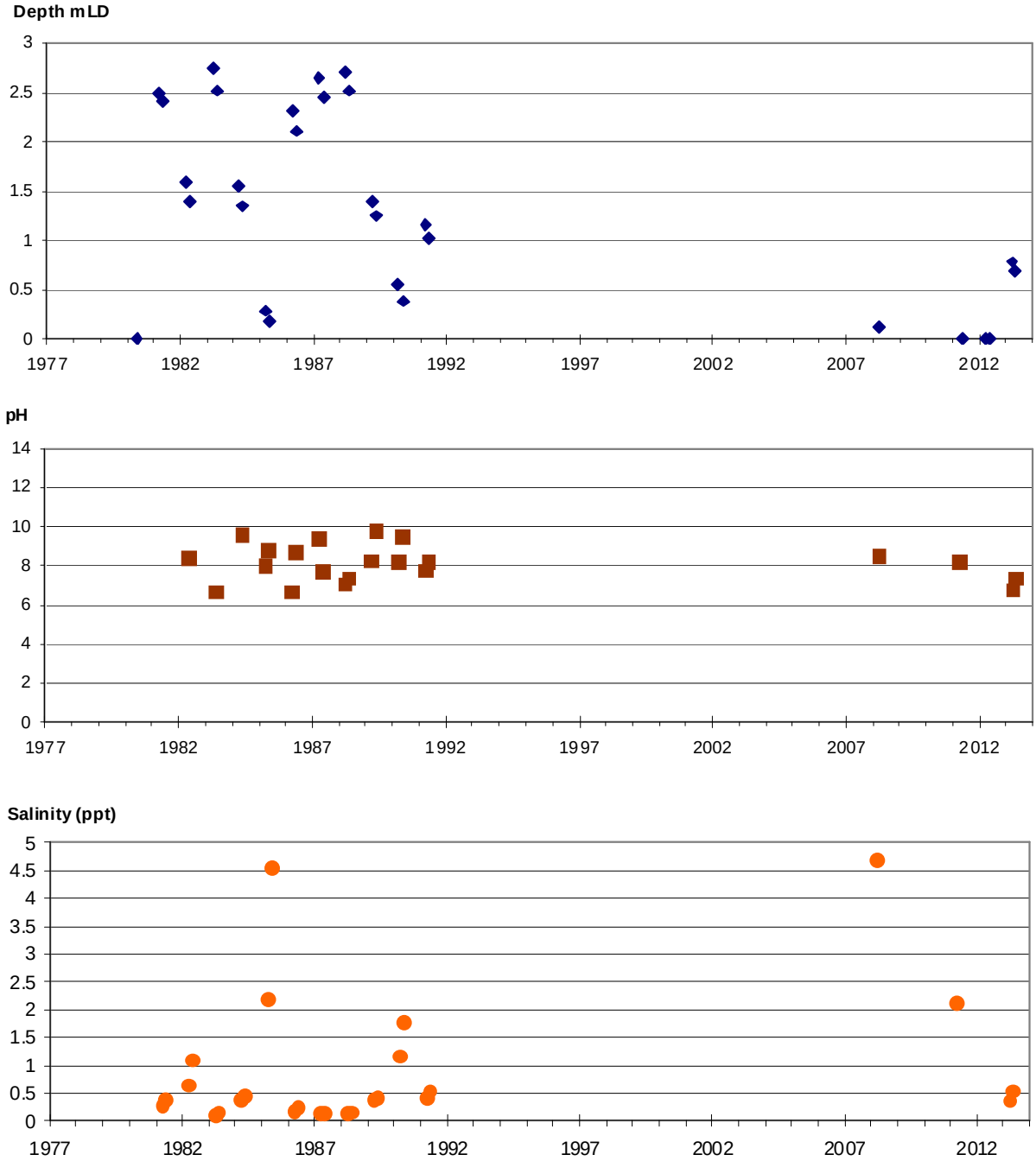




Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Egret is in the Wellington District (headquartered in Collie) of the South West DPaW Region.

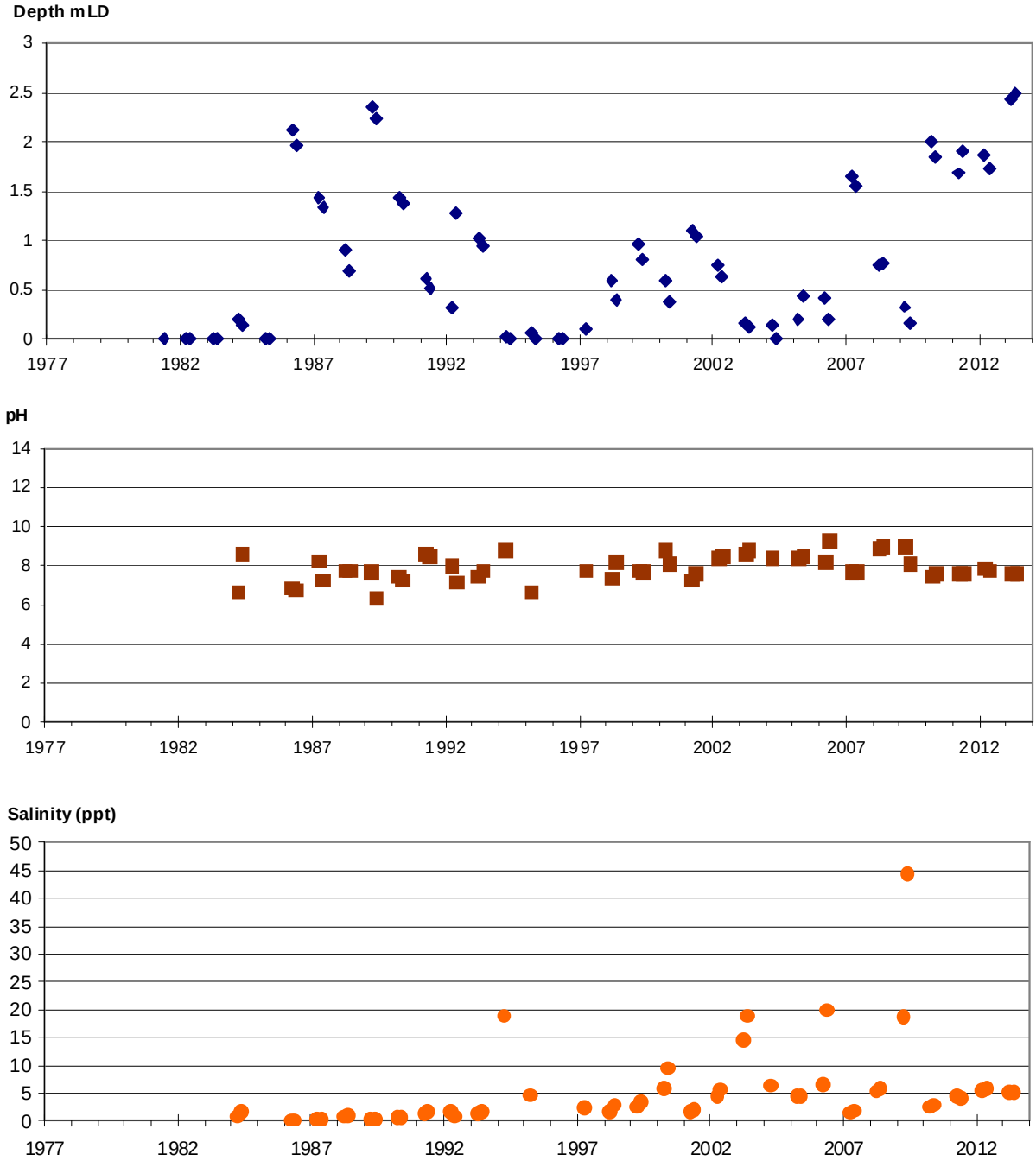
ENEMINGA



Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Eneminga is in the Moora District (headquartered in Jurien Bay) of the Midwest DPaW Region.

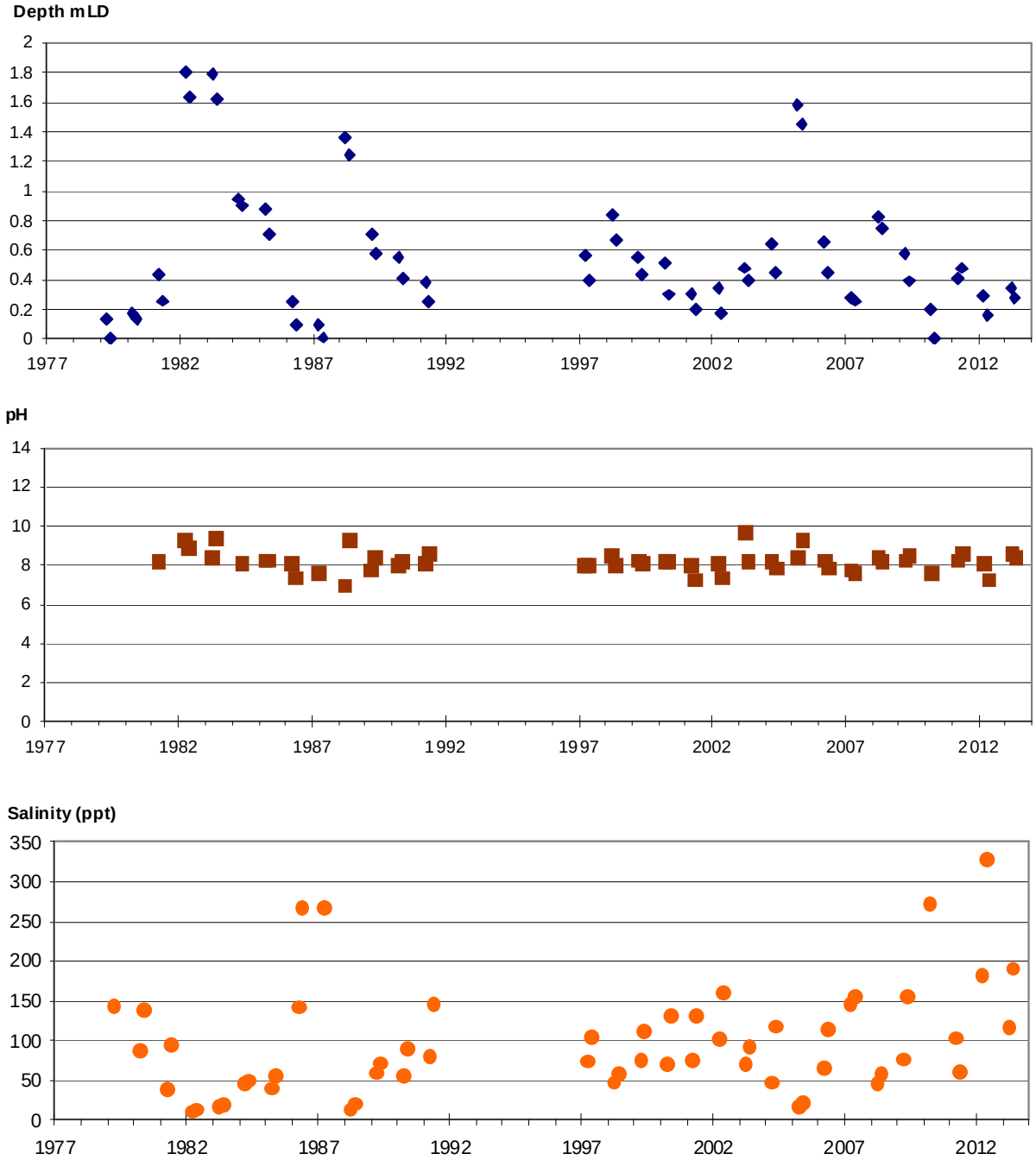
ESPERANCE 26410



Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Esperance 26410 is in the Esperance District of the South Coast DPaW Region.

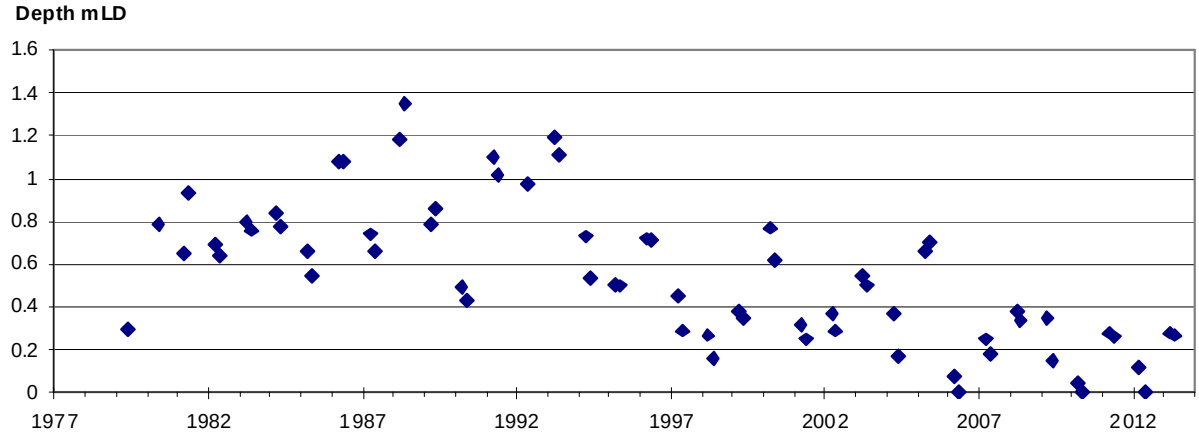
FLAGSTAFF

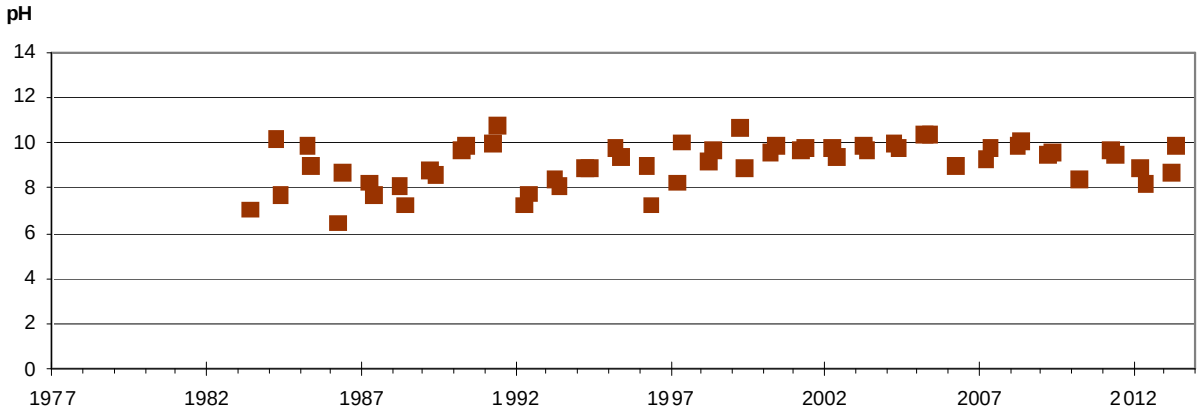


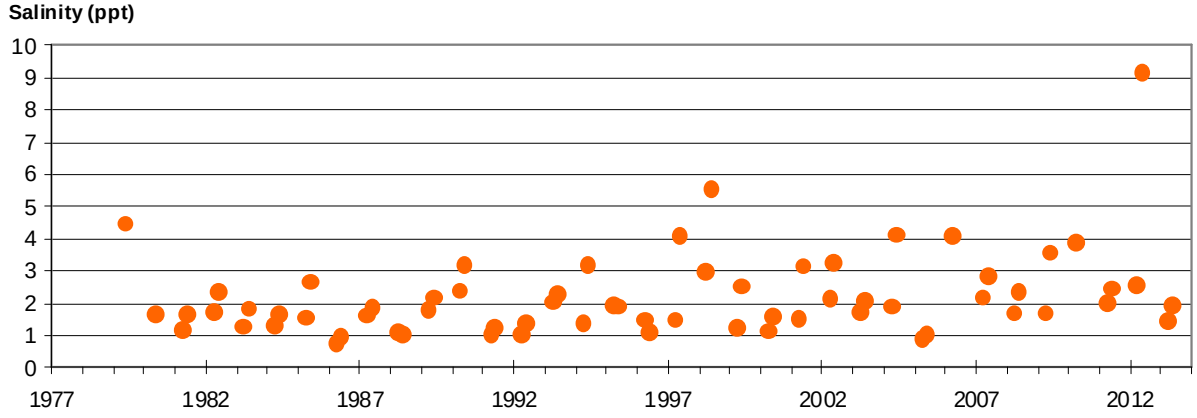
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Flagstaff is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

FORRESTDALE





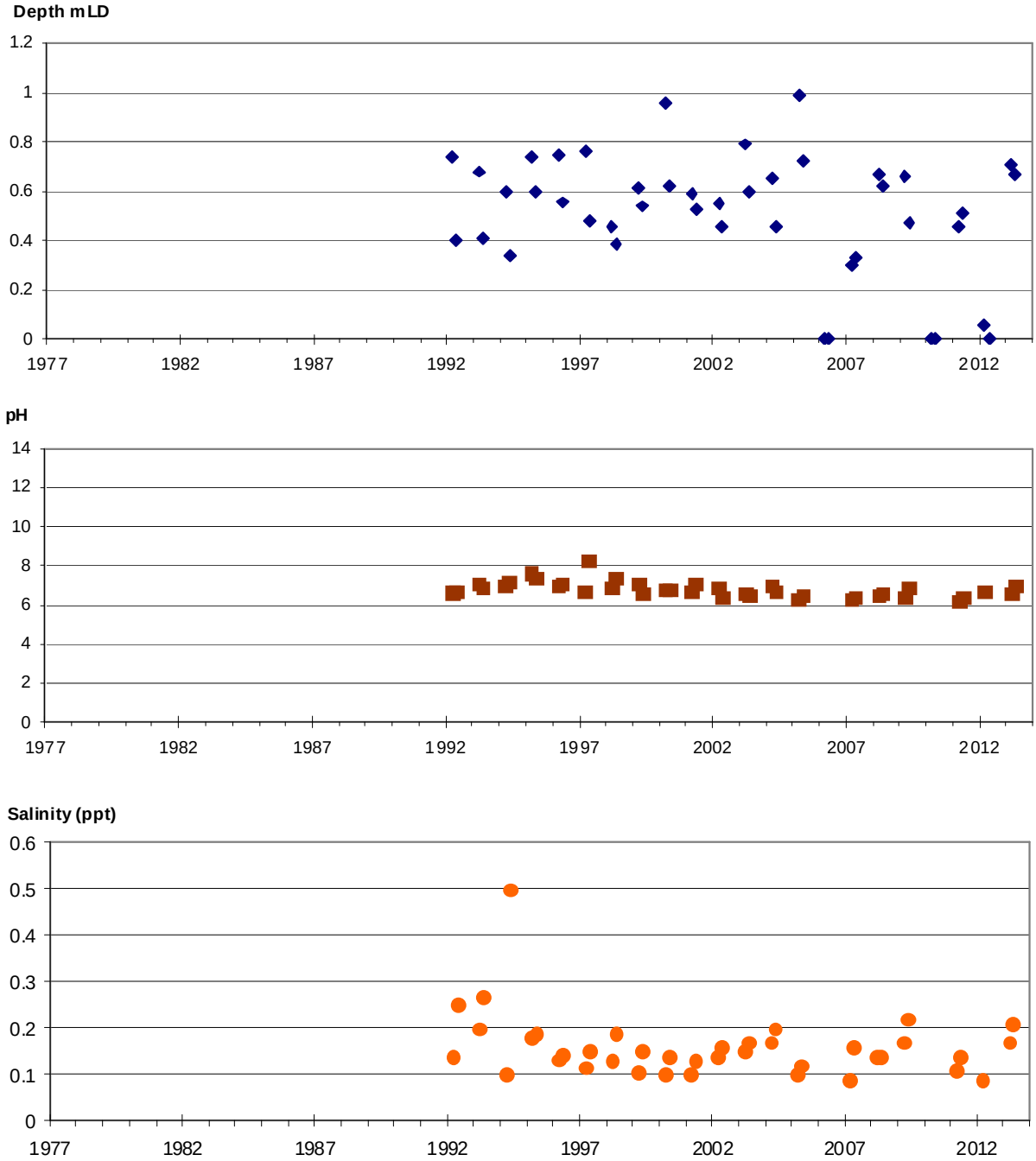


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Forrestdale Lake is a component of the 'Forrestdale and Thomsons Lakes' system, which is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands, and is also listed in the 'Directory of Important Wetlands in Australia'.

Forrestdale is in the Swan Coastal District (headquartered in Wanneroo) of the Swan DPaW Region.

GIBBS

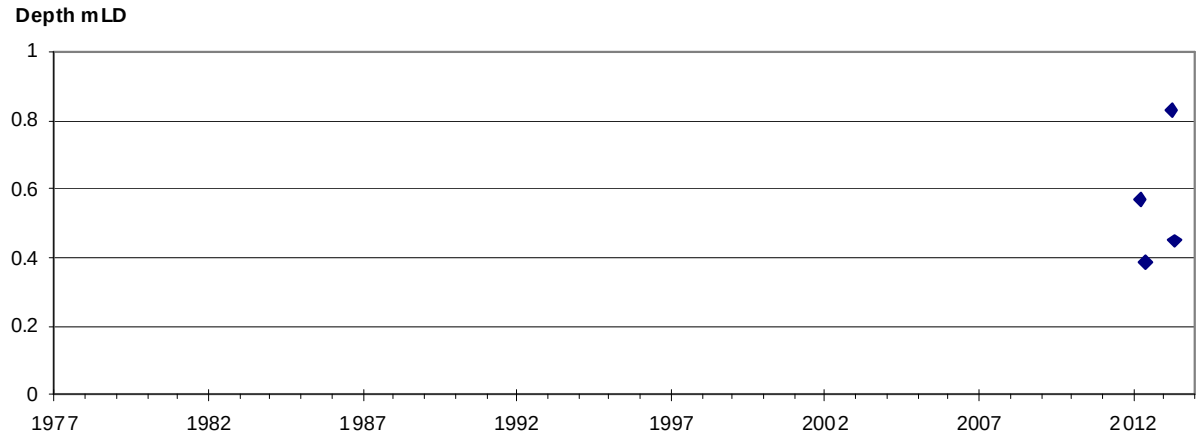


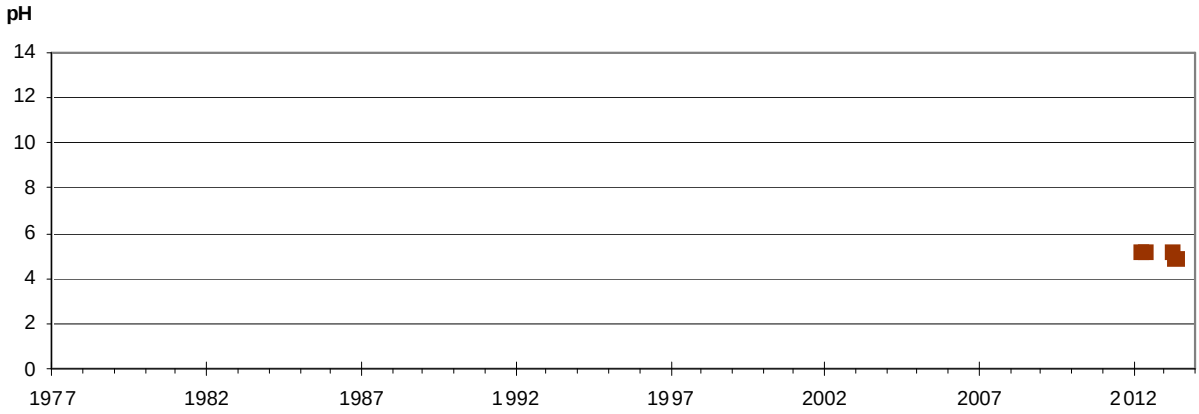
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

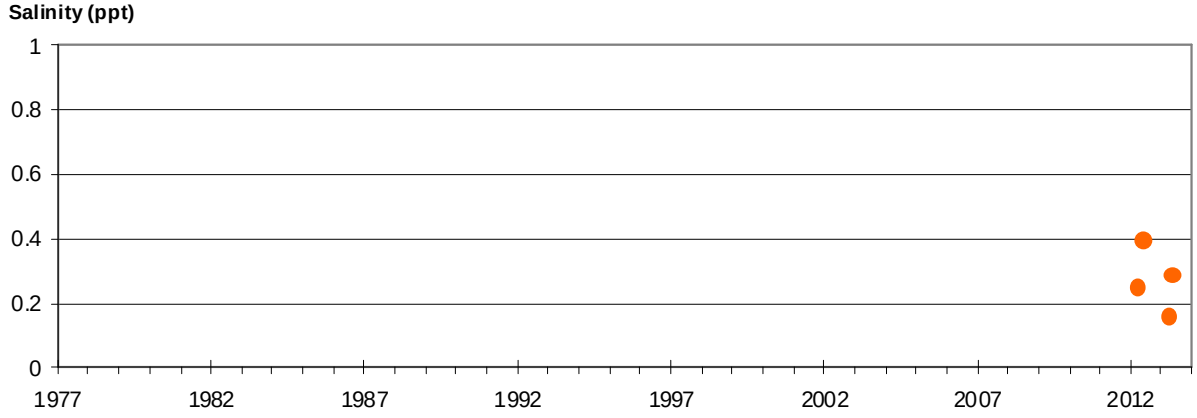
Gibbs is a component of the 'Gibbs Road Swamp System', which is listed in the 'Directory of Important Wetlands in Australia'.

Gibbs is in the Swan Coastal District (headquartered in Wanneroo) of the Swan DPaW Region.

GINGILUP



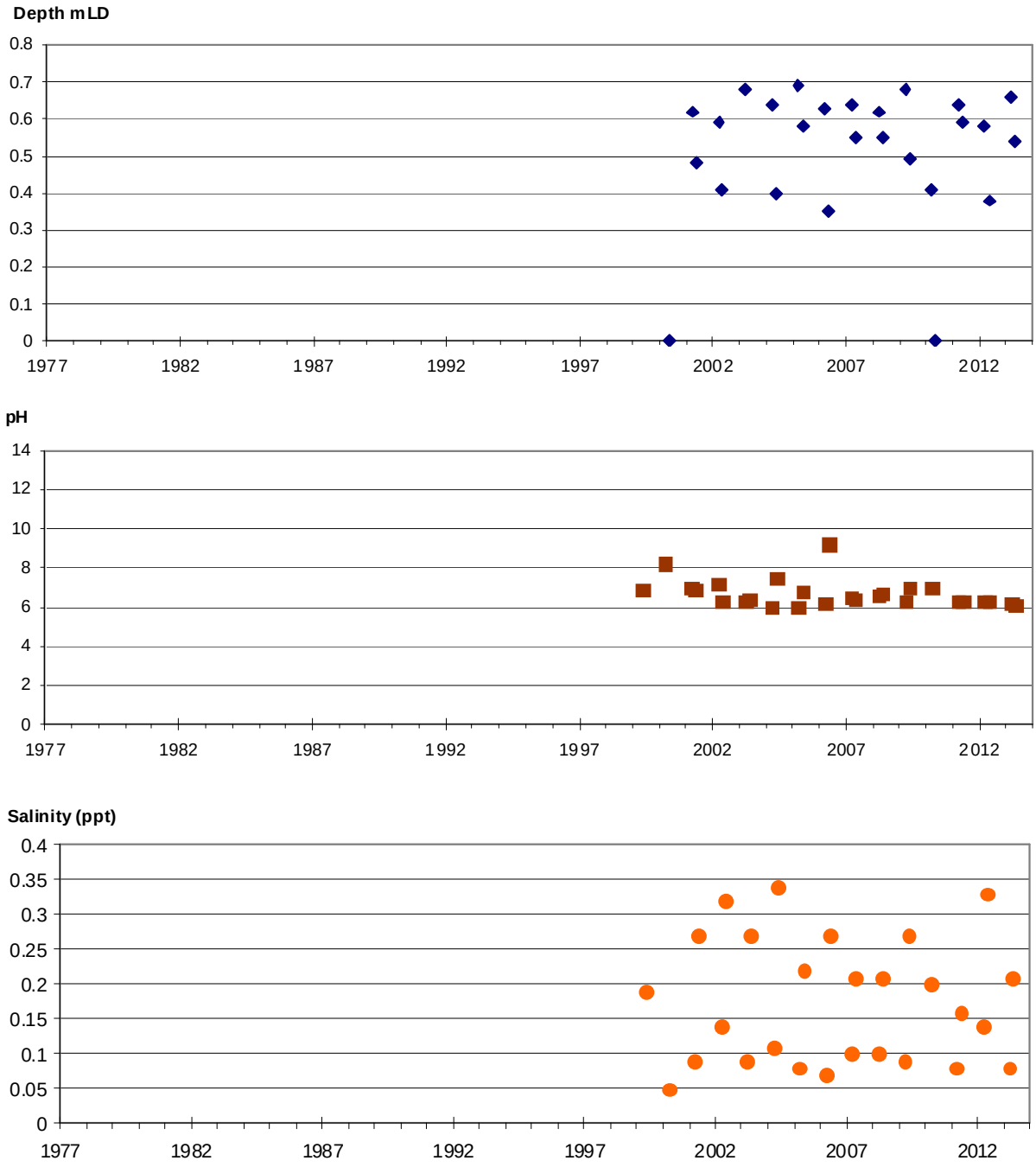




Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Gingilup is in the Blackwood District (headquartered in Busselton) of the South West DPaW Region.

GOONAPING [IM]

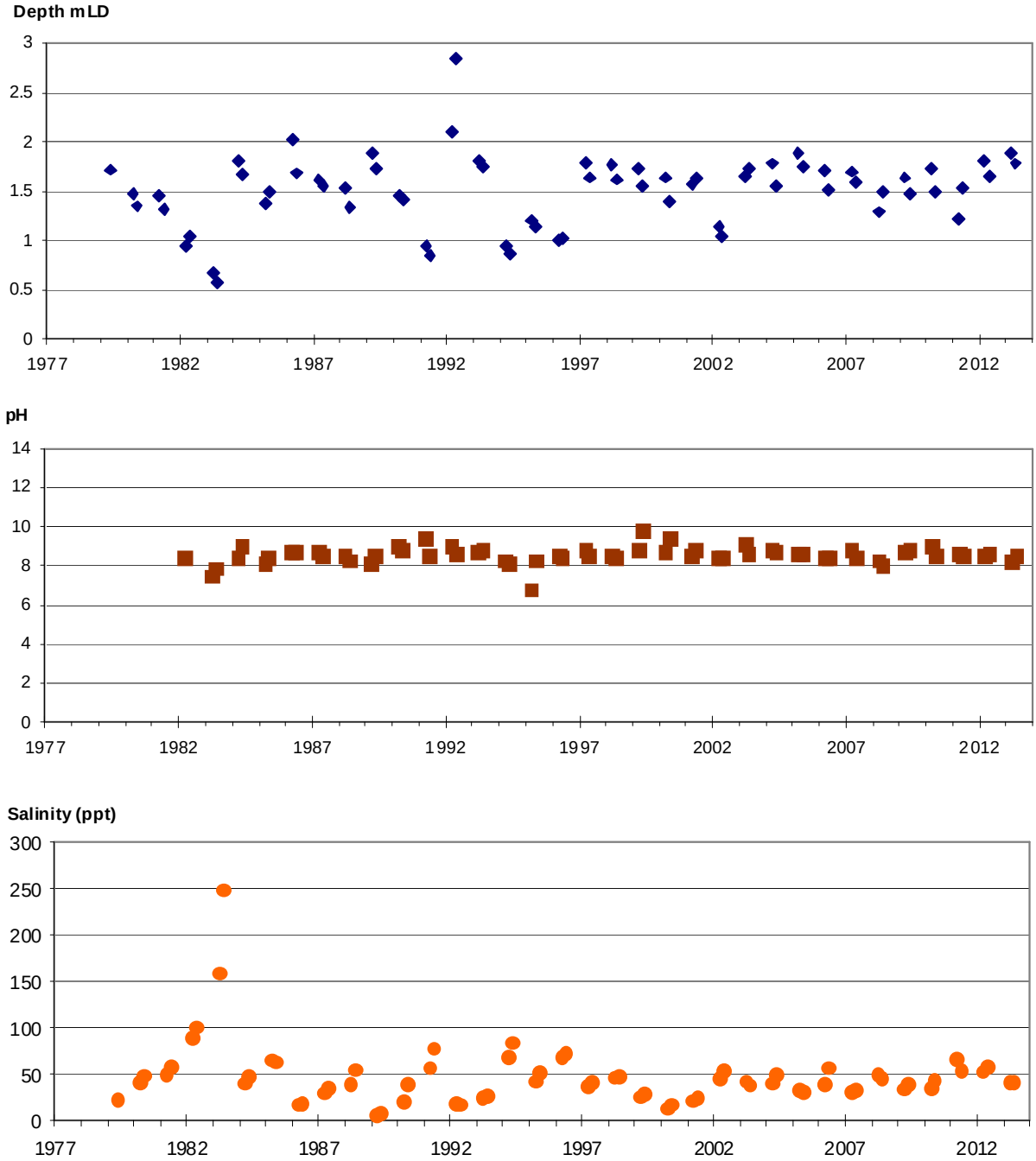


Notes:

1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Goonaping is in the Perth Hills District (headquartered in Mundaring) of the Swan DPaW Region.

GORE



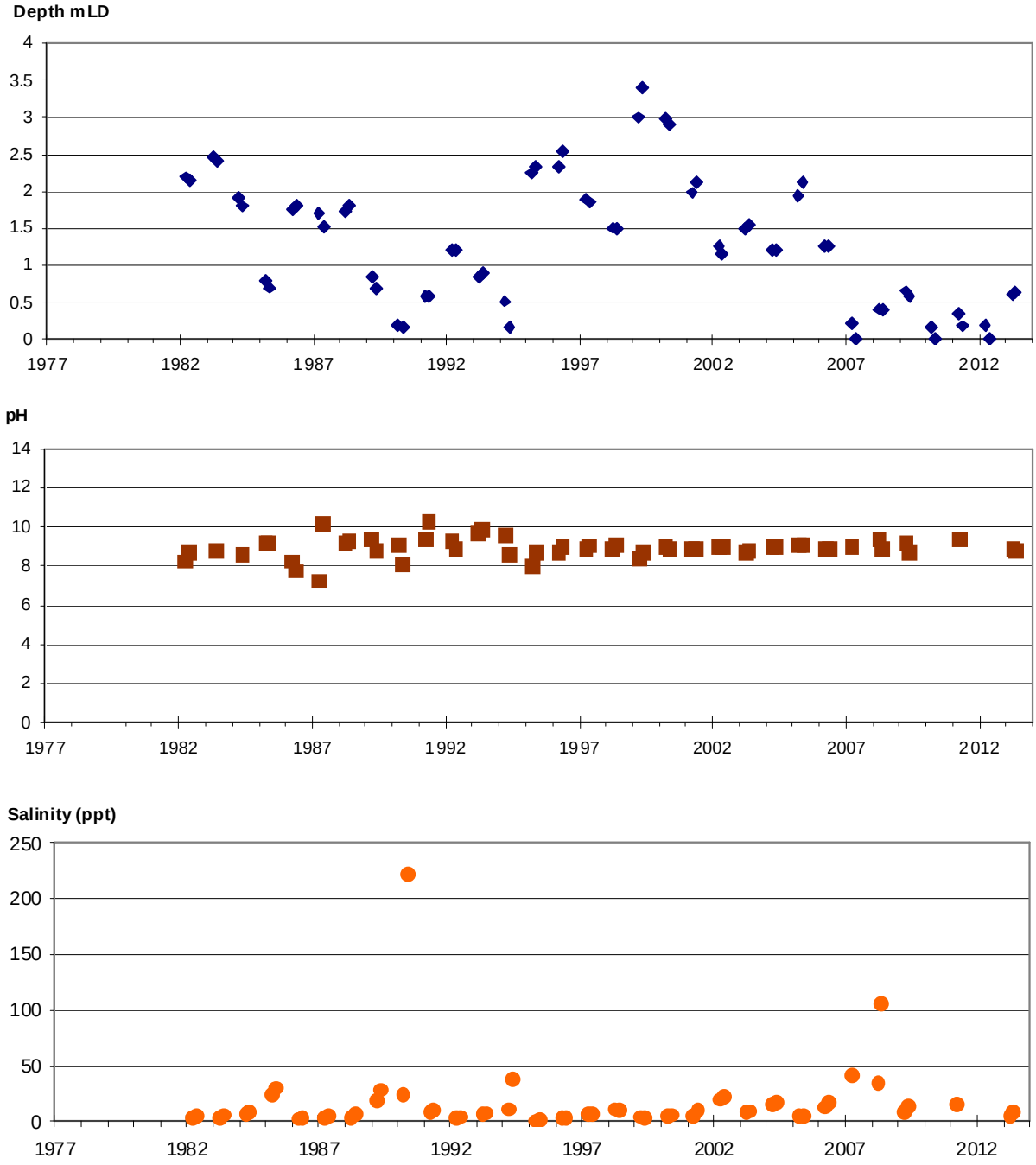
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Lake Gore is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands.

Lake Gore is also a component of the 'Lake Gore System', which is listed in the 'Directory of Important Wetlands in Australia'.

Gore is in the Esperance District of the South Coast DPaW Region.

GURAGA (with Salinity axis 0-250ppt)

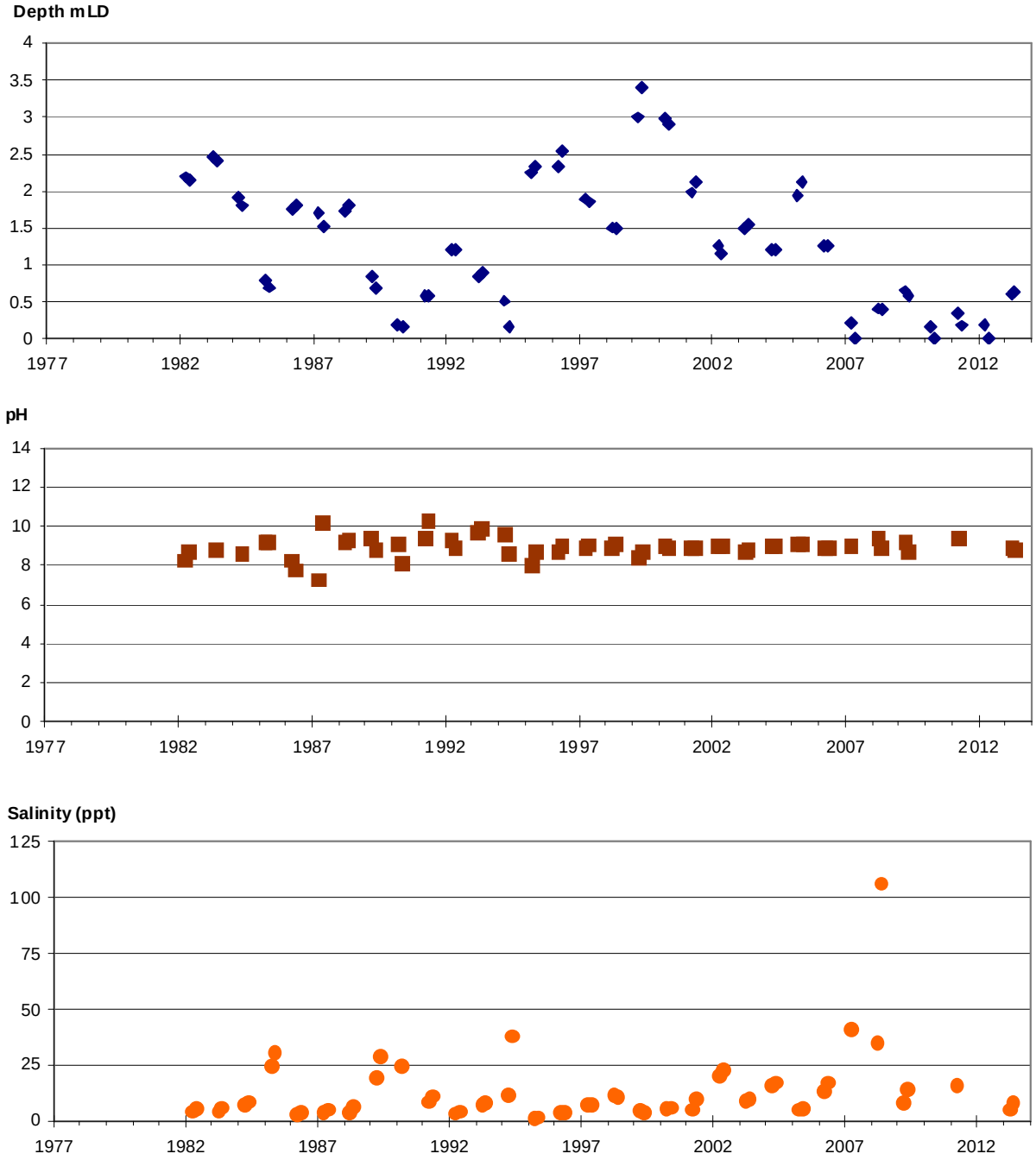


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Guraga Lake is listed in the 'Directory of Important Wetlands in Australia'.

Guraga is in the Moora District (headquartered in Jurien Bay) of the Midwest DPaW Region.

GURAGA (with Salinity axis 0-125ppt)

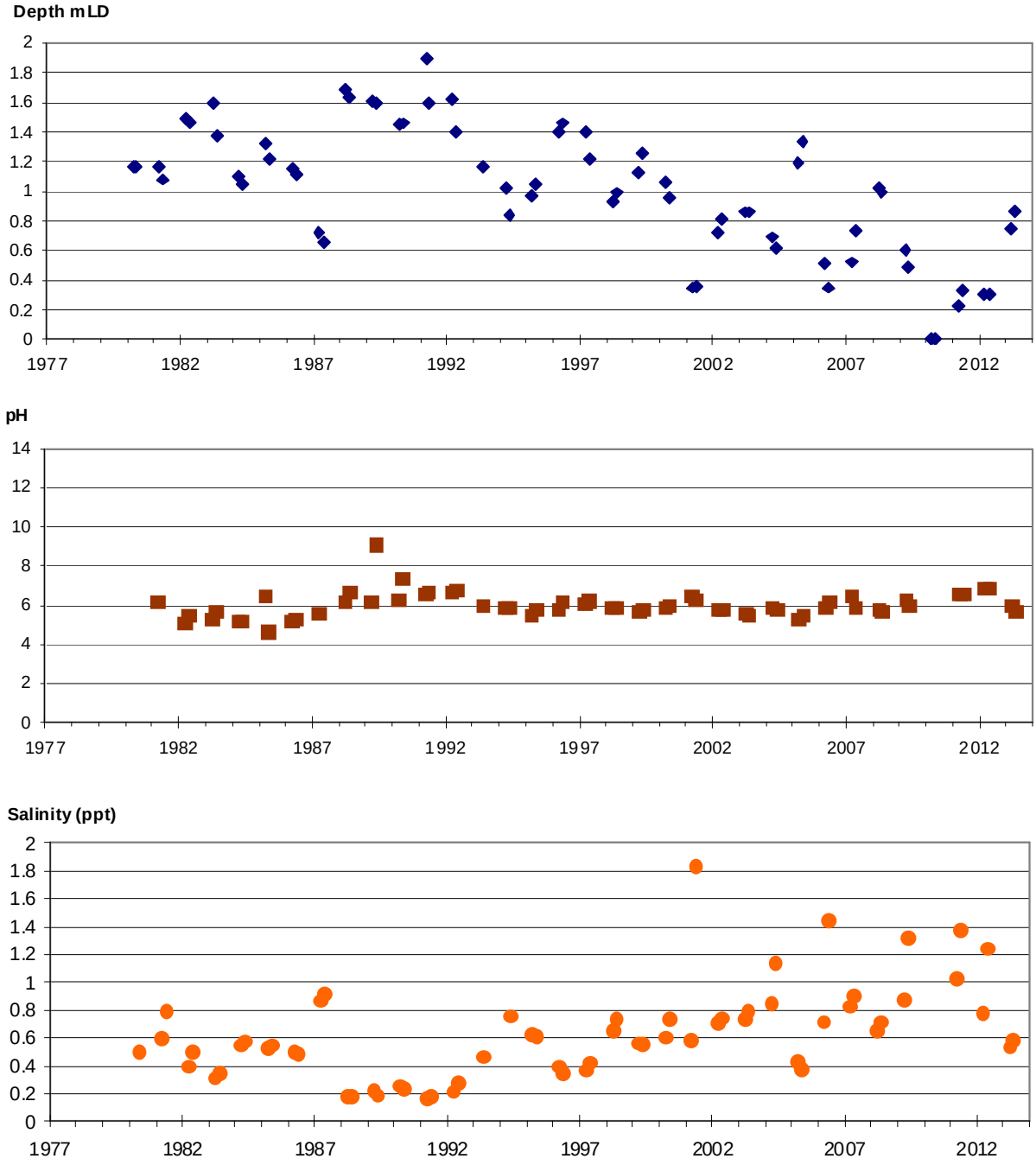


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Guraga Lake is listed in the 'Directory of Important Wetlands in Australia'.

Guraga is in the Moora District (headquartered in Jurien Bay) of the Midwest DPaW Region.

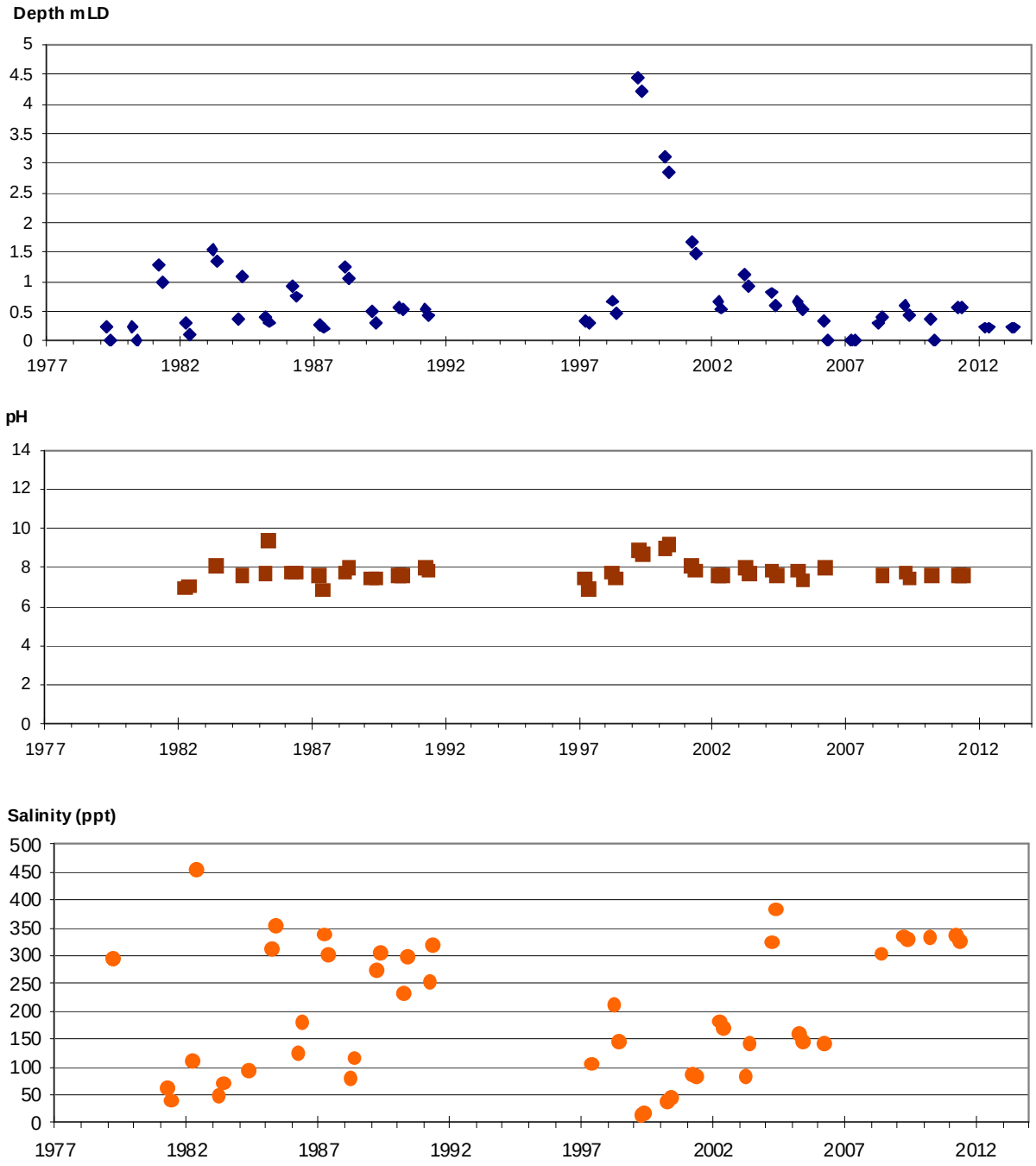
HARVEY 12632



Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Harvey 12632 is in the Wellington District (headquartered in Collie) of the South West DPaW Region.

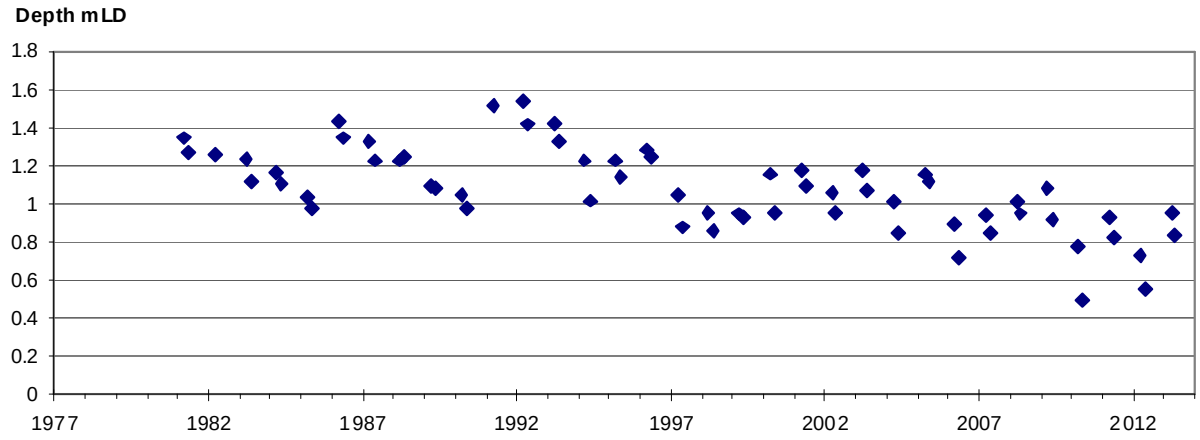
HINDS

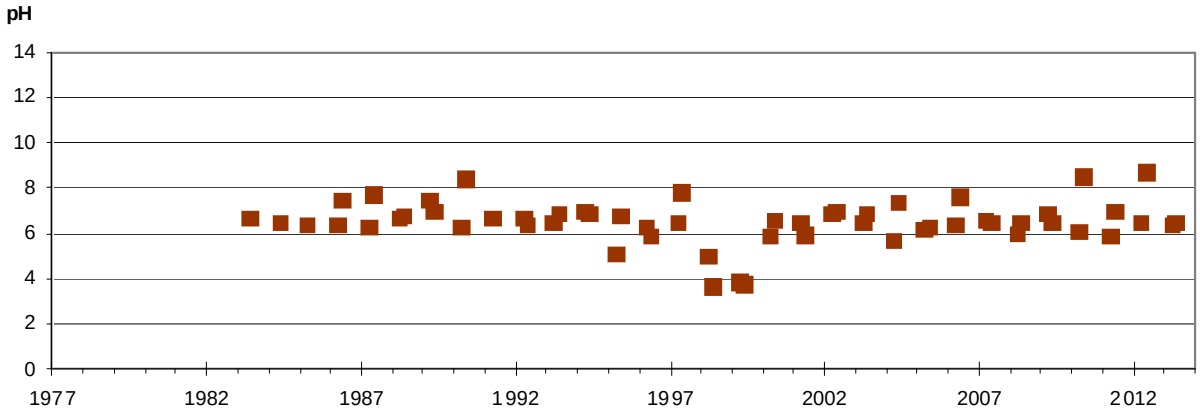


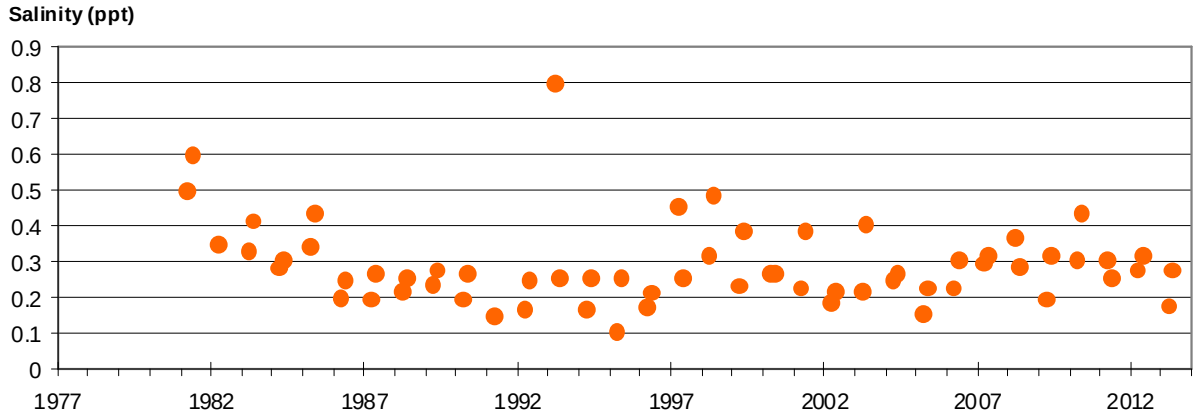
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Hinds is in the Central District (headquartered in Merredin) of the Wheatbelt DPaW Region.

JANDABUP



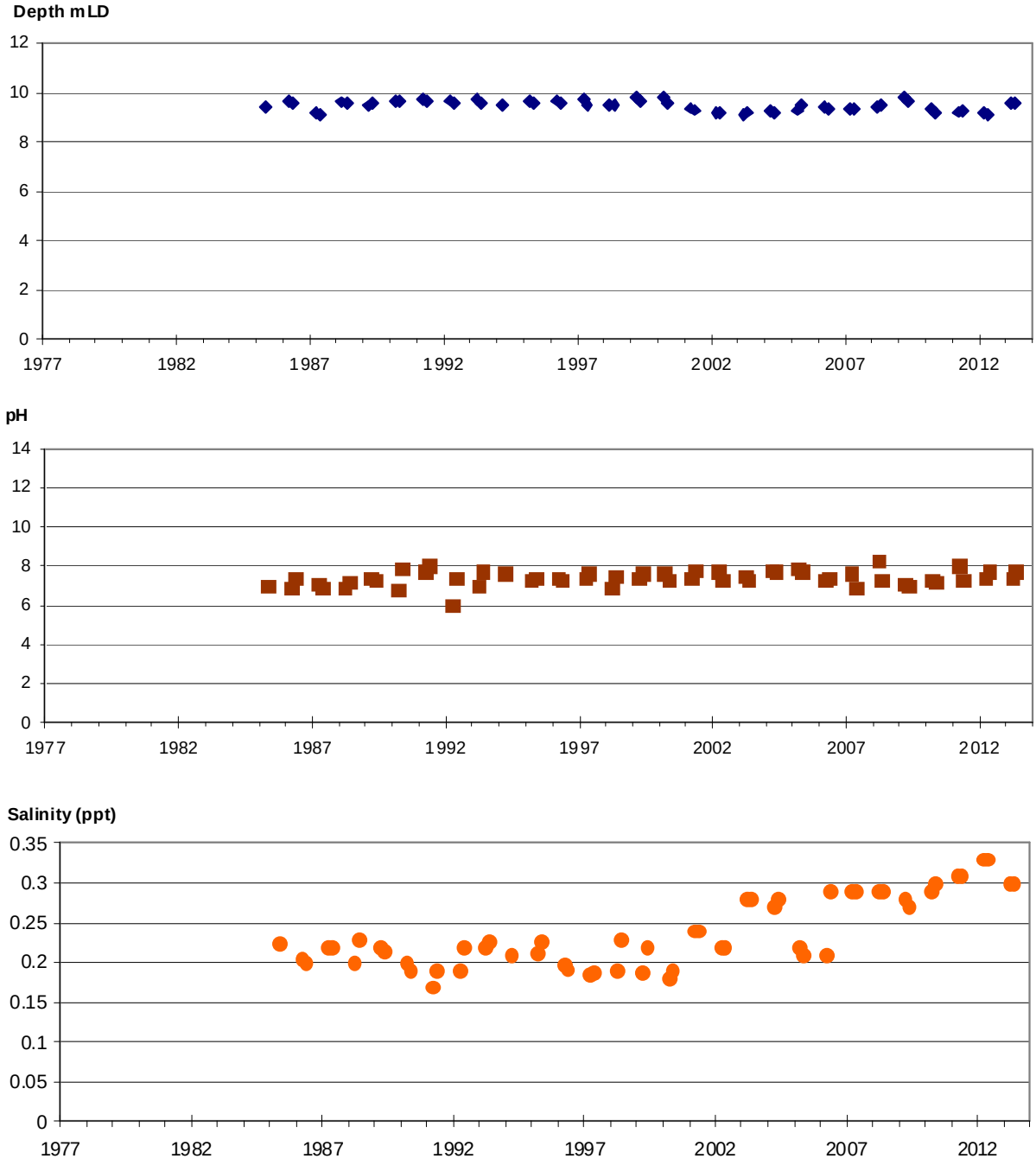




Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Jandabup is in the Swan Coastal District (headquartered in Wanneroo) of the Swan DPaW Region.

JASPER (with Depth axis 0-12m)



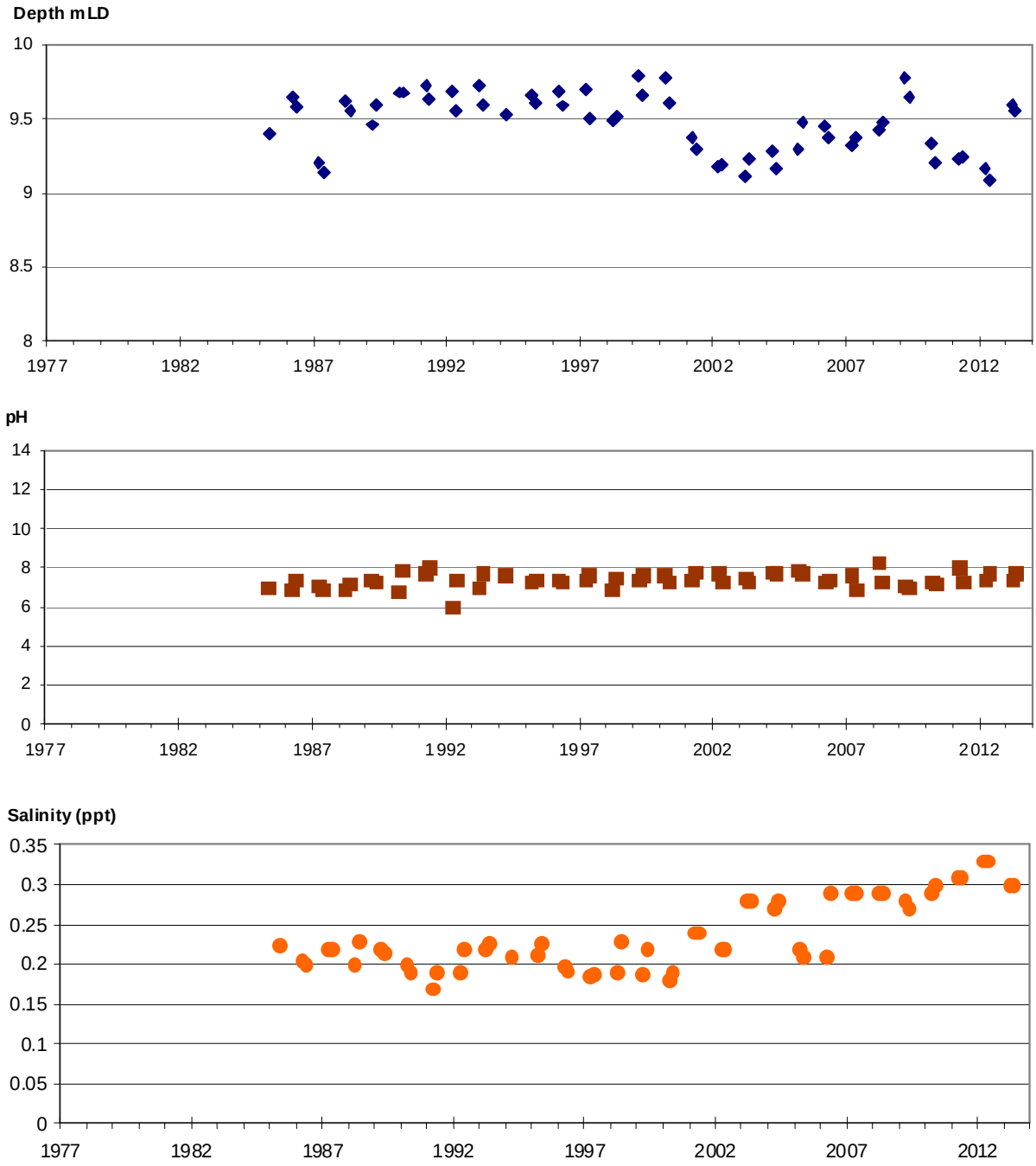
Notes:

1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Jasper is a component of the 'Gingilup-Jasper Wetland System', which is listed in the 'Directory of Important Wetlands in Australia'.

Jasper is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

JASPER (with Depth axis 8-10m)

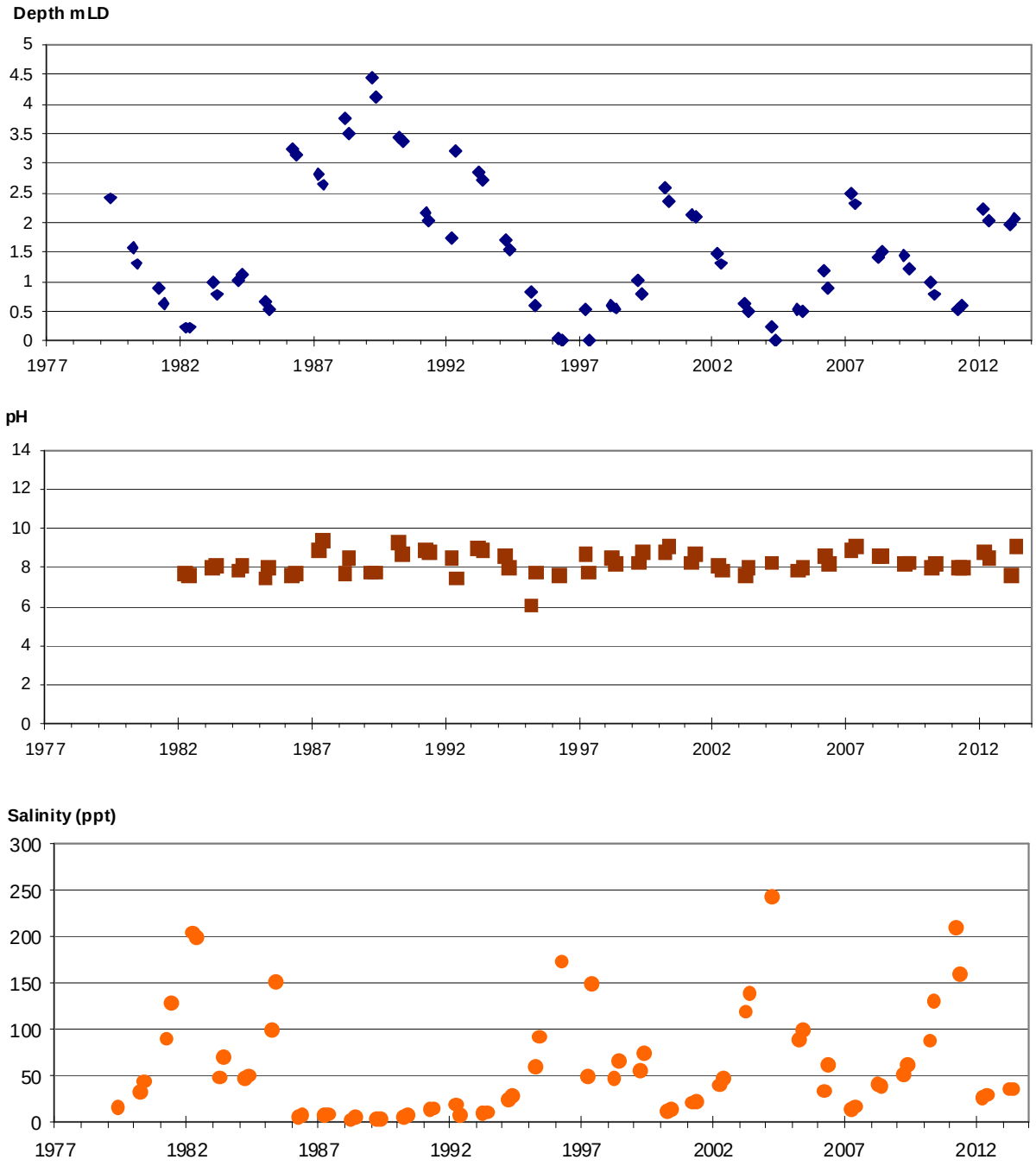


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Jasper is a component of the 'Gingilup-Jasper Wetland System', which is listed in the 'Directory of Important Wetlands in Australia'.

Jasper is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

JERDACUTTUP

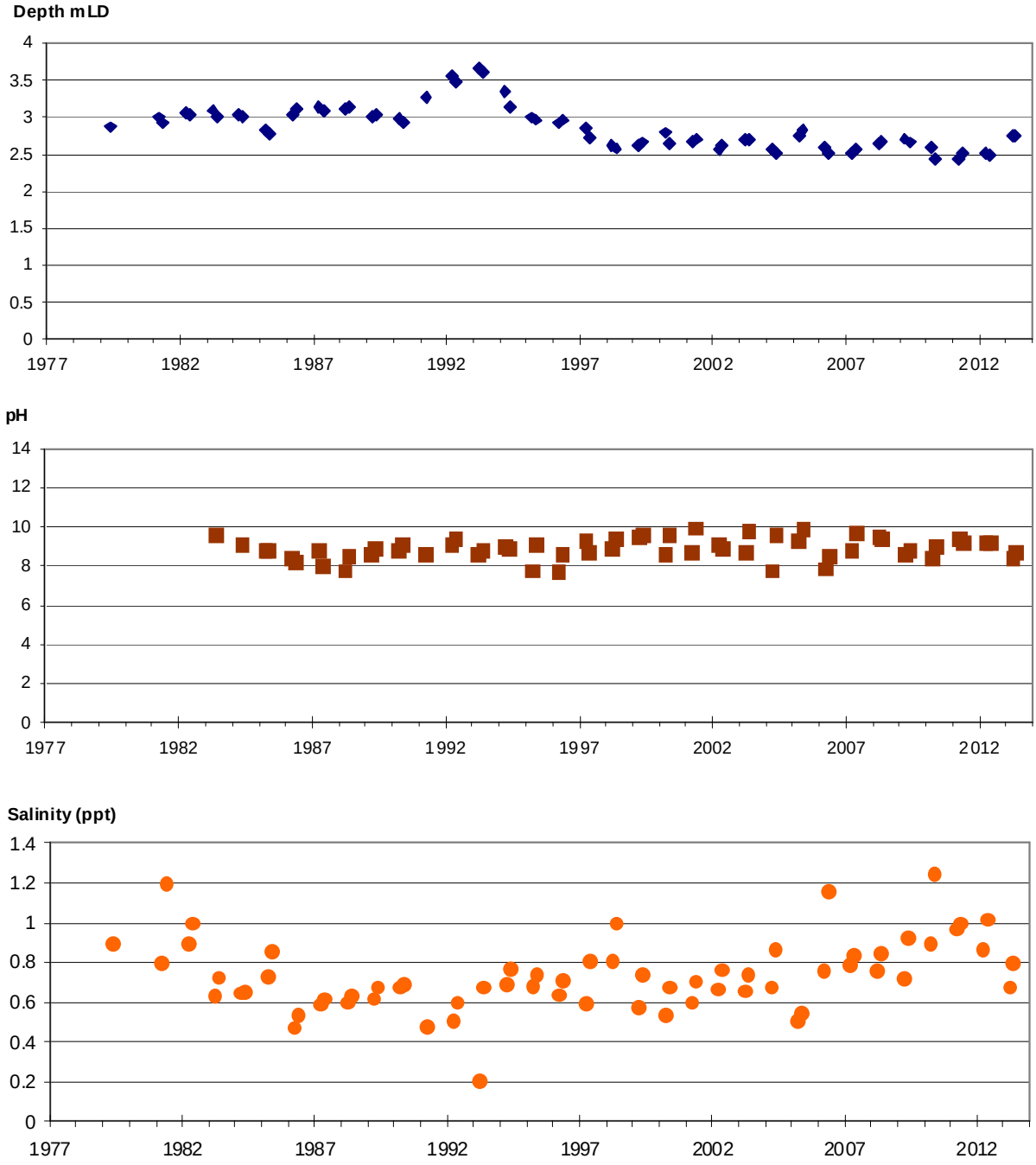


Notes:

1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Jerdacuttup is in the Albany District of the South Coast DPaW Region

JOONDALUP

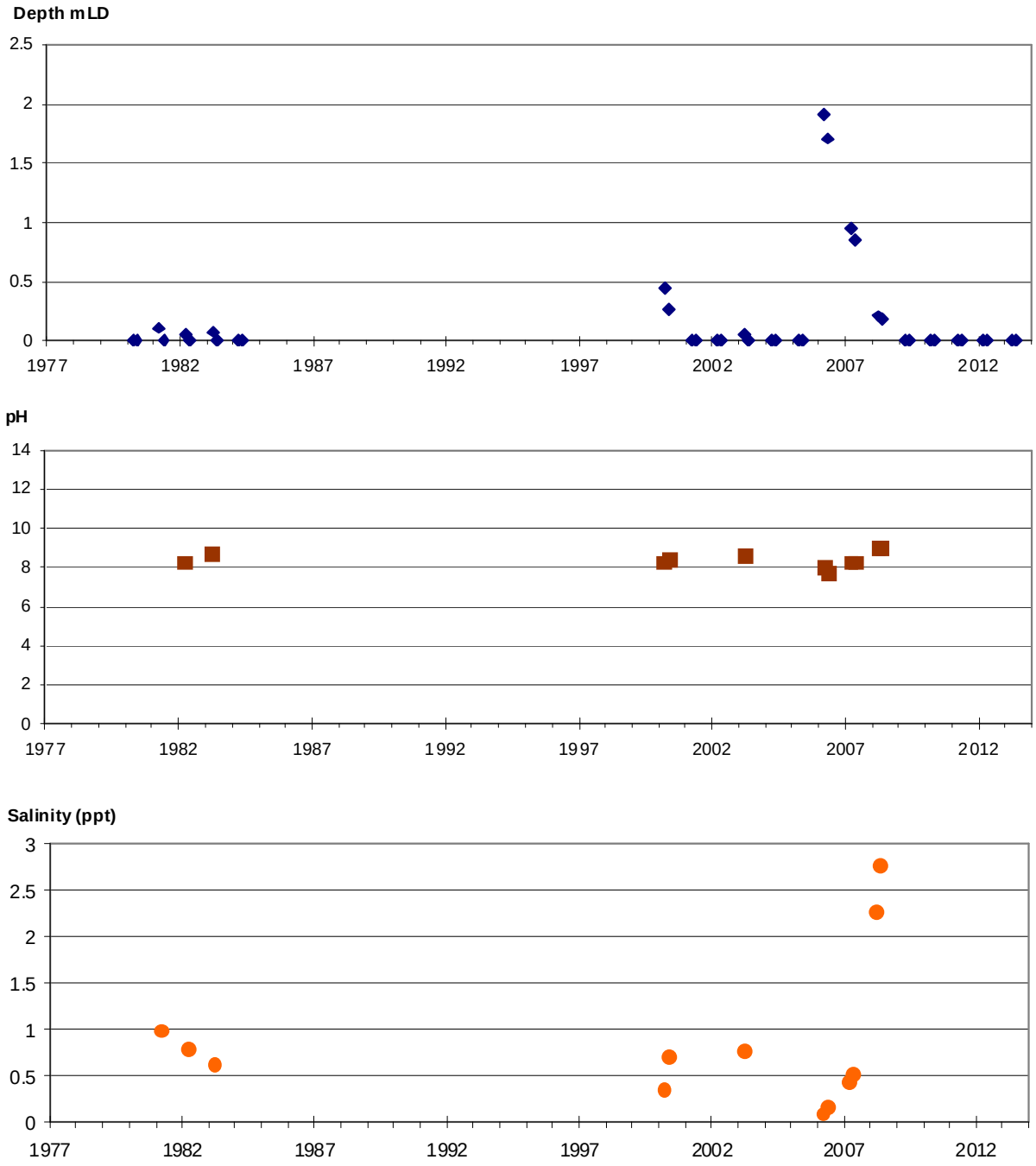


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Joondalup Lake is listed in the 'Directory of Important Wetlands in Australia'.

Joondalup is in the Swan Coastal District (headquartered in Wanneroo) of the Swan DPaW Region.

KENT 29020

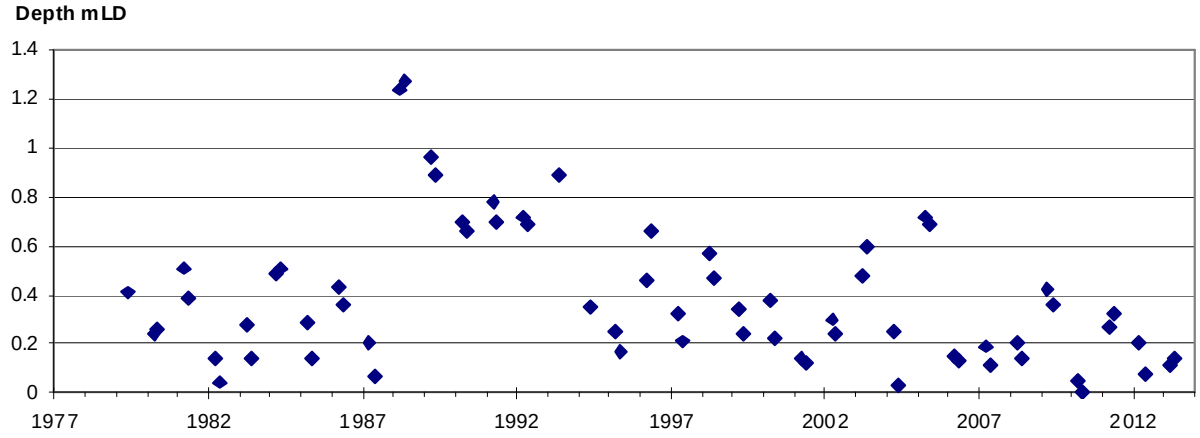


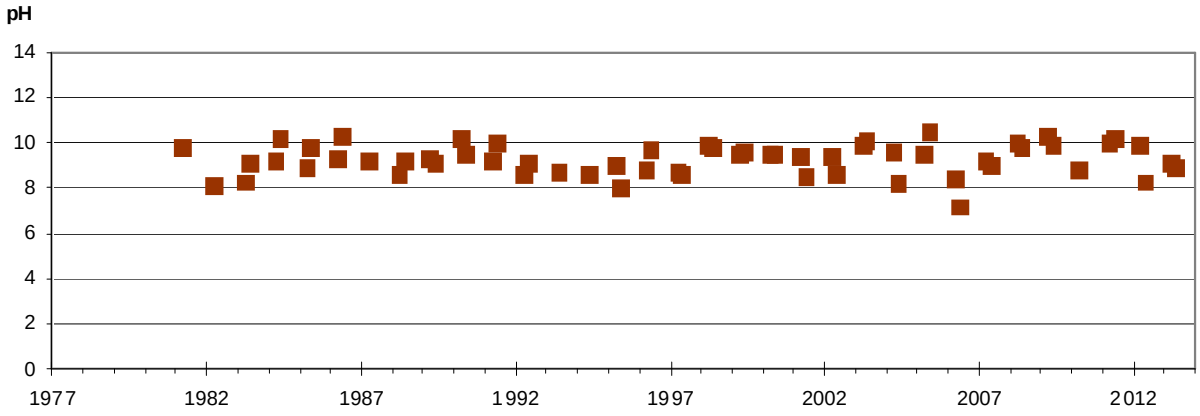
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

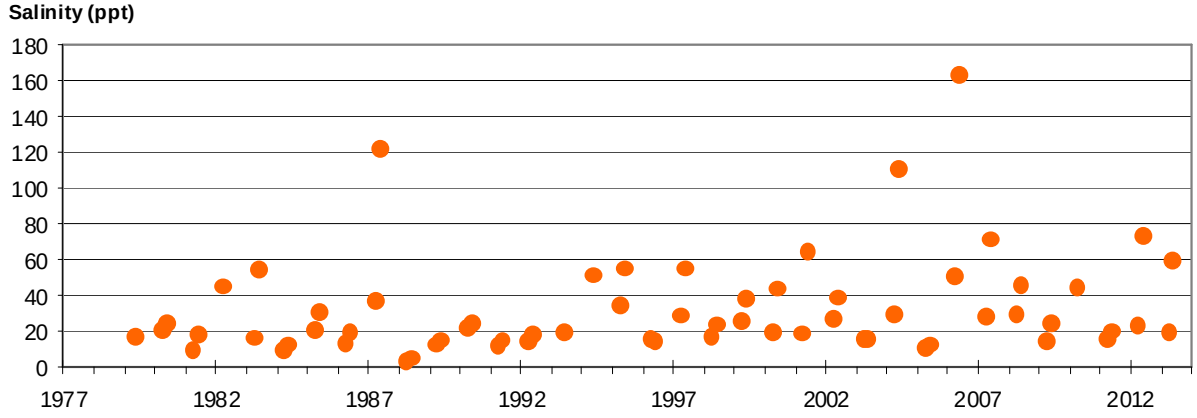
Kent 29020 (also known as East Lake Bryde) is a component of the 'Lake Bryde – East Lake Bryde System', which is listed in the 'Directory of Important Wetlands in Australia'.

Kent 29020 is within the Lake Bryde Natural Diversity Recovery Catchment and is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

KWORNICUP



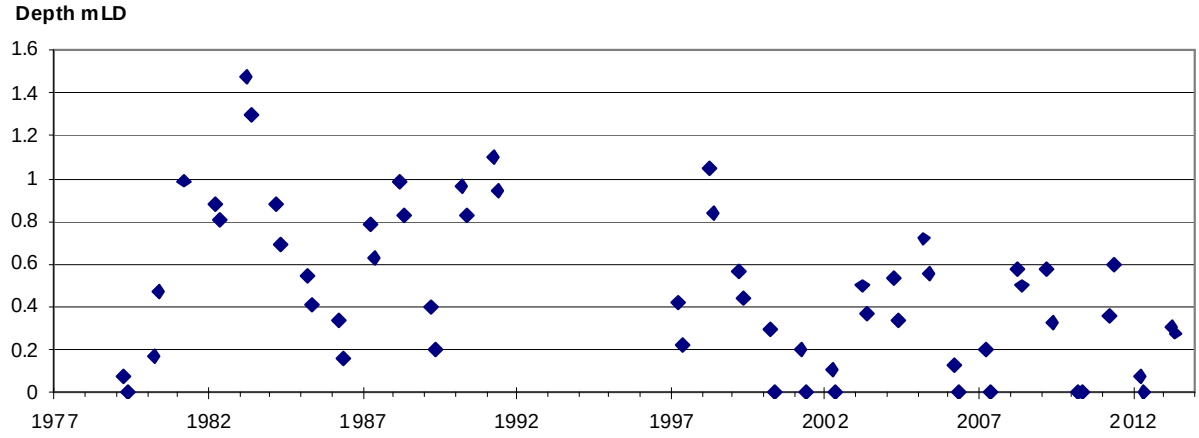


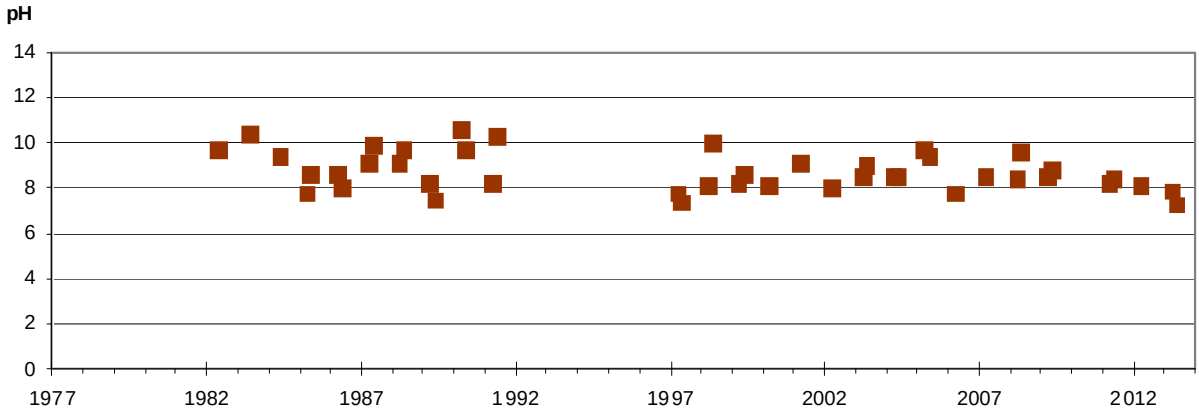


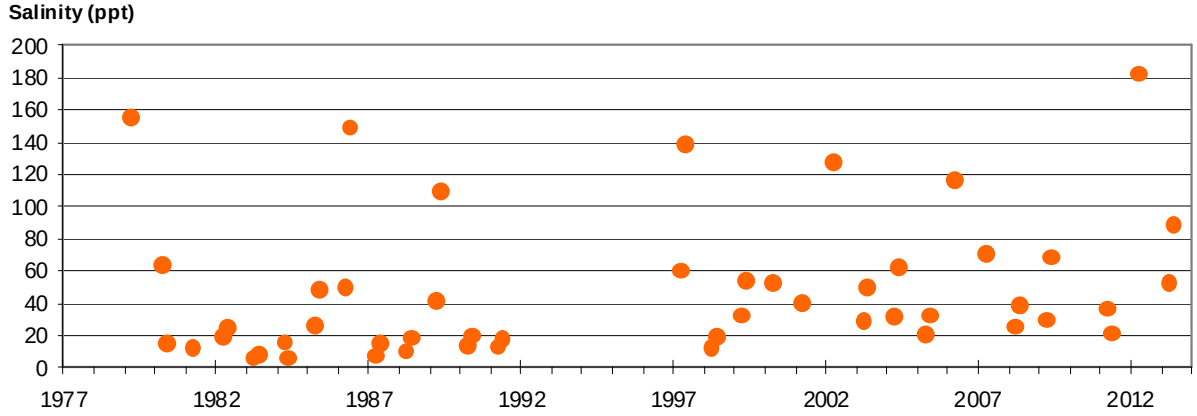
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Kwornicup is in the Frankland District (headquartered in Walpole) of the Warren DPaW Region.

LITTLE WHITE



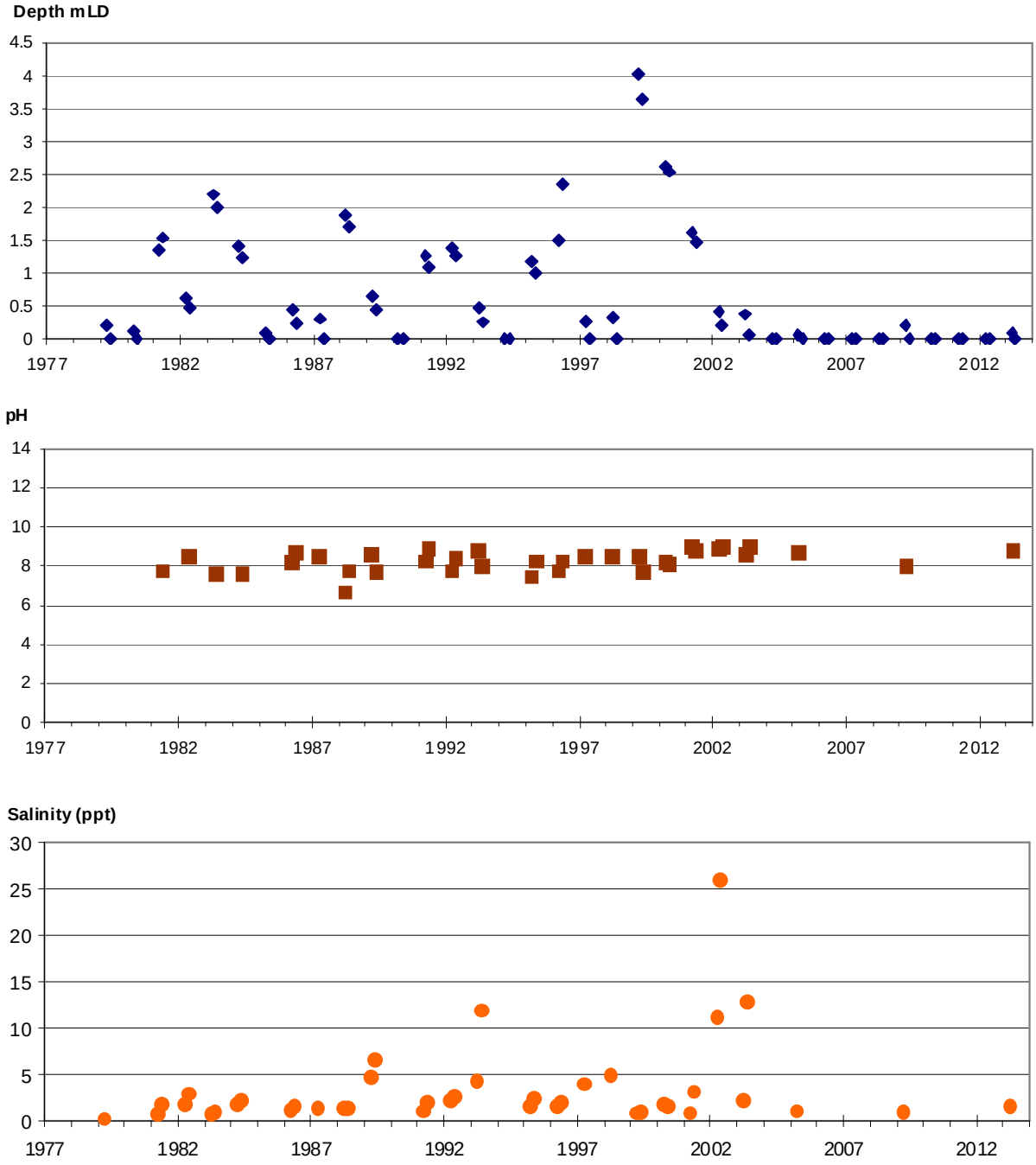




Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Little White is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

LOGUE [IM]

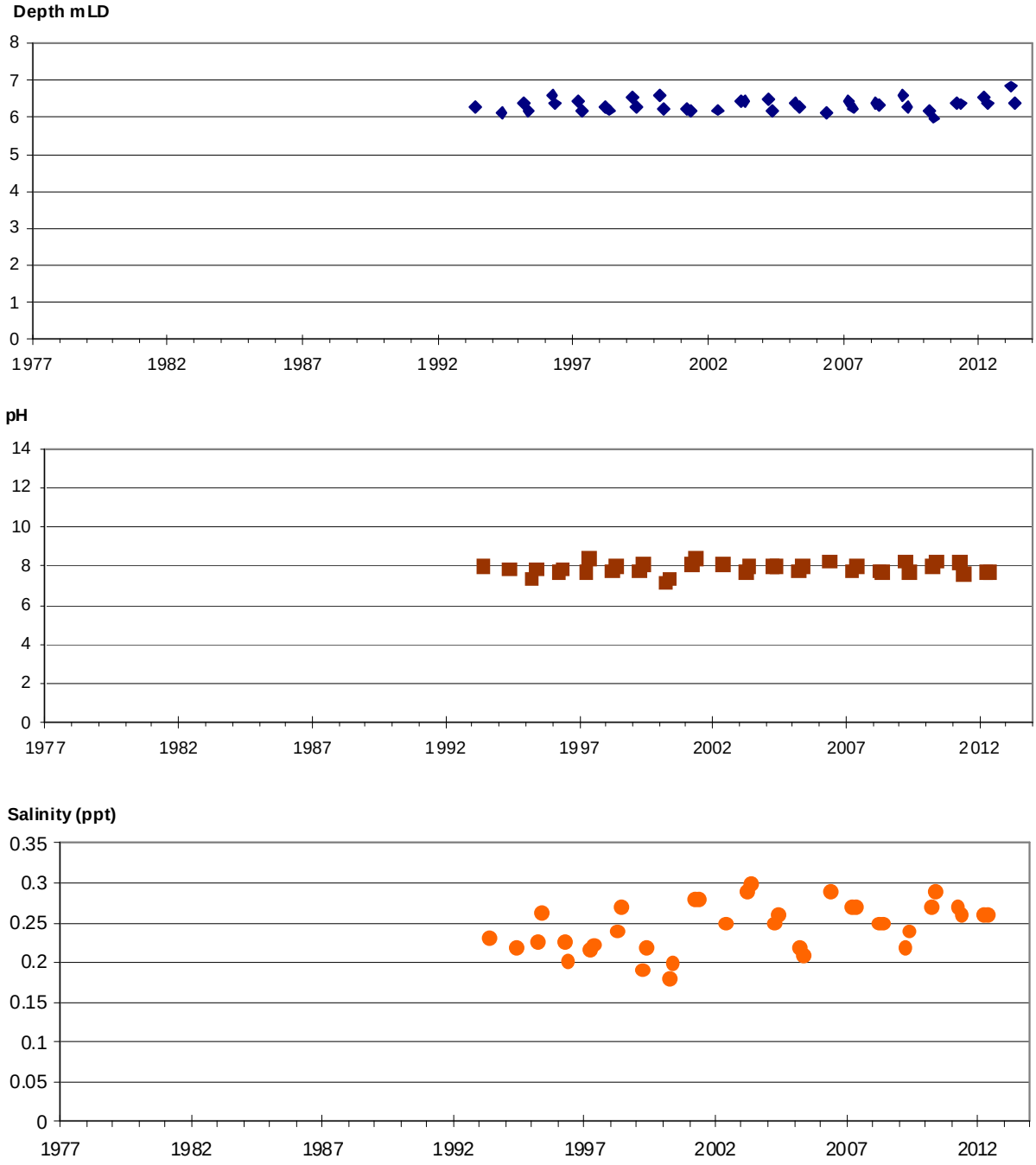


Notes:
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Logue is a component of the 'Lake Logue-Indoon System', which is listed in the 'Directory of Important Wetlands in Australia'.

Logue is in the Moora District (headquartered in Jurien Bay) of the Midwest DPaW Region.

MARINGUP (with Depth axis 0-7m)

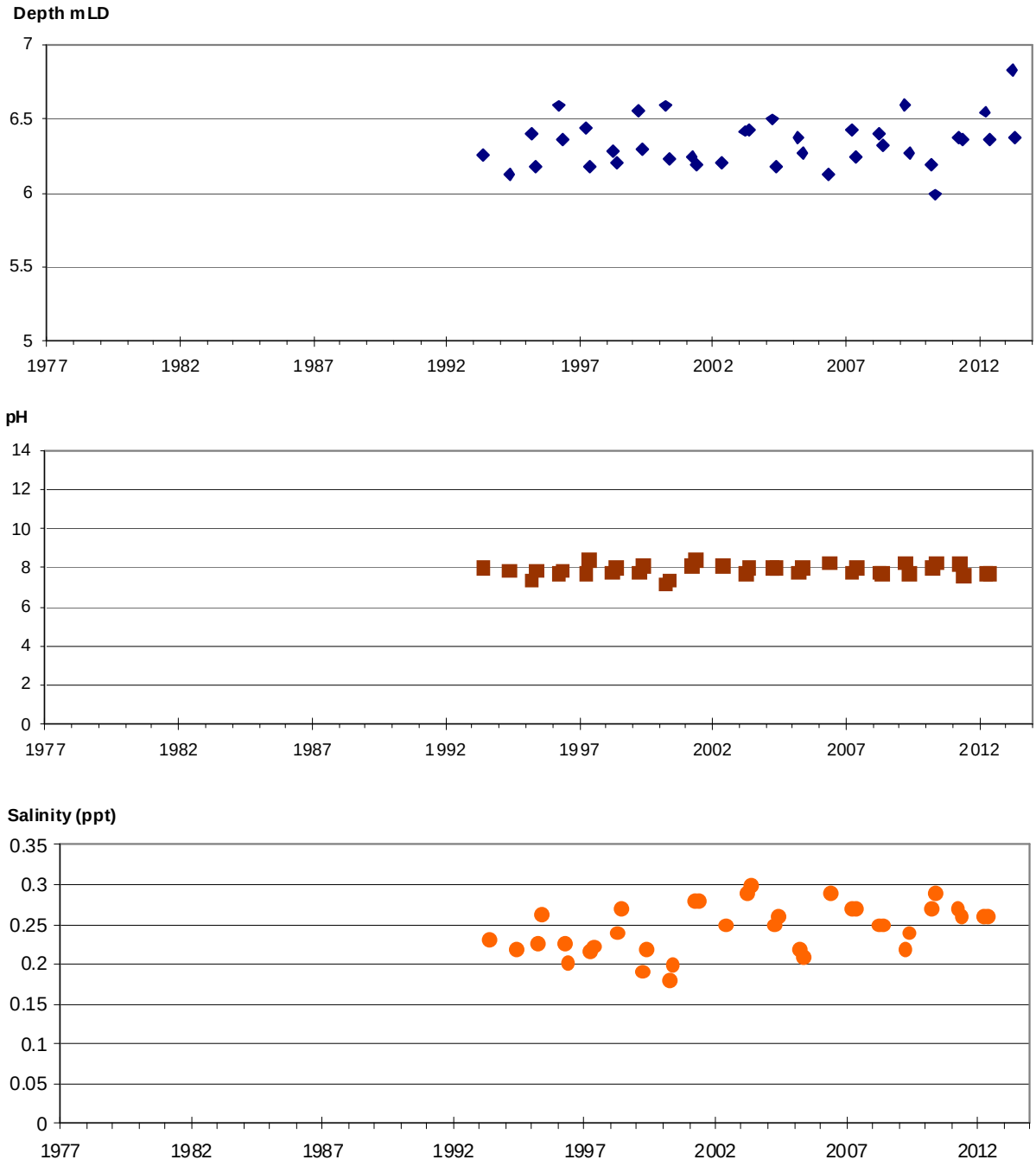


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Maringup Lake is listed in the 'Directory of Important Wetlands in Australia'.

Maringup is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

MARINGUP (with Depth axis 5-7m)

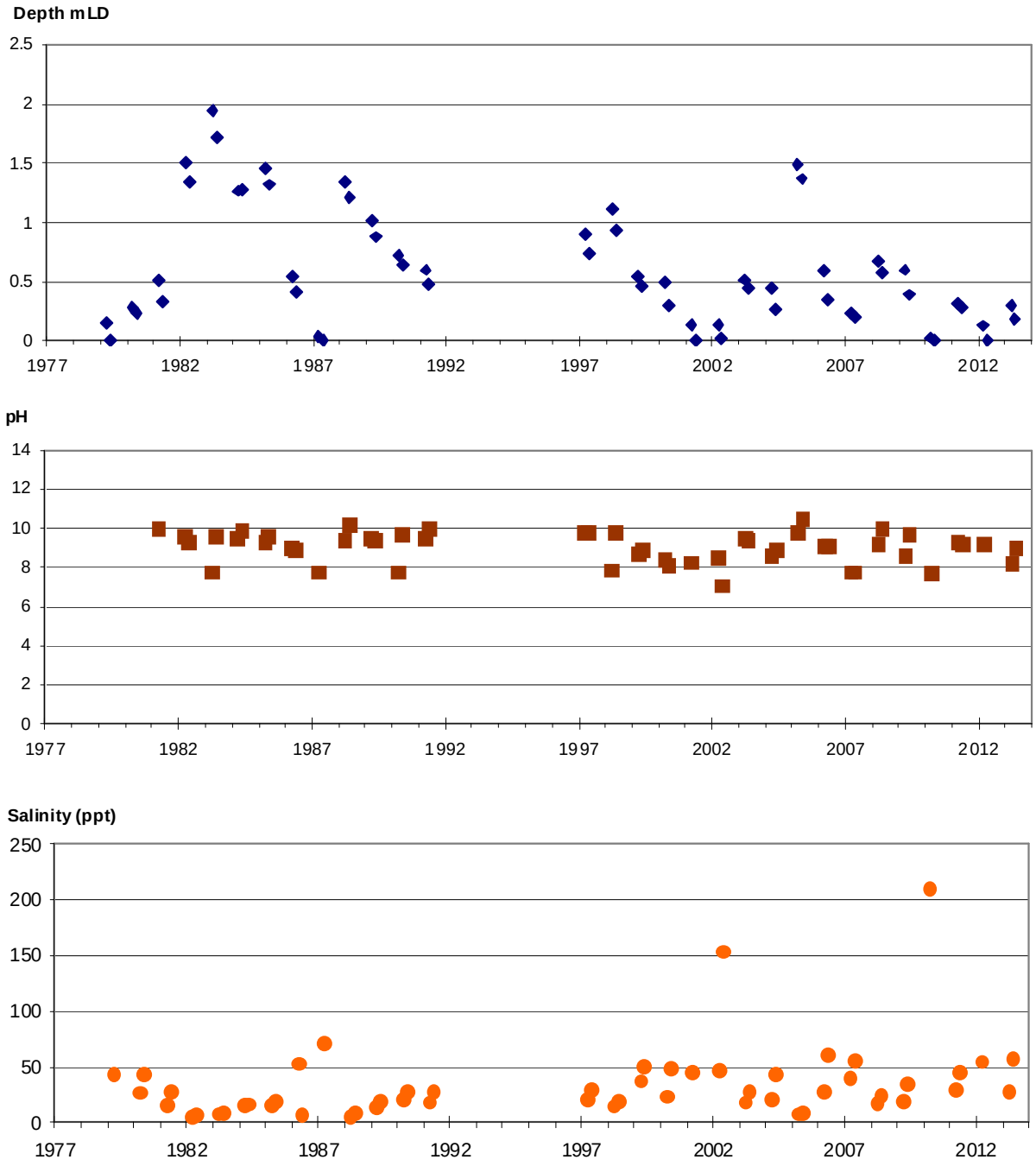


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Maringup Lake is listed in the 'Directory of Important Wetlands in Australia'.

Maringup is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

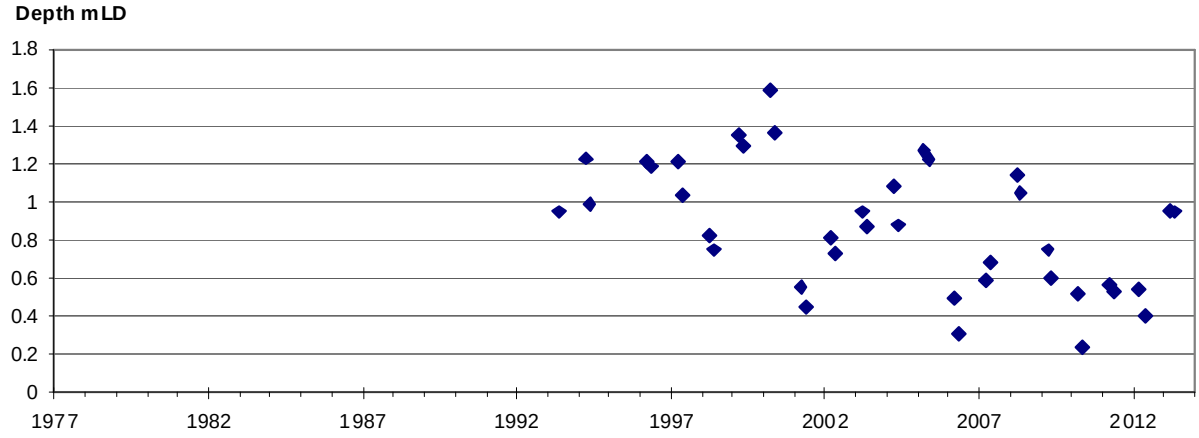
MARTINUP

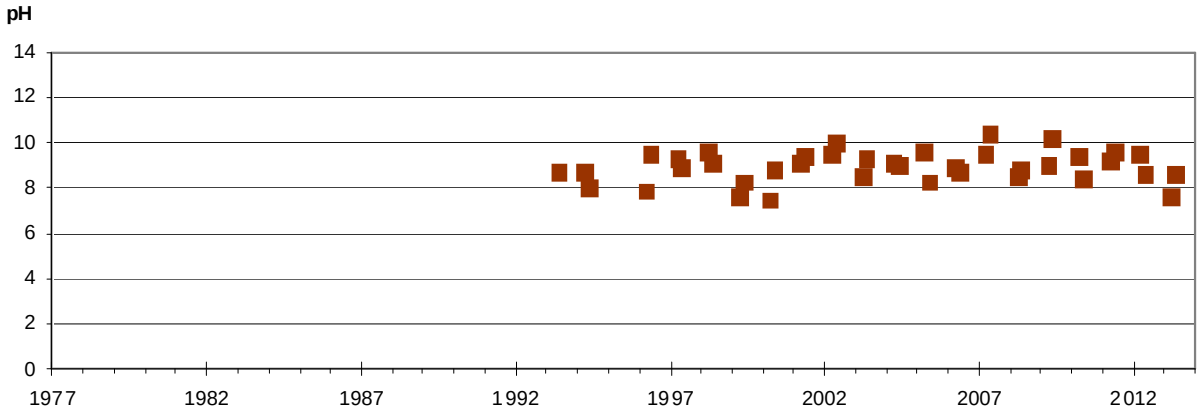


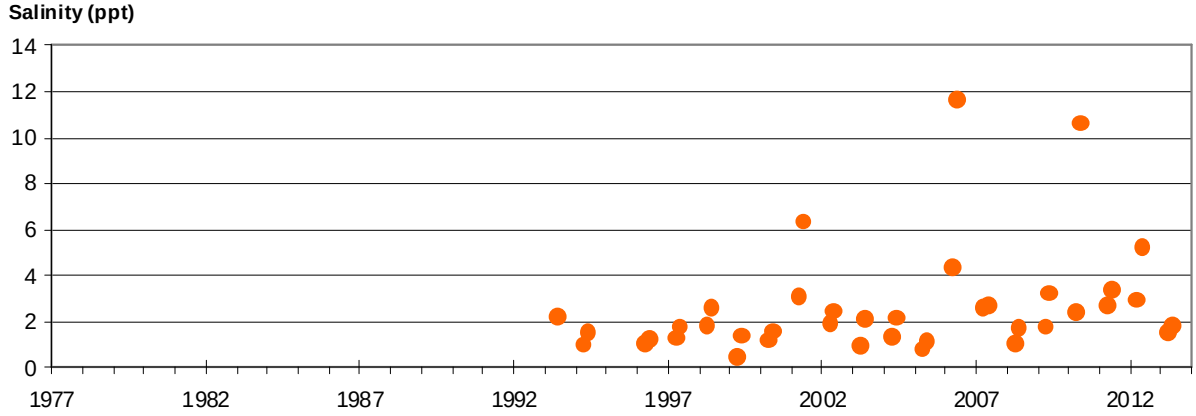
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Martinup is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

McLARTY





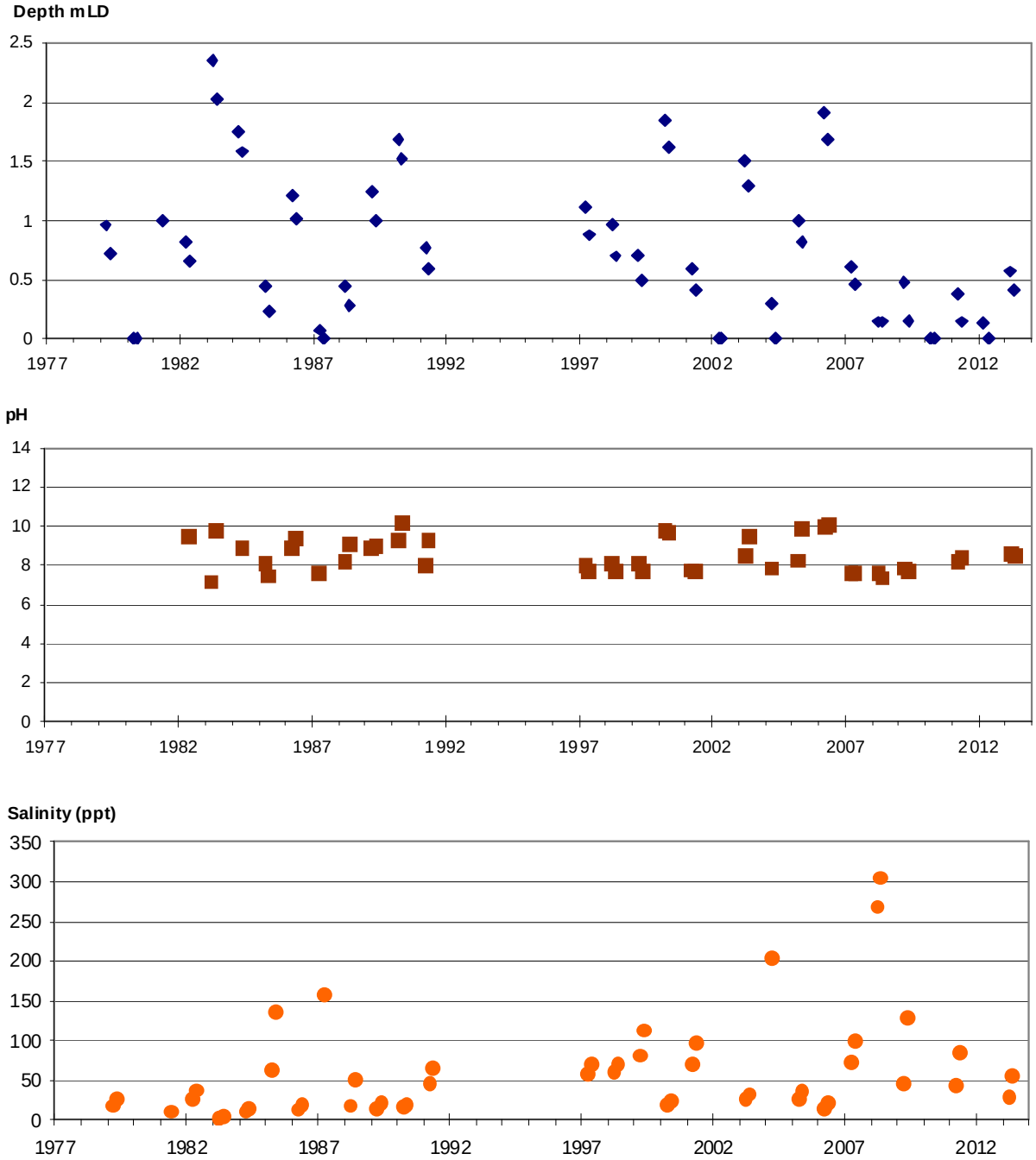


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

McLarty is a component of the 'Peel-Yalgorup System', which is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands, and is also a component of the 'Lake McLarty System' listed in the 'Directory of Important Wetlands in Australia'.

McLarty is in the Swan Coastal District (headquartered in Wanneroo) of the Swan DPaW Region.

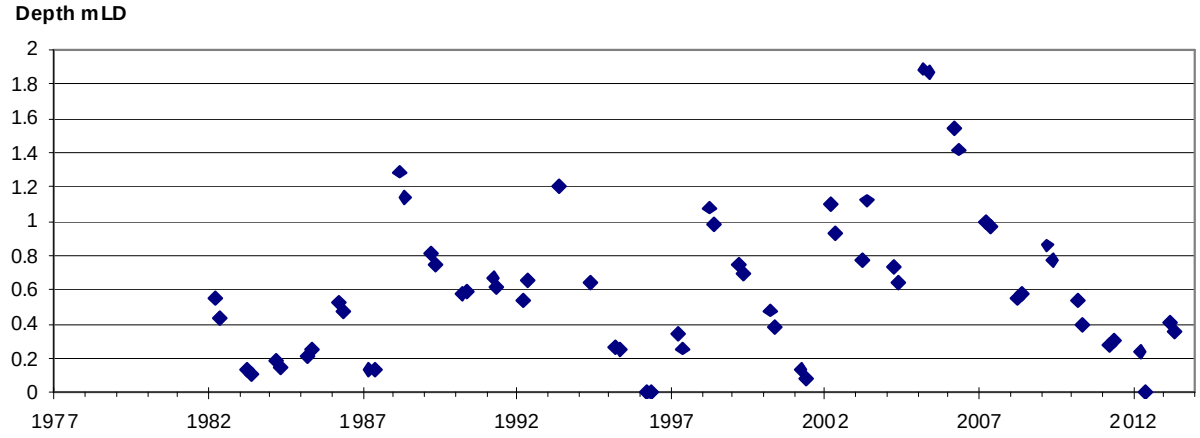
MEARS

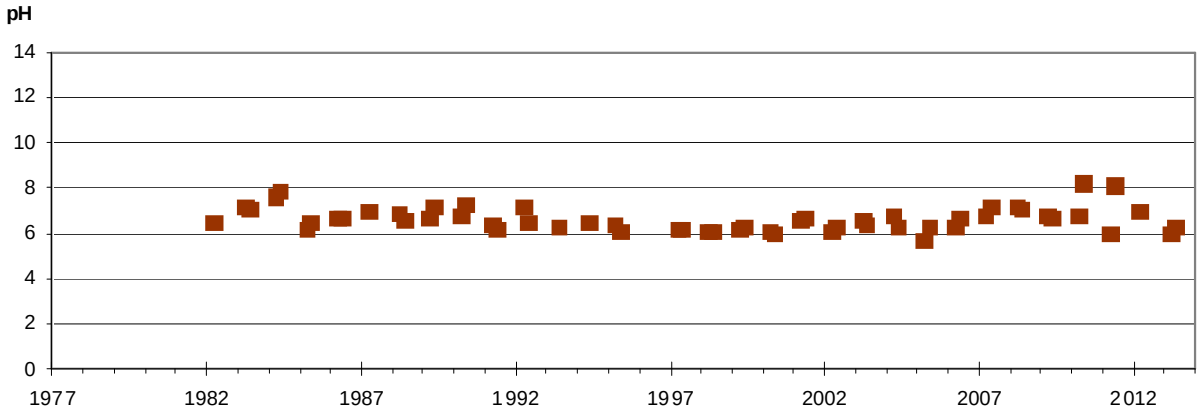


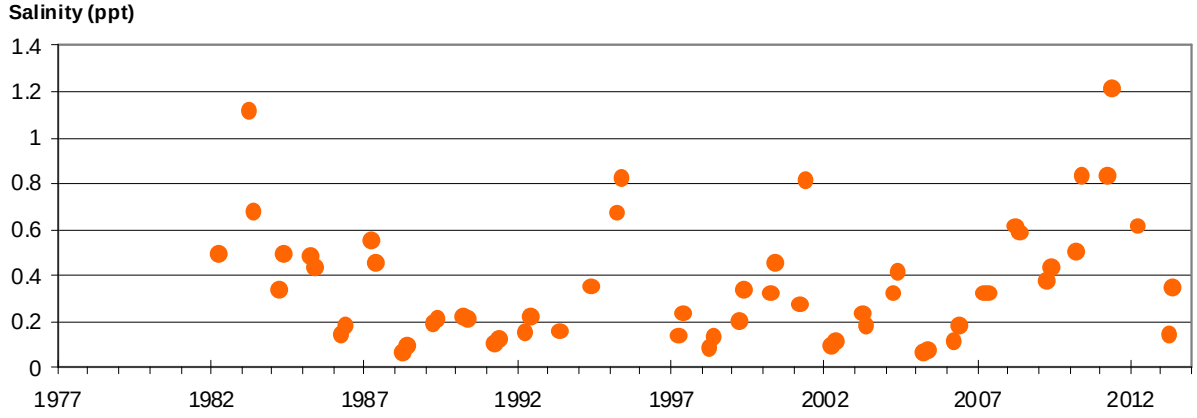
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Mears is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

METTLER



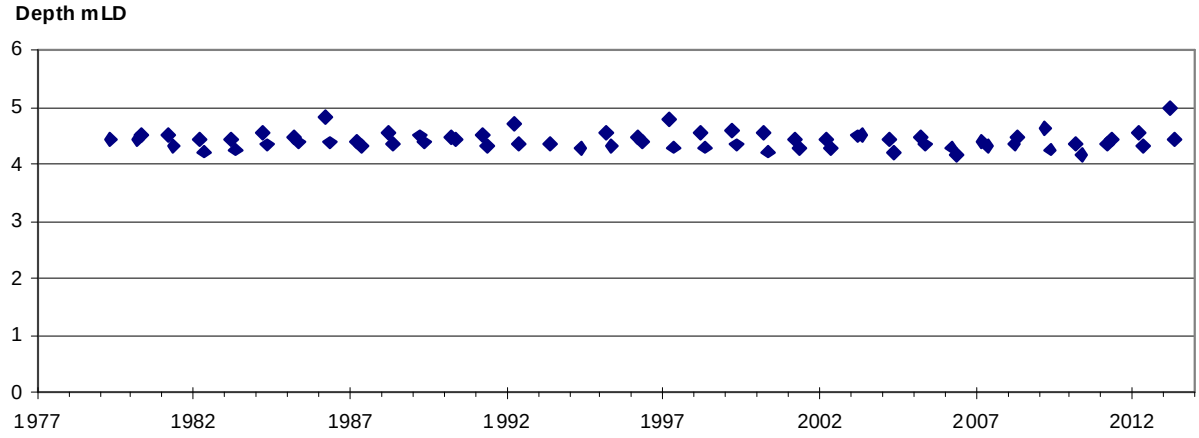


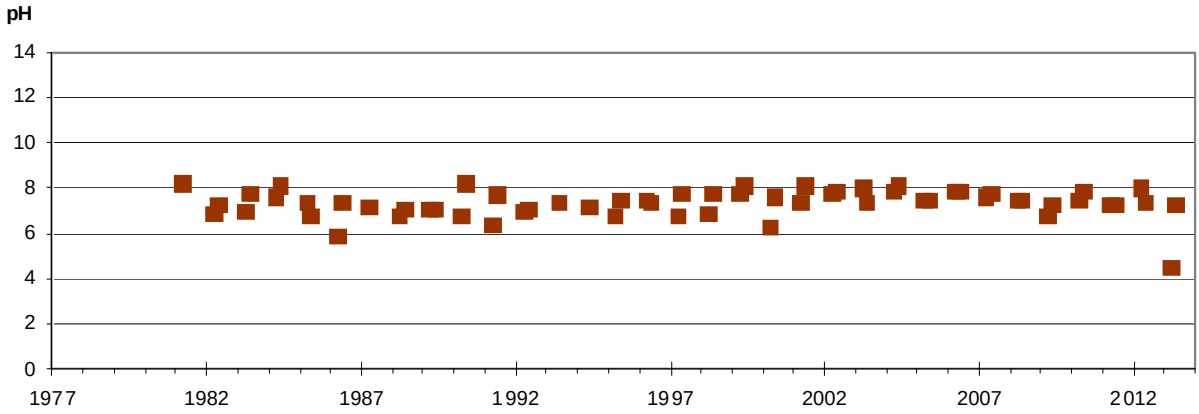


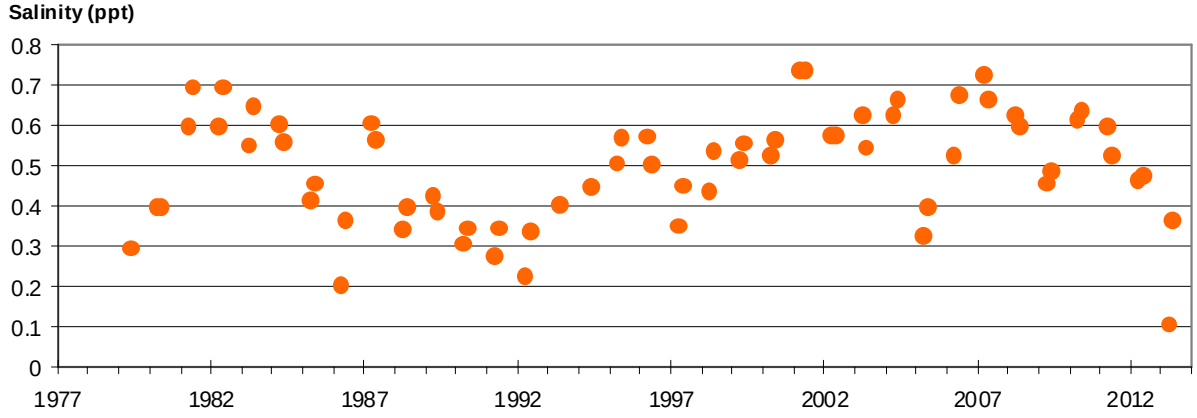
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Mettler is in the Albany District of the South Coast DPaW Region

MOATES (with Depth axis 0-6m)





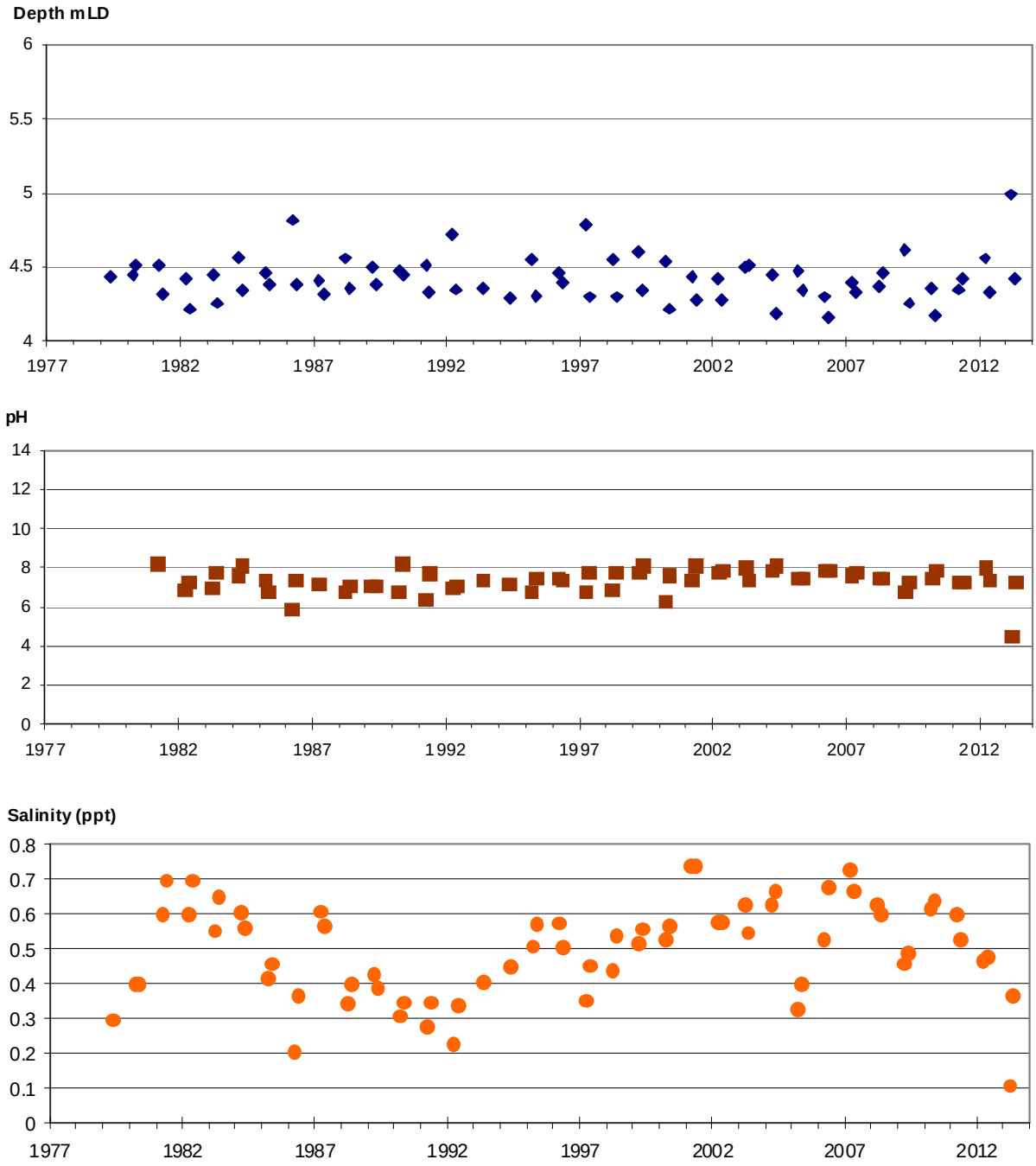


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Moates is a component of the 'Moates Lake System', which is listed in the 'Directory of Important Wetlands in Australia'.

Moates is in the Albany District of the South Coast DPaW Region

MOATES (with Depth axis 4-6m)



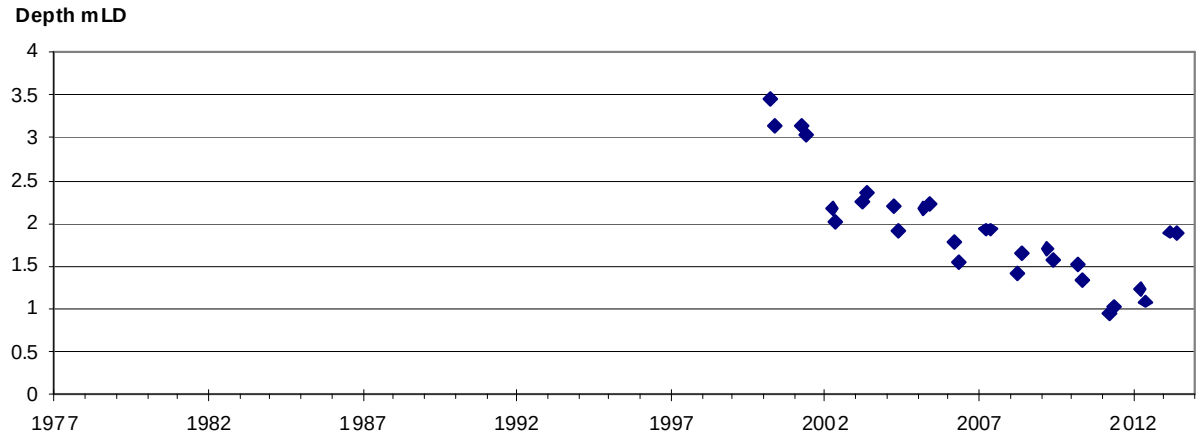
Notes:

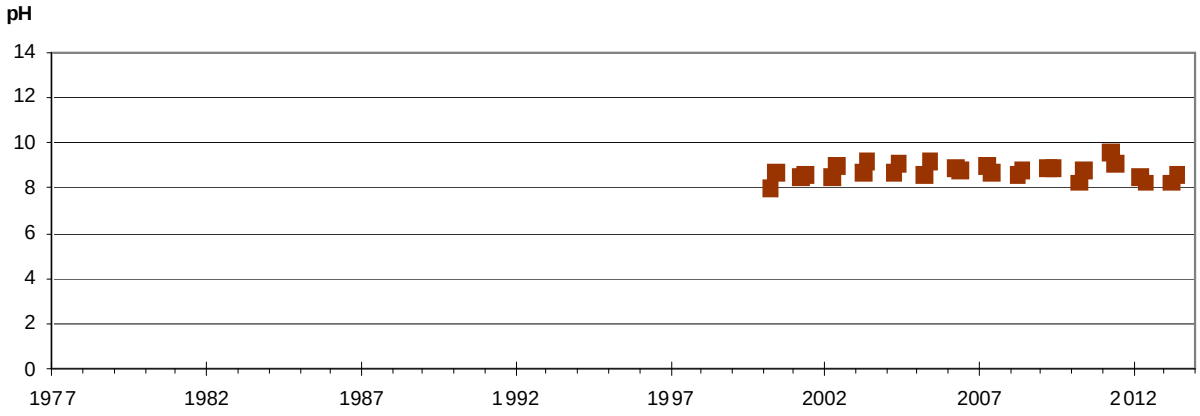
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

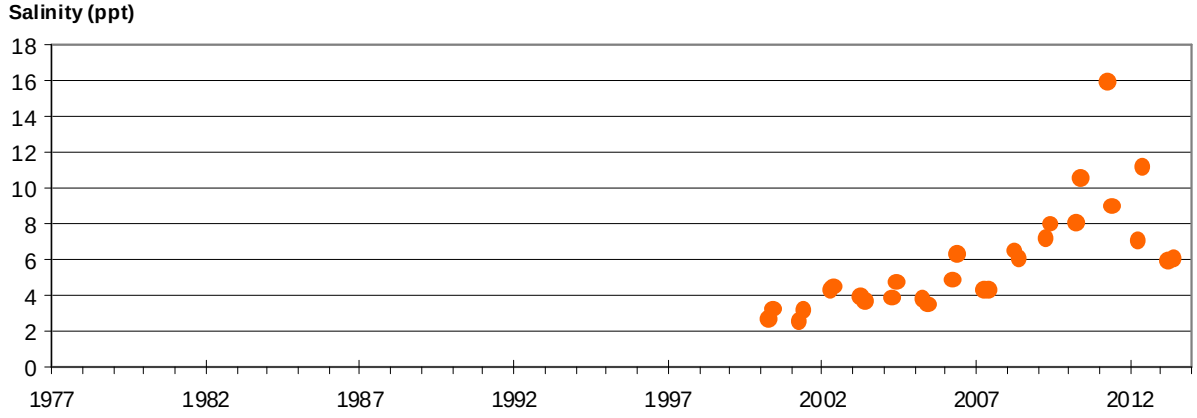
Moates is a component of the 'Moates Lake System', which is listed in the 'Directory of Important Wetlands in Australia'.

Moates is in the Albany District of the South Coast DPaW Region

MORTIJINUP





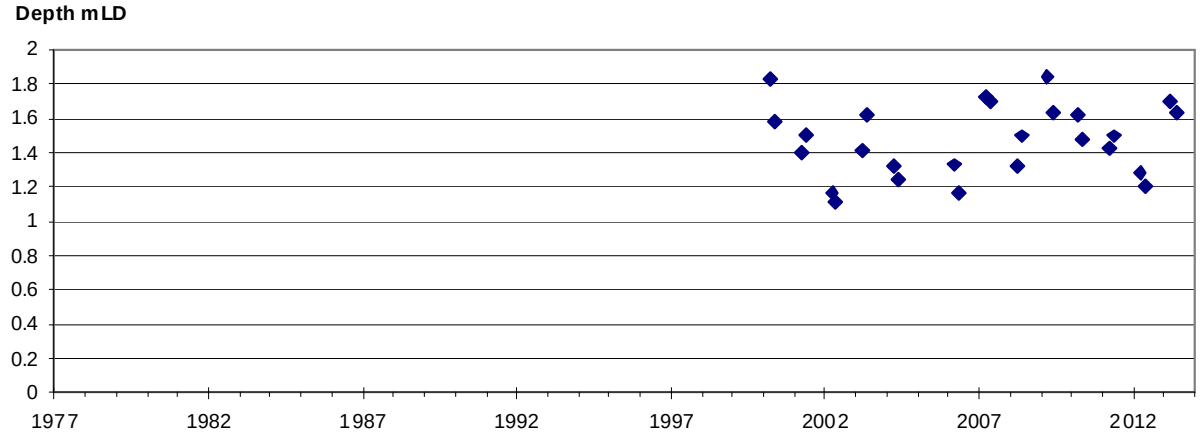


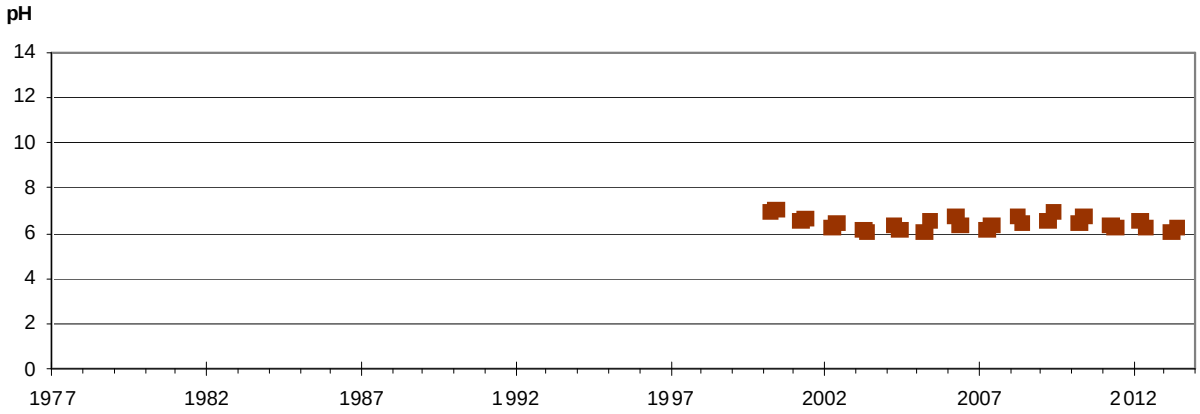
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

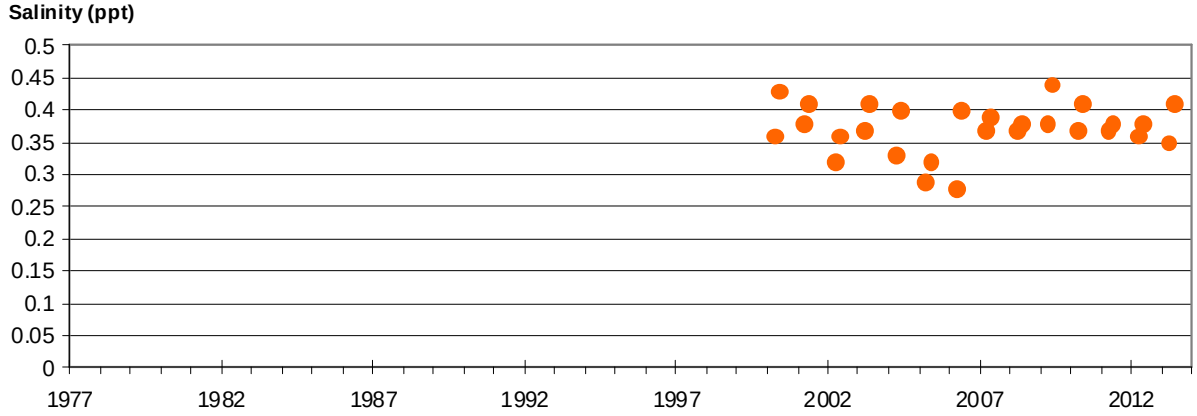
Mortijinup is a component of the 'Mortijinup Lake System', which is listed in the 'Directory of Important Wetlands in Australia'.

Mortijinup is in the Esperance District of the South Coast DPaW Region.

MOUNT LE GRAND



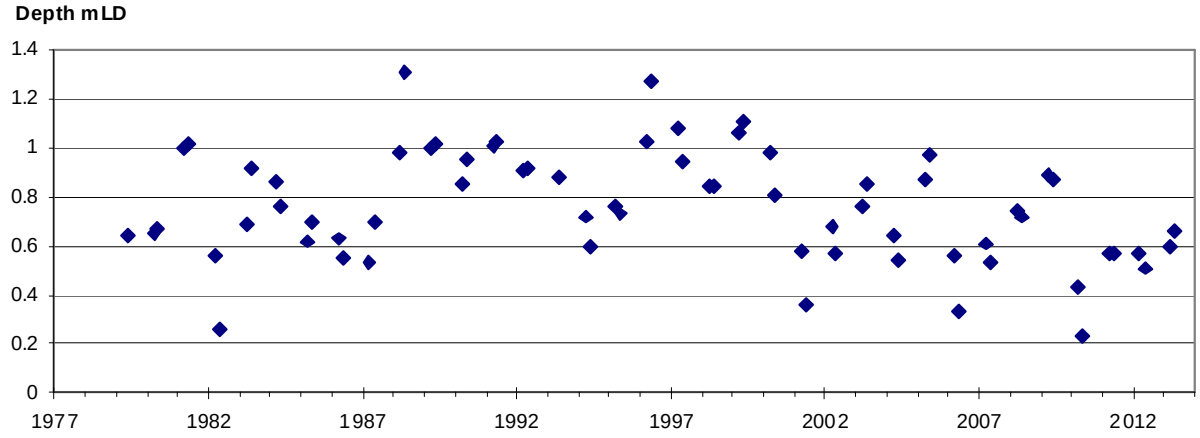


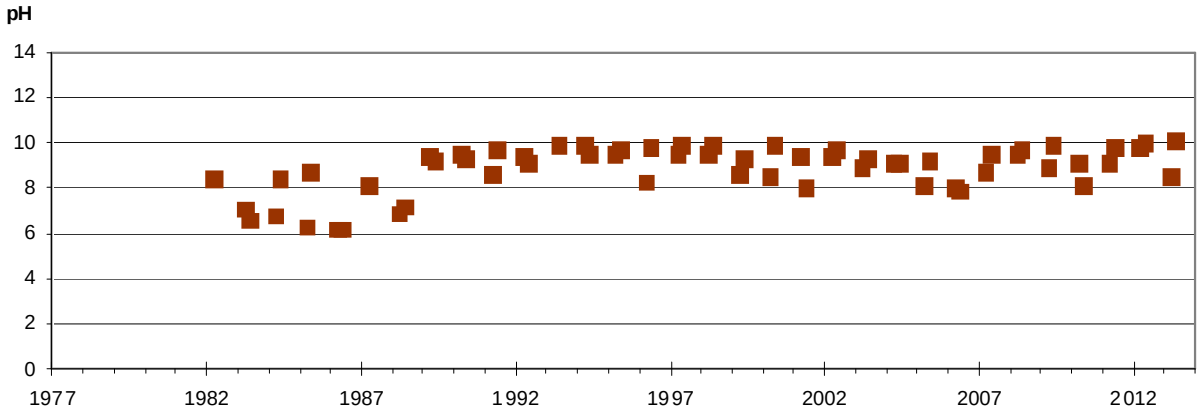


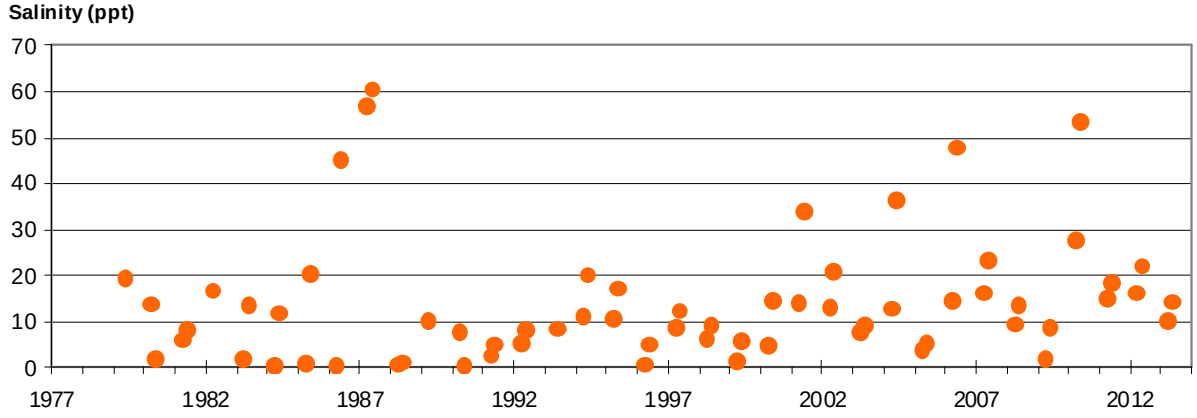
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Mount Le Grand is in the Esperance District of the South Coast DPaW Region.

MUIR







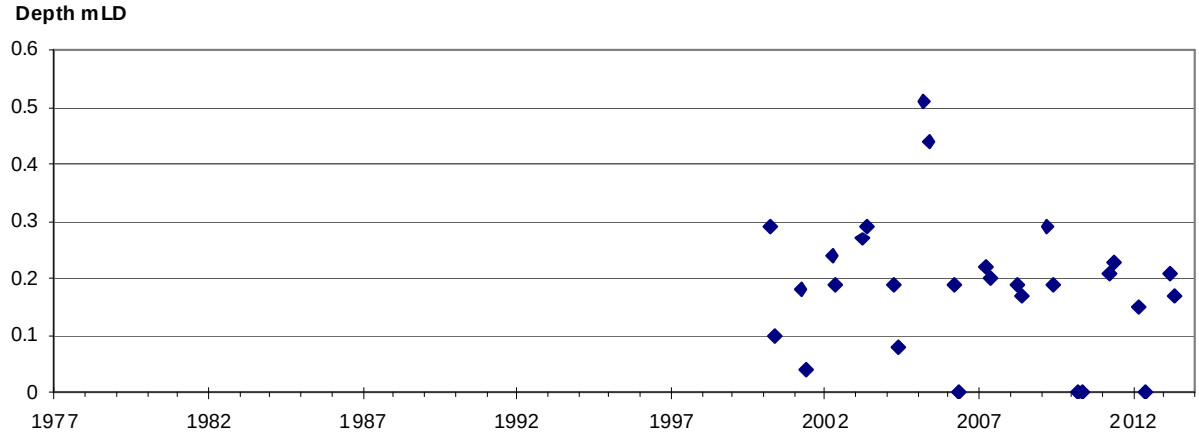
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

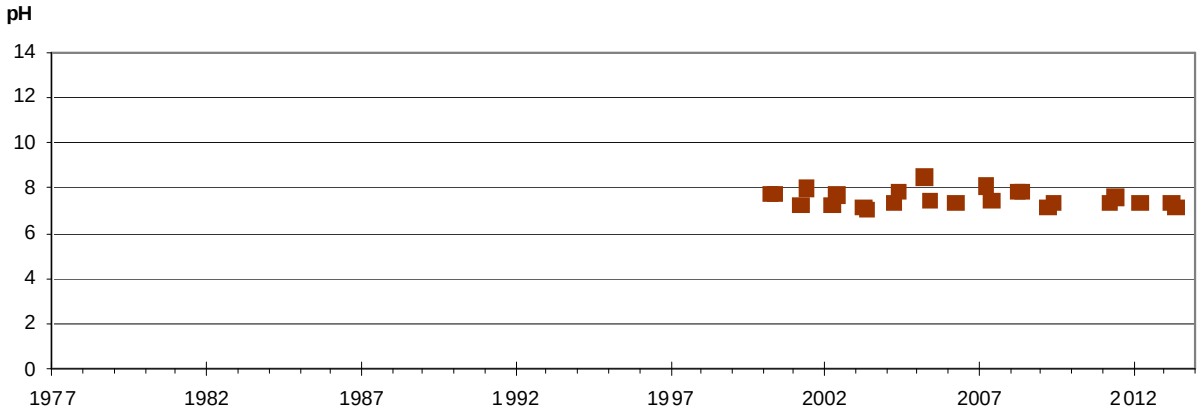
Lake Muir is a component of the 'Muir-Byenup System', which is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands.

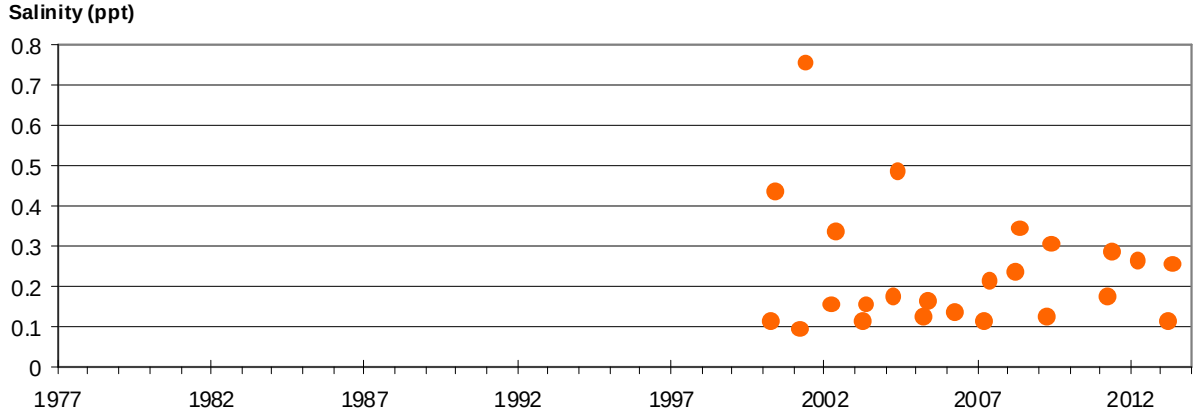
Lake Muir is also listed in the 'Directory of Important Wetlands in Australia'.

Muir is within the former Muir-Unicup Natural Diversity Recovery Catchment and is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

NGOPITCHUP



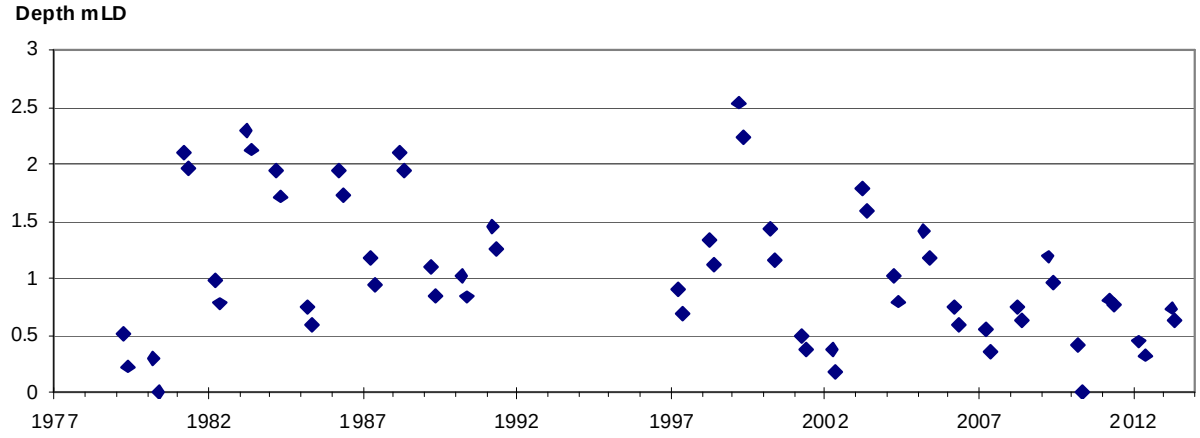


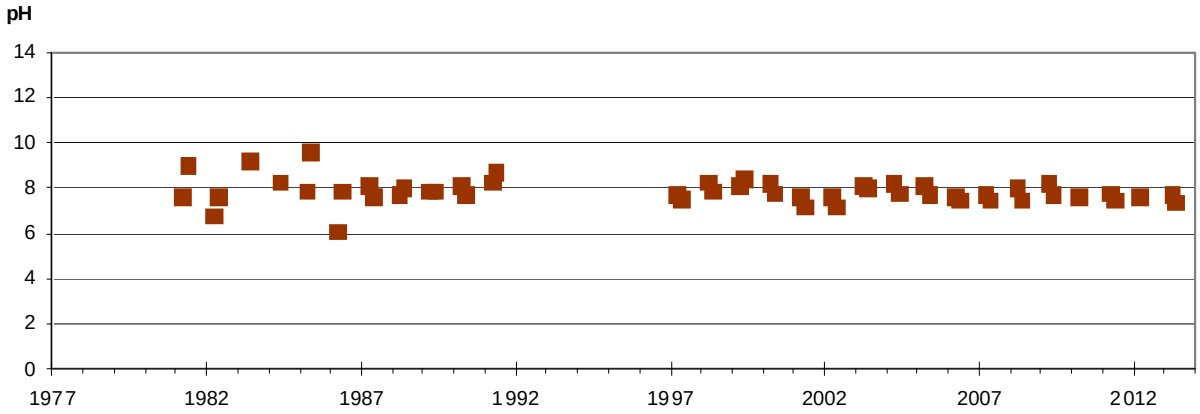


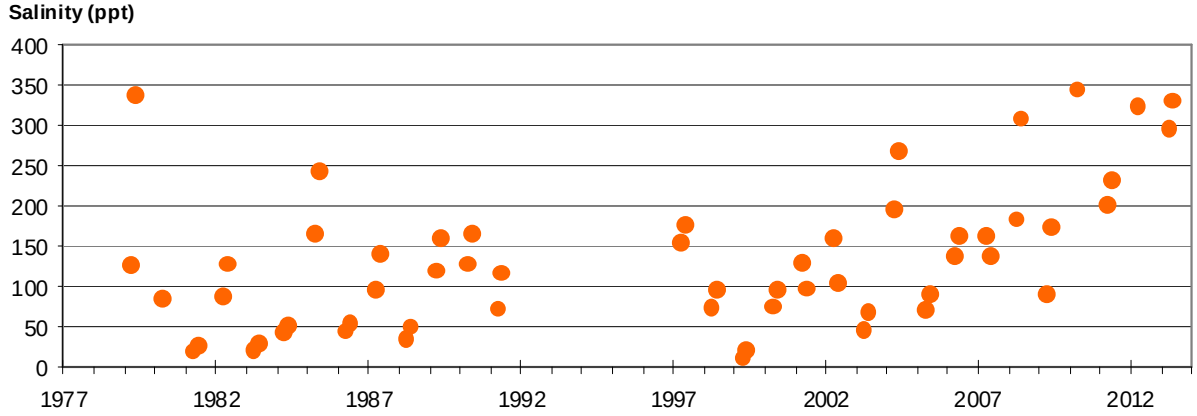
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Ngopitchup is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

NINAN



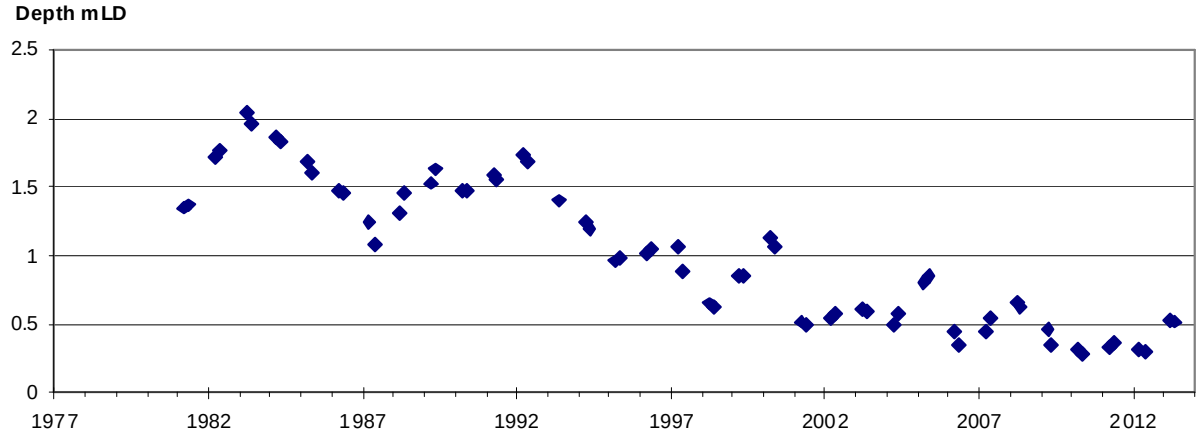


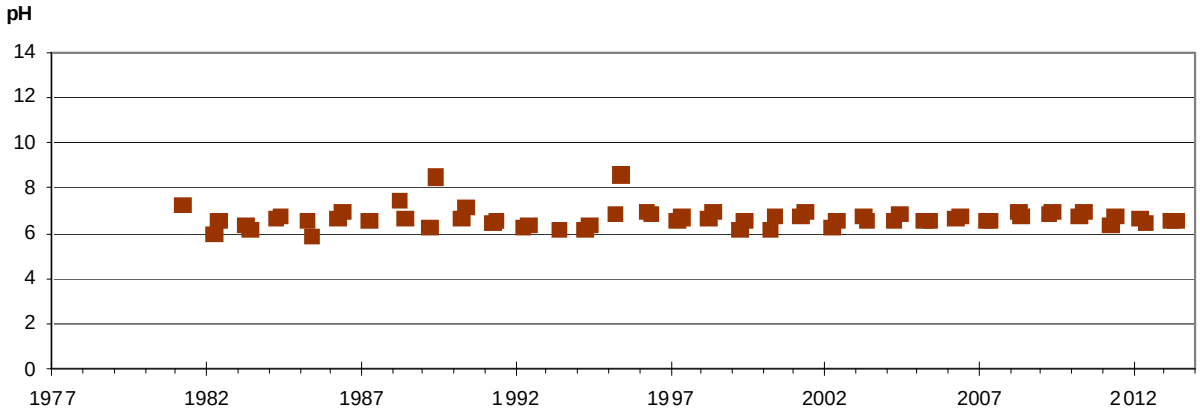


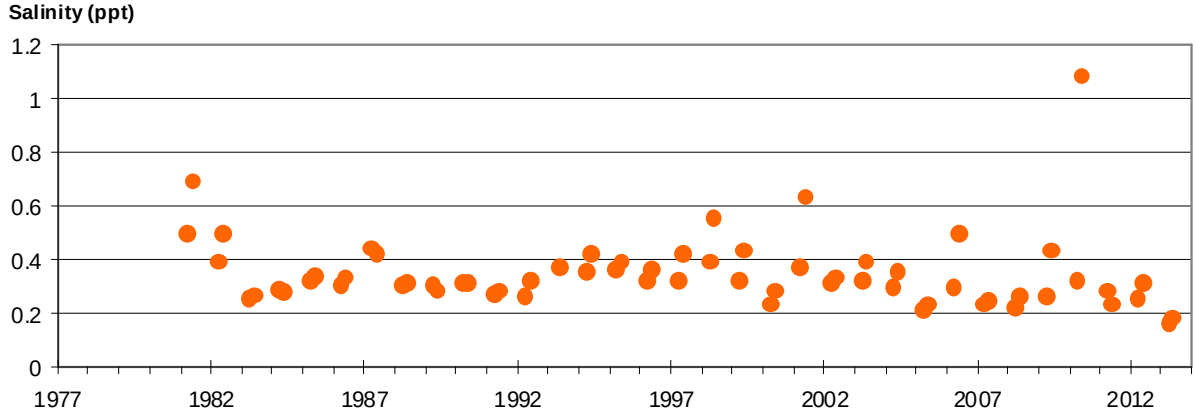
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Ninan is in the Central District (headquartered in Merredin) of the Wheatbelt DPaW Region.

NINE MILE



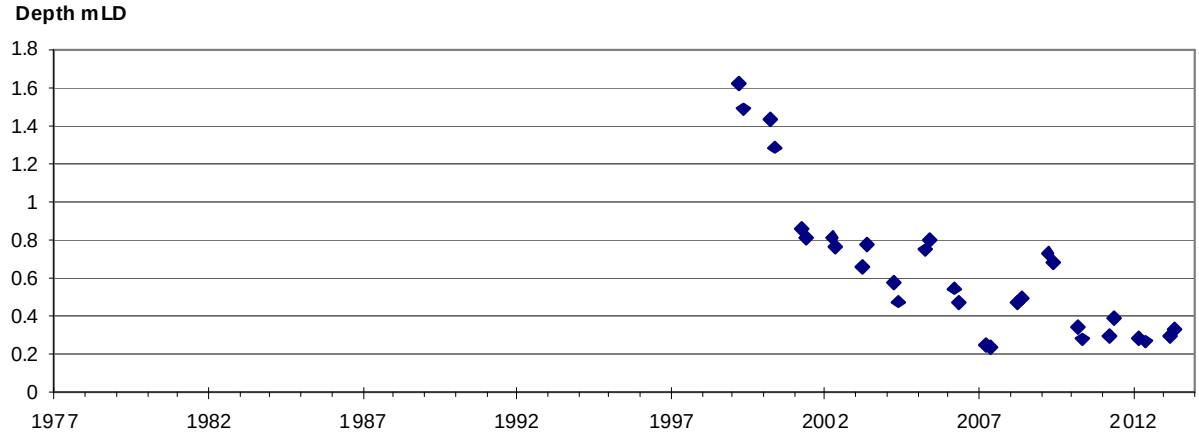


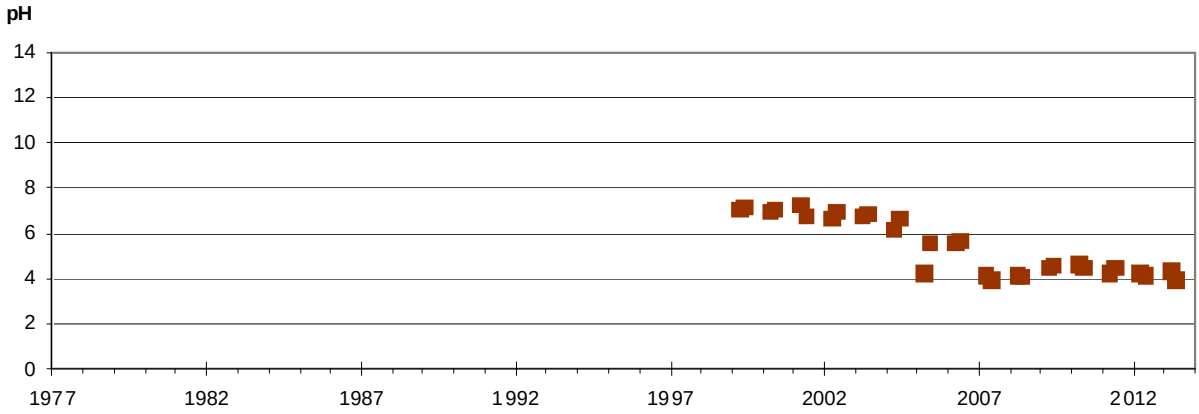


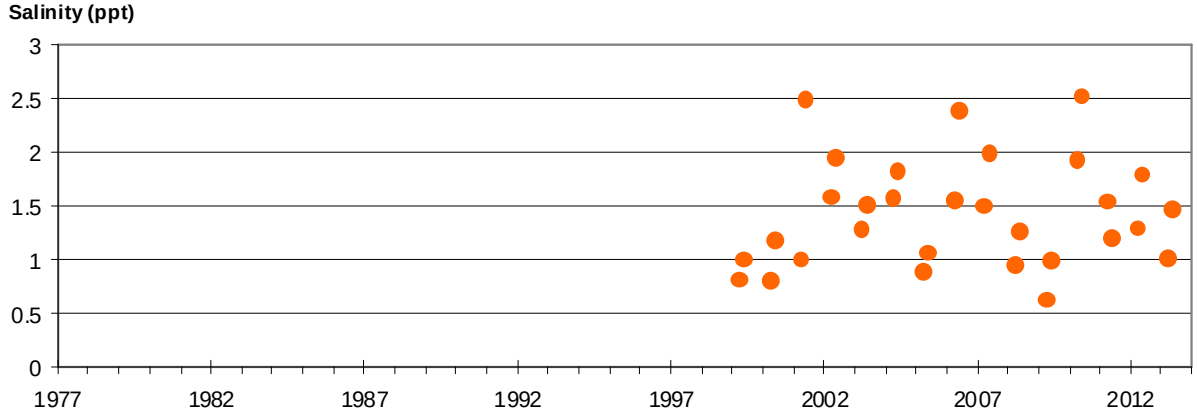
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Nine Mile is in the Swan Coastal District (headquartered in Wanneroo) of the Swan DPaW Region.

NOOBIJUP [IM]





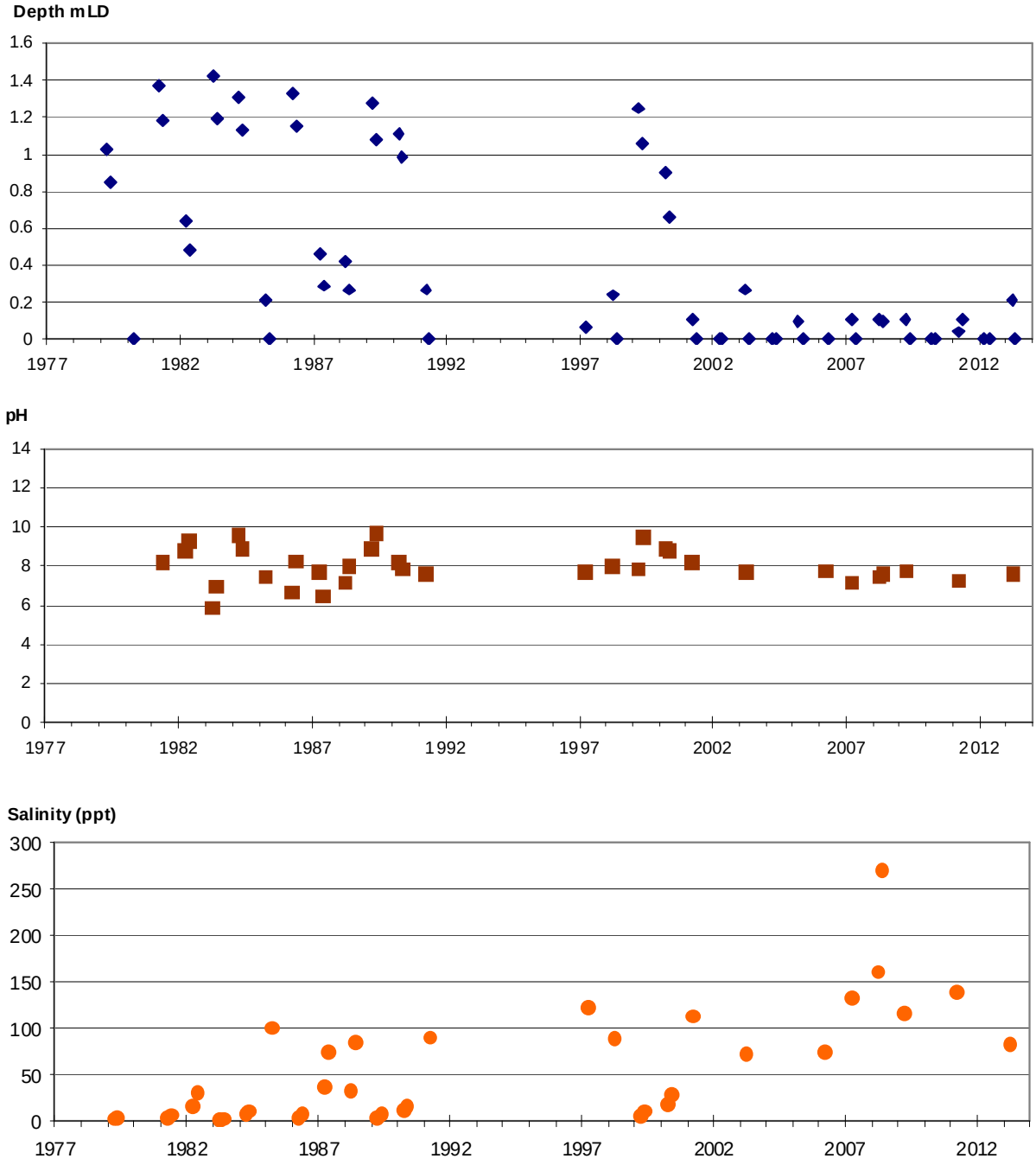


Notes:
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Noobijup is a component of the 'Byenup Lagoon System', which is listed in the 'Directory of Important Wetlands in Australia'.

Noobijup is within the former Muir-Unicup Natural Diversity Recovery Catchment and is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

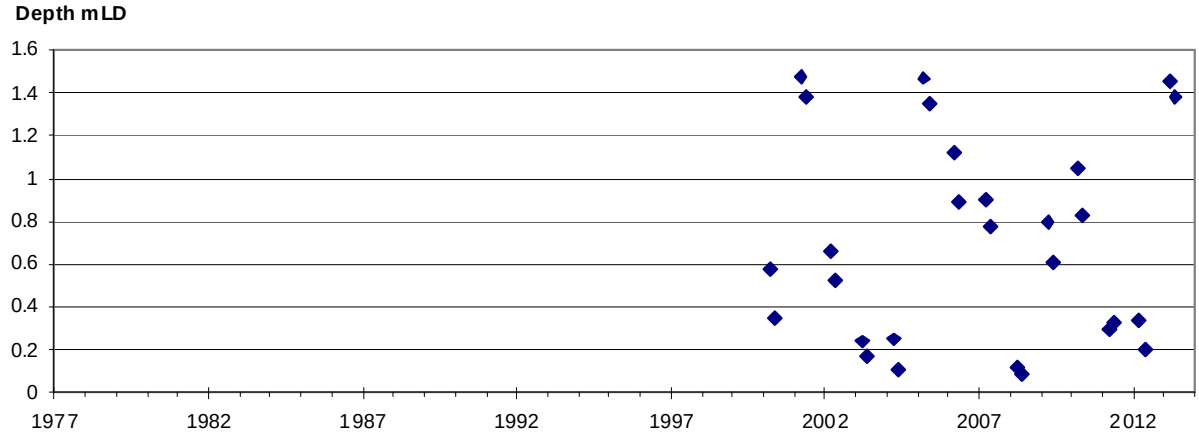
NOONYING

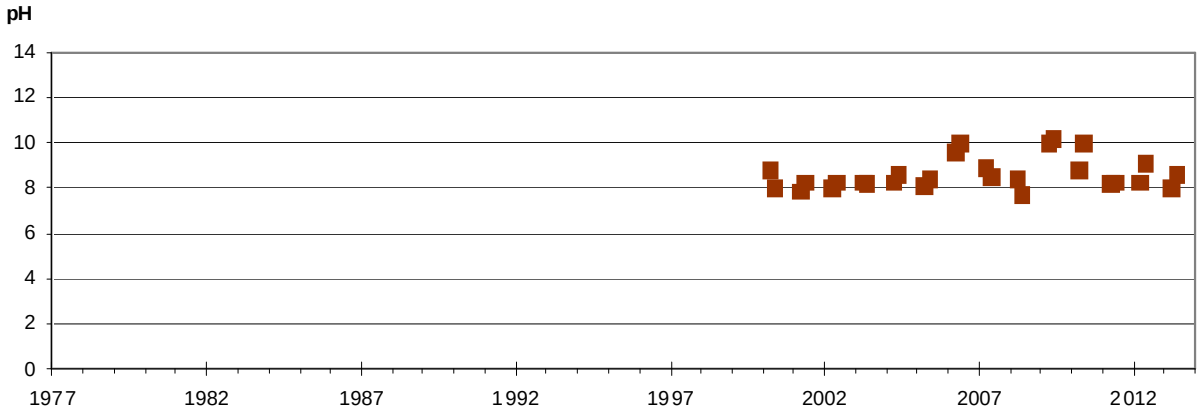


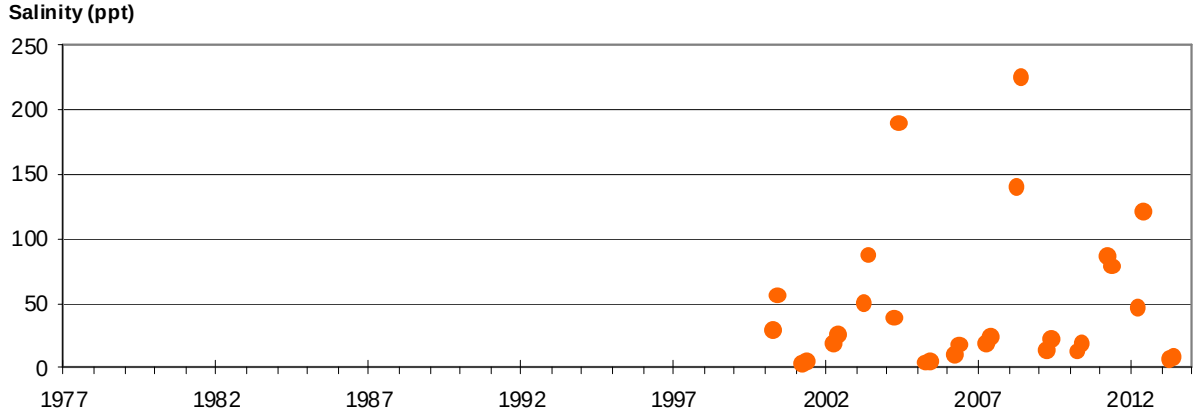
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Noonying is in the Central District (headquartered in Merredin) of the Wheatbelt DPaW Region.

NORTH PARRIUP



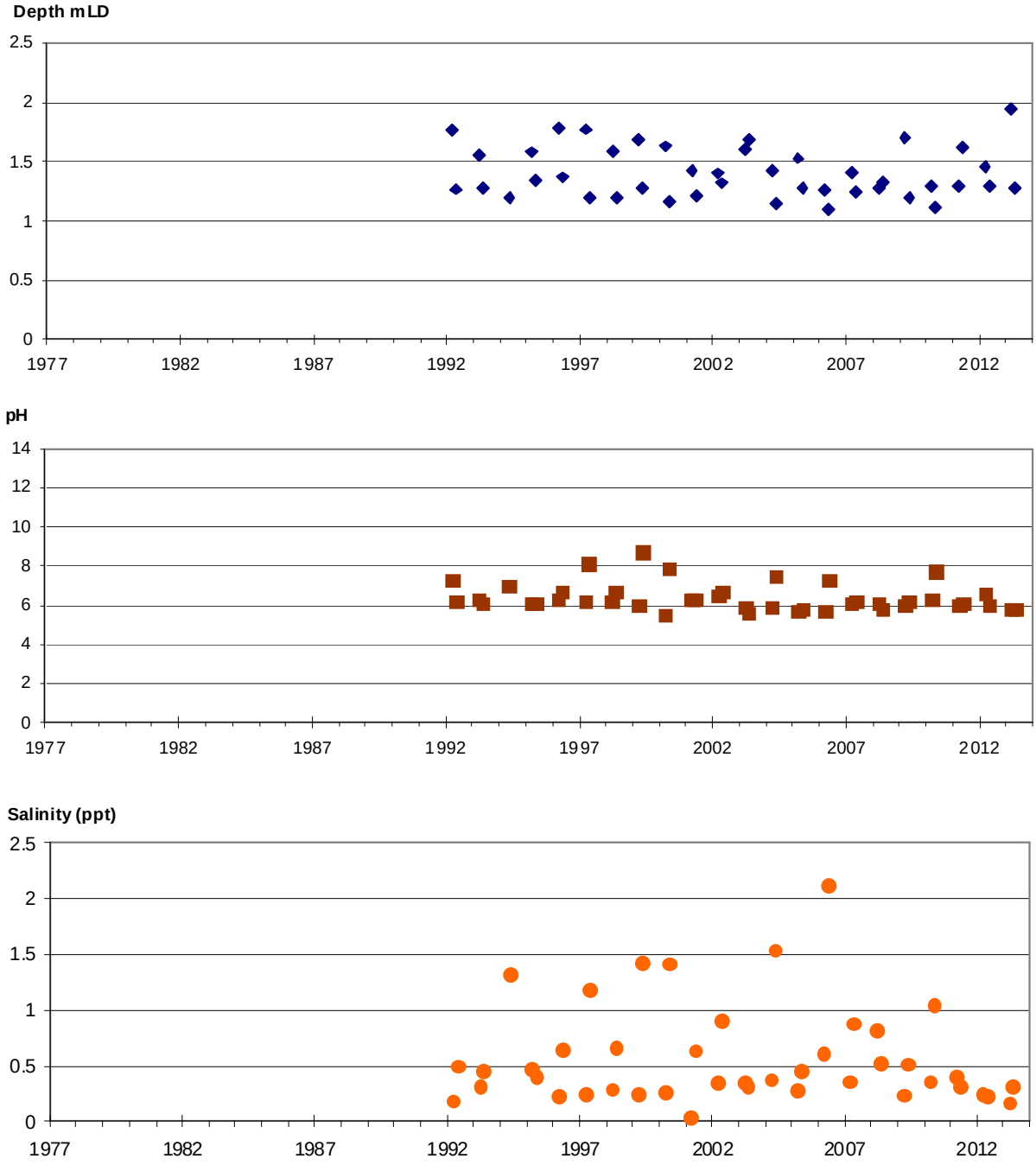




Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

North Parriup is in the Esperance District of the South Coast DPaW Region.

OWINGUP

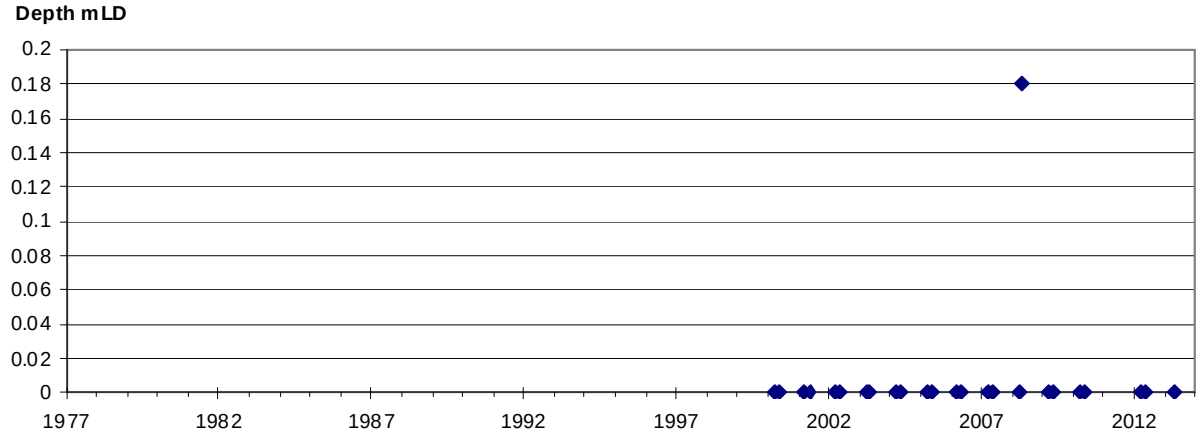


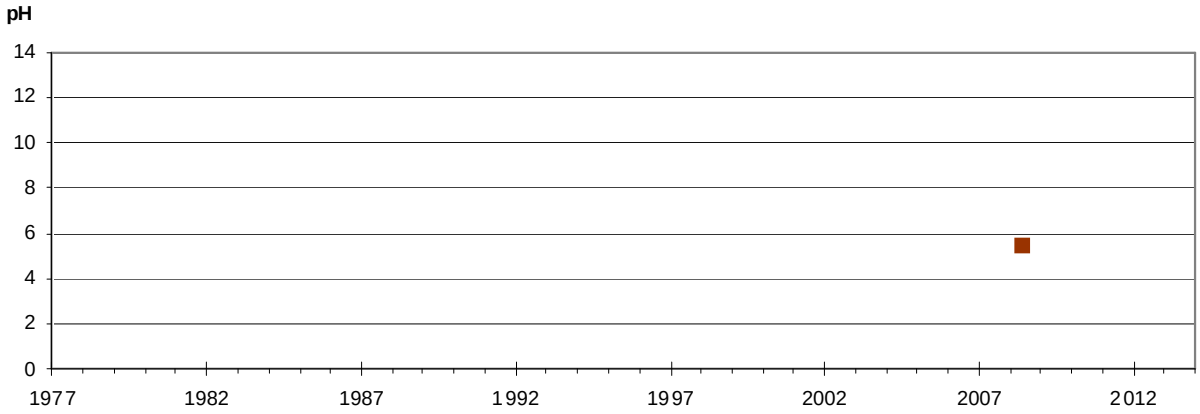
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

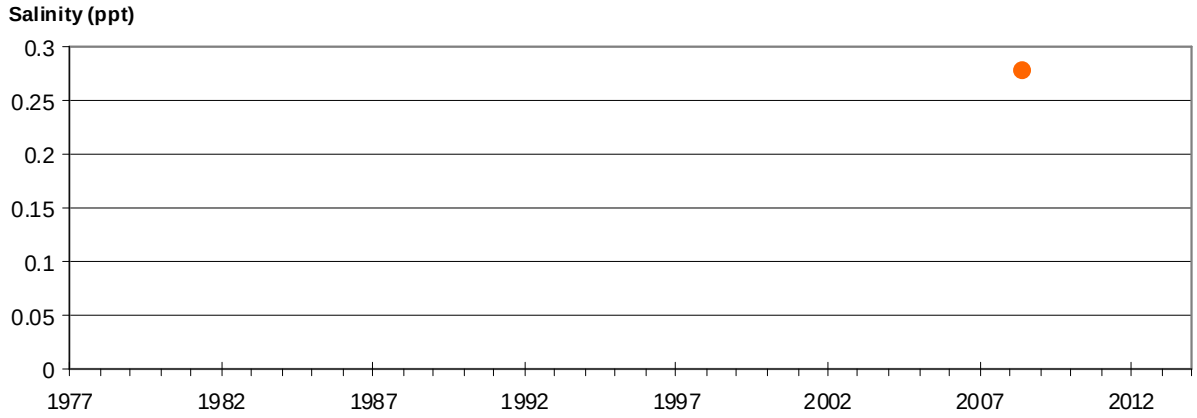
Owingup is a component of the 'Owingup Swamp System', which is listed in the 'Directory of Important Wetlands in Australia'.

Owingup is in the Frankland District (headquartered in Walpole) of the Warren DPaW Region.

PABELUP SOUTH



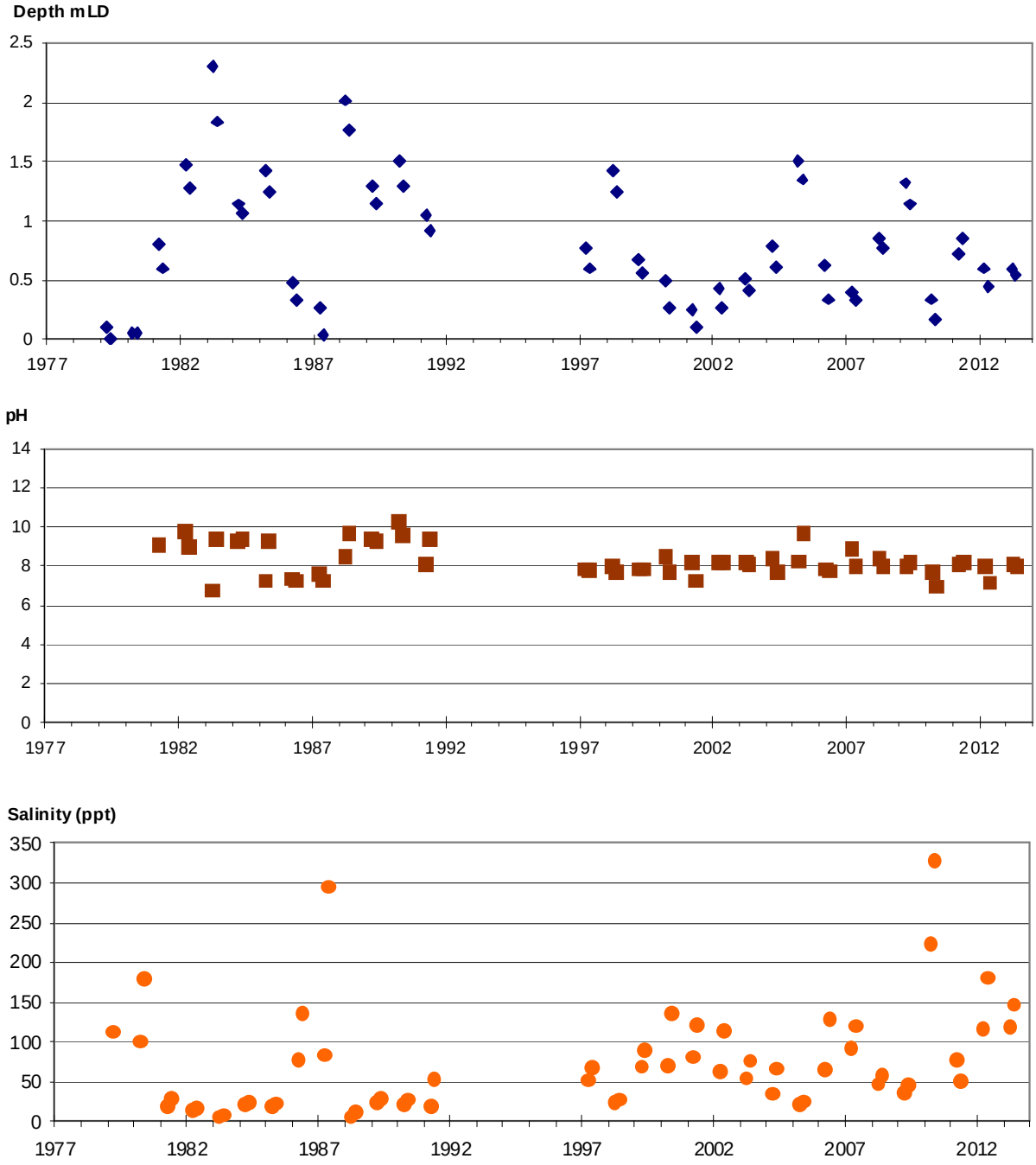




Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Pabelup South is in the Albany District of the South Coast DPaW Region

PARKEYERRING [IM]

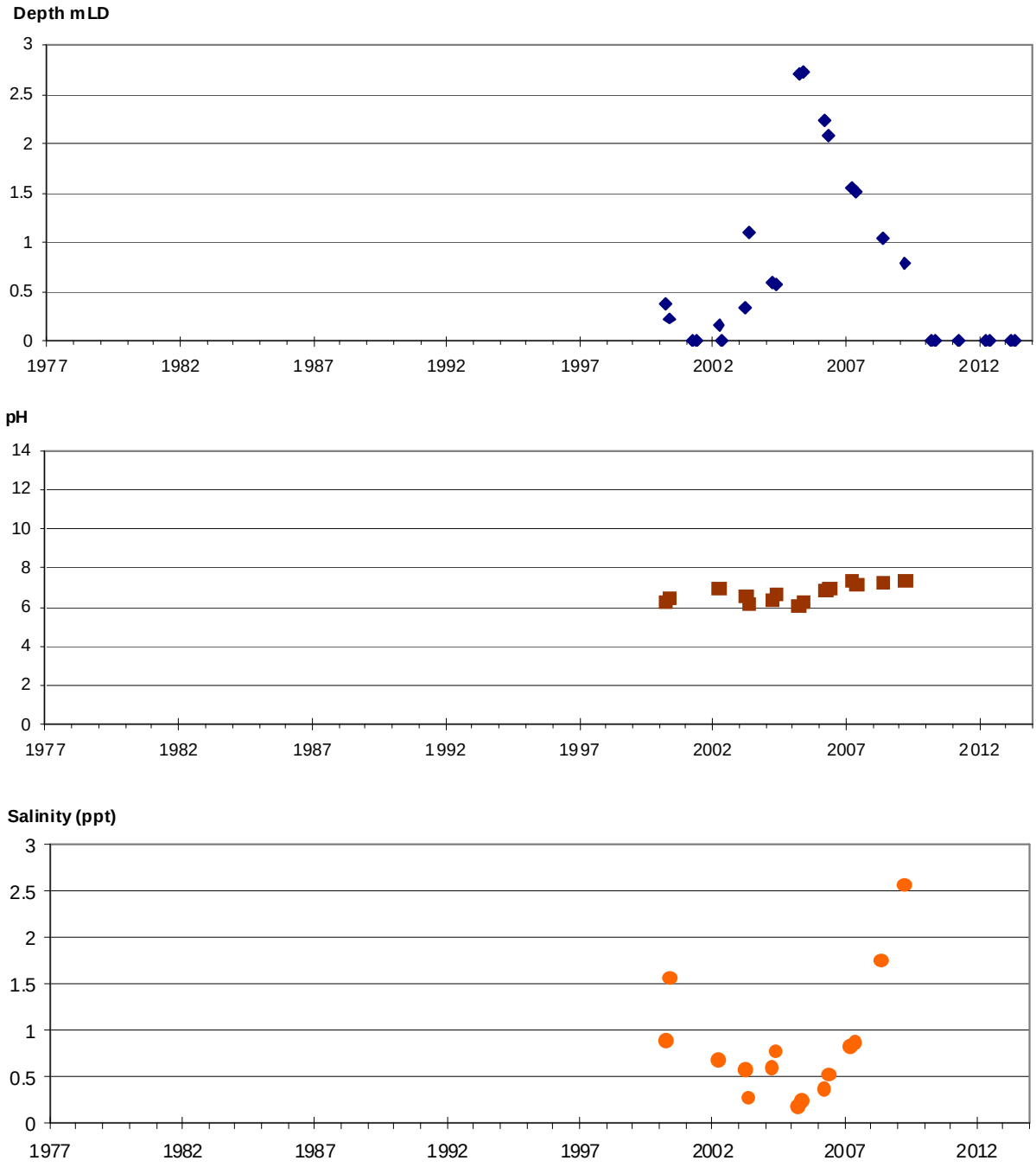


Notes:

1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Parkeyerring is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

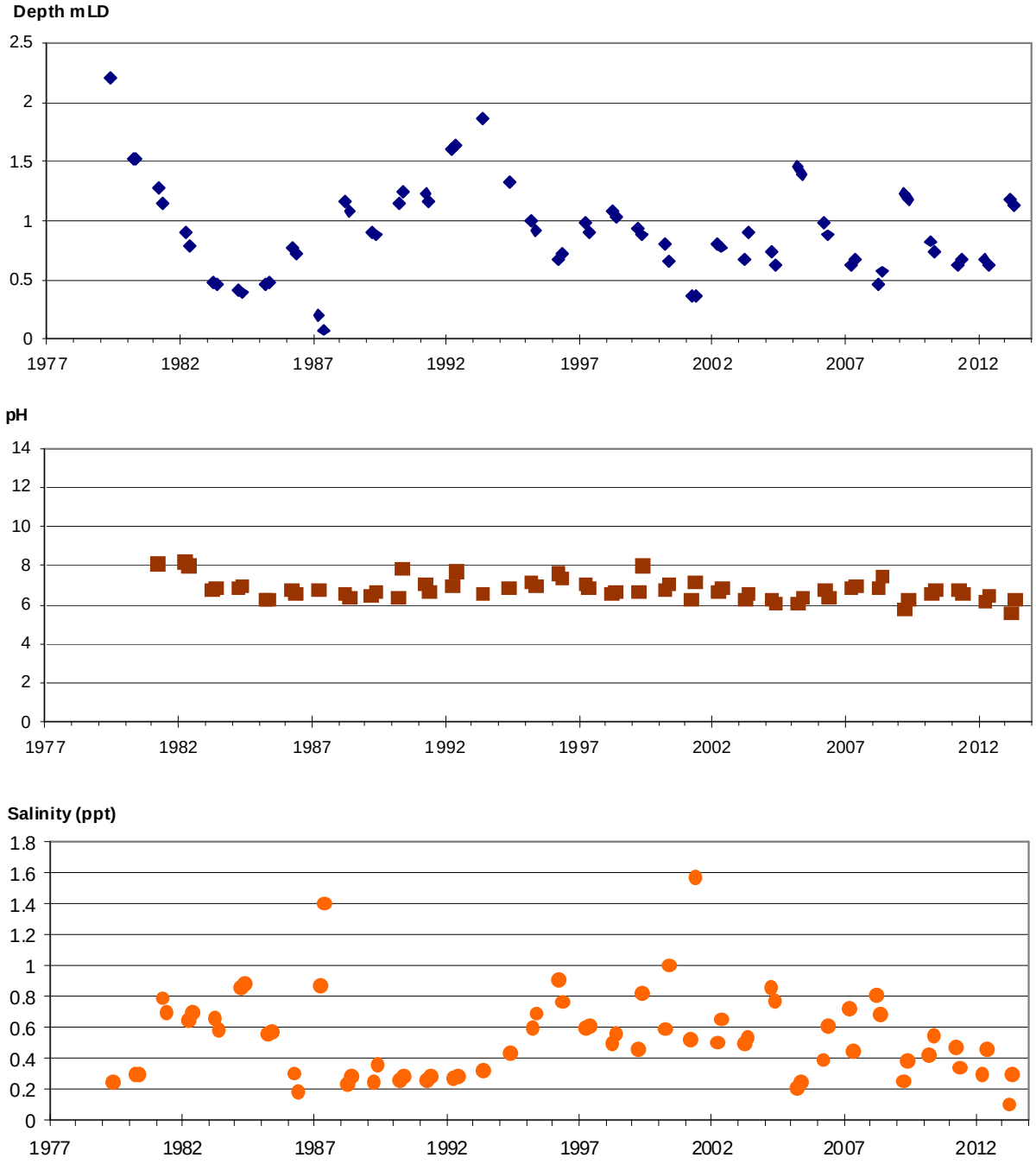
PILLENORUP



Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Pillenorup is in the Albany District of the South Coast DPaW Region

PLEASANT VIEW [IM]

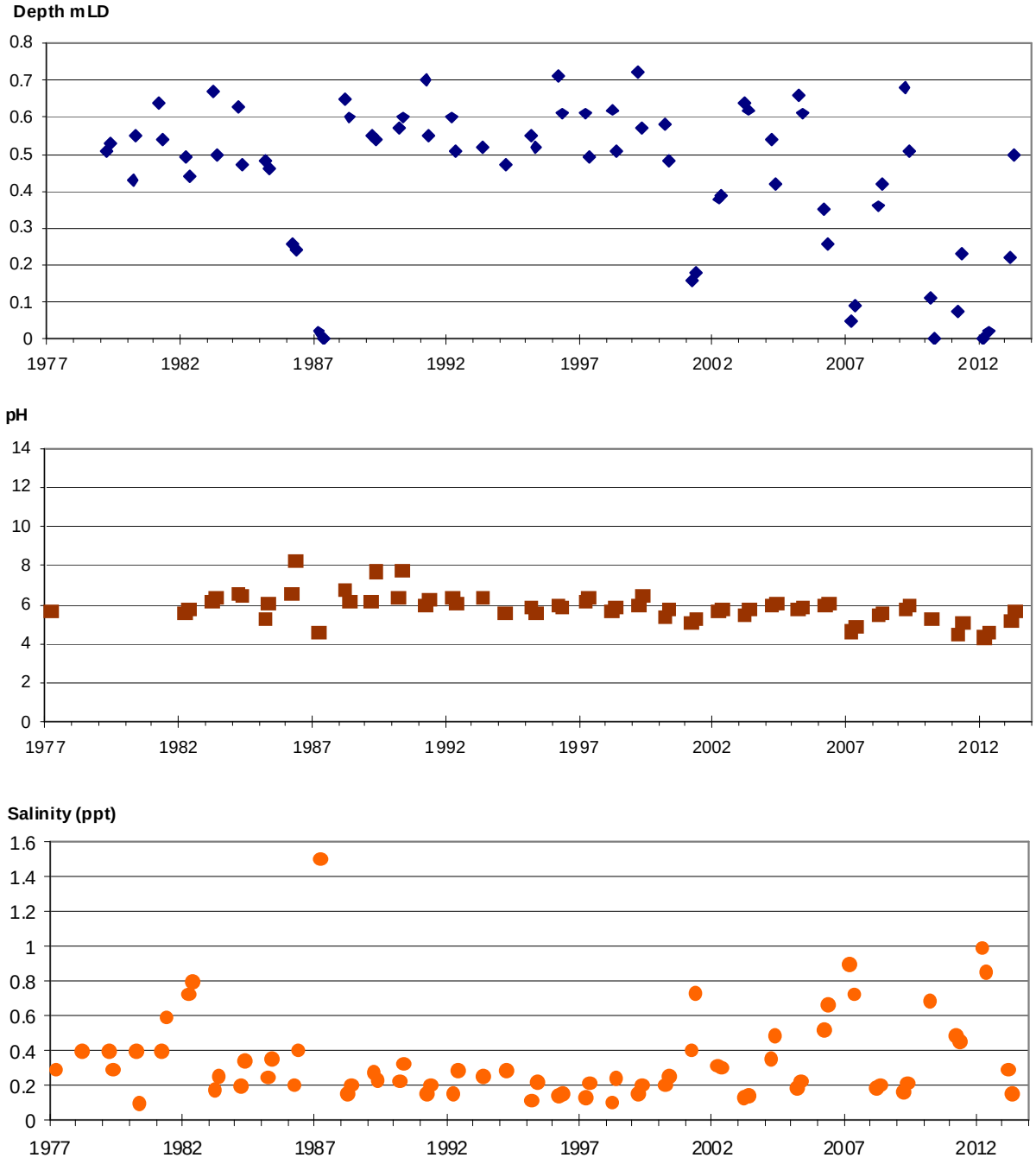


Notes:
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Pleasant View is a component of the 'Lake Pleasant View System', which is listed in the 'Directory of Important Wetlands in Australia'.

Pleasant View is in the Albany District of the South Coast DPaW Region

POORGINUP

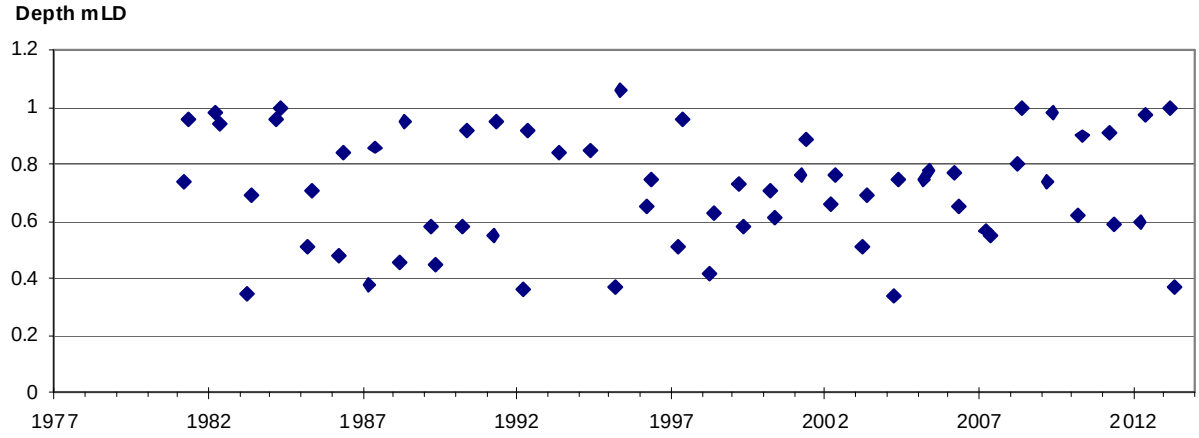


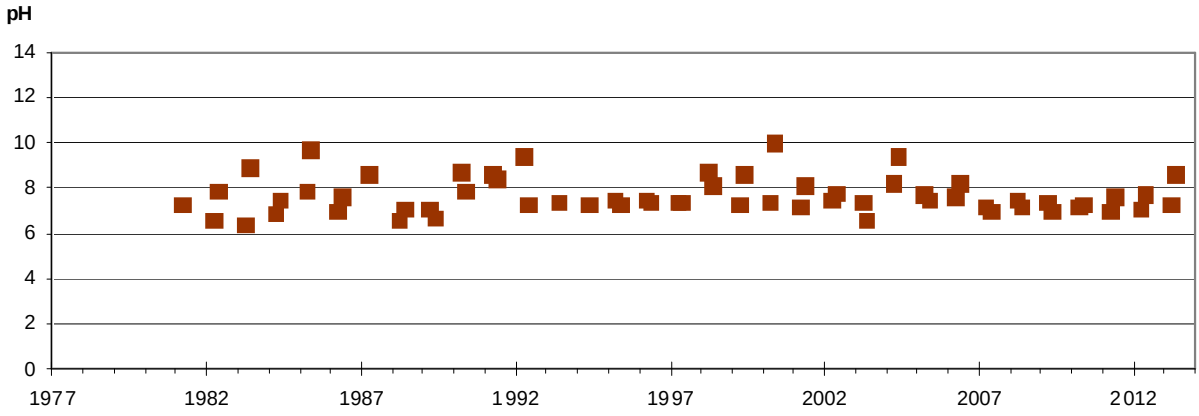
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

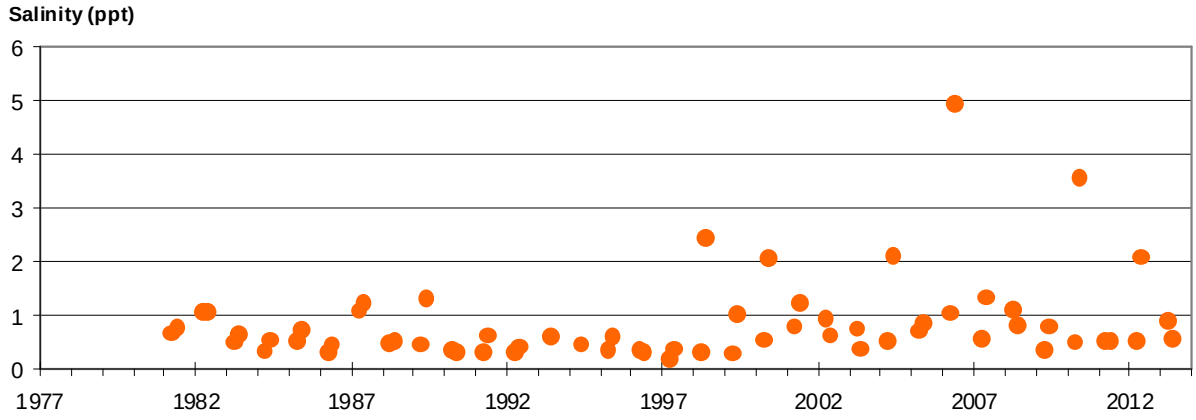
Poorginup is a component of the 'Muir-Byenup System', which is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands, and is also a component of the 'Byenup Lagoon System', which is listed in the 'Directory of Important Wetlands in Australia'.

Poorginup is within the former Muir-Unicup Natural Diversity Recovery Catchment and is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

POWELL



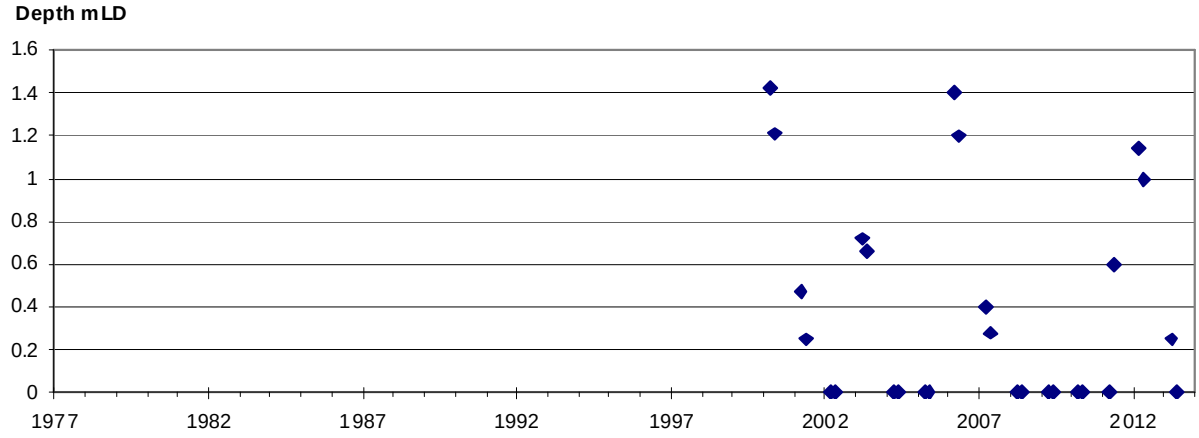


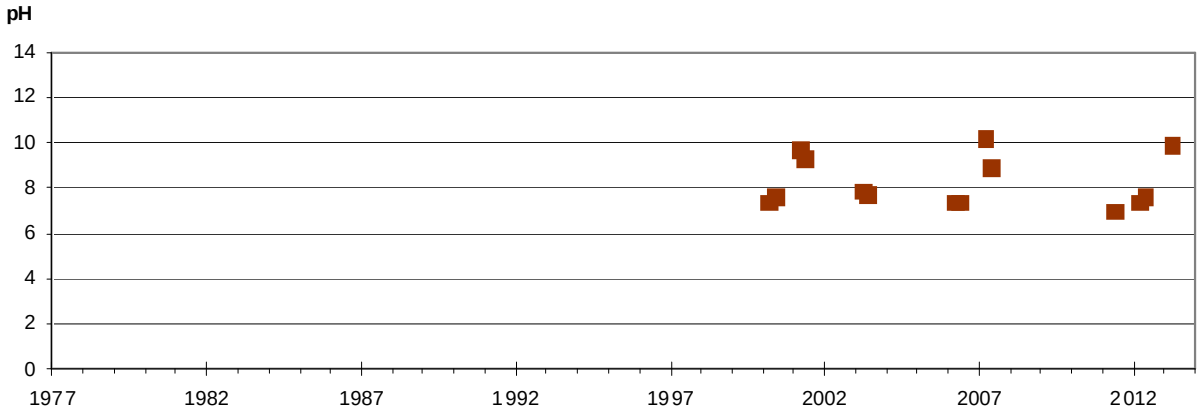


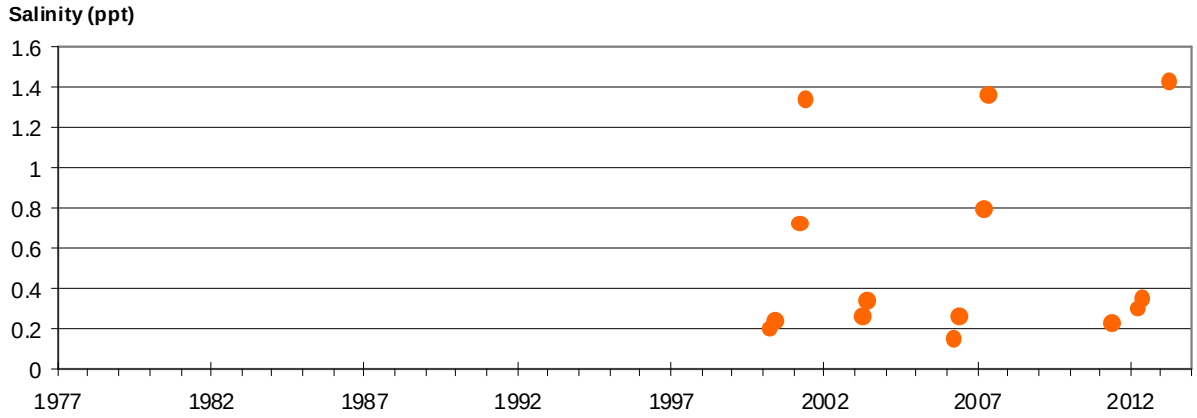
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Powell is in the Albany District of the South Coast DPaW Region

RANGE ROAD YATE



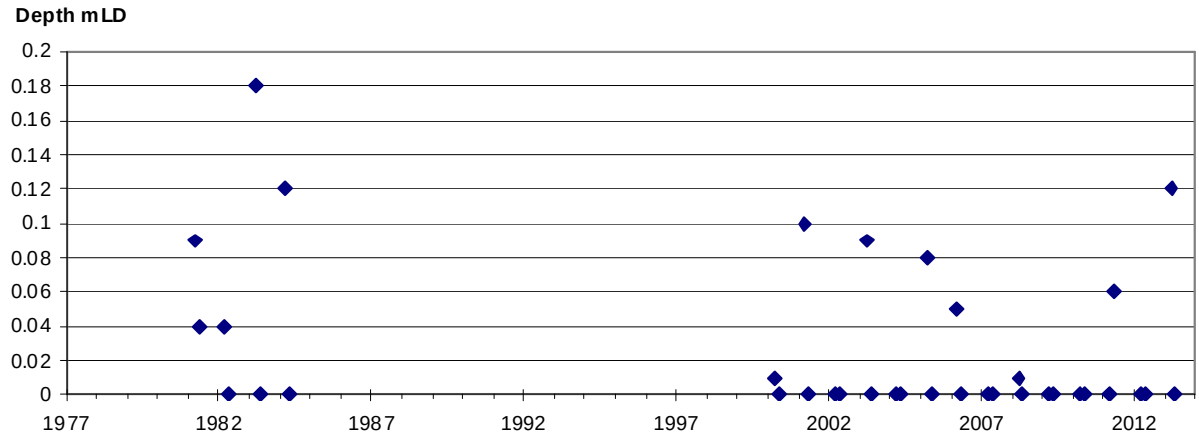


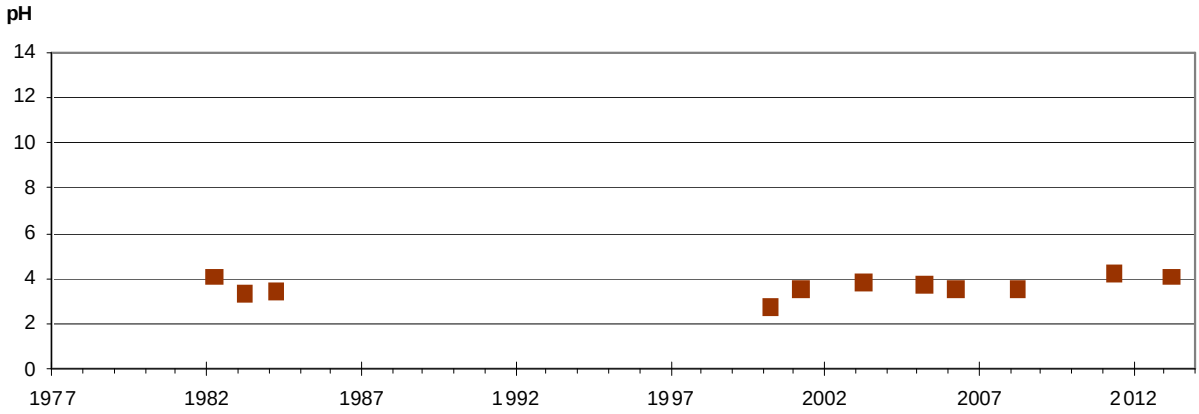


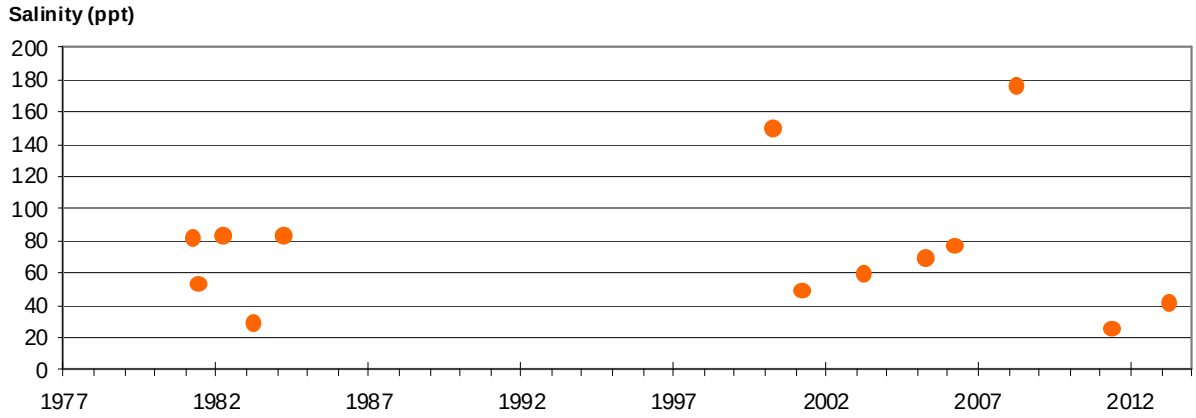
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Range Road Yate is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

RED (BRUCE ROCK)



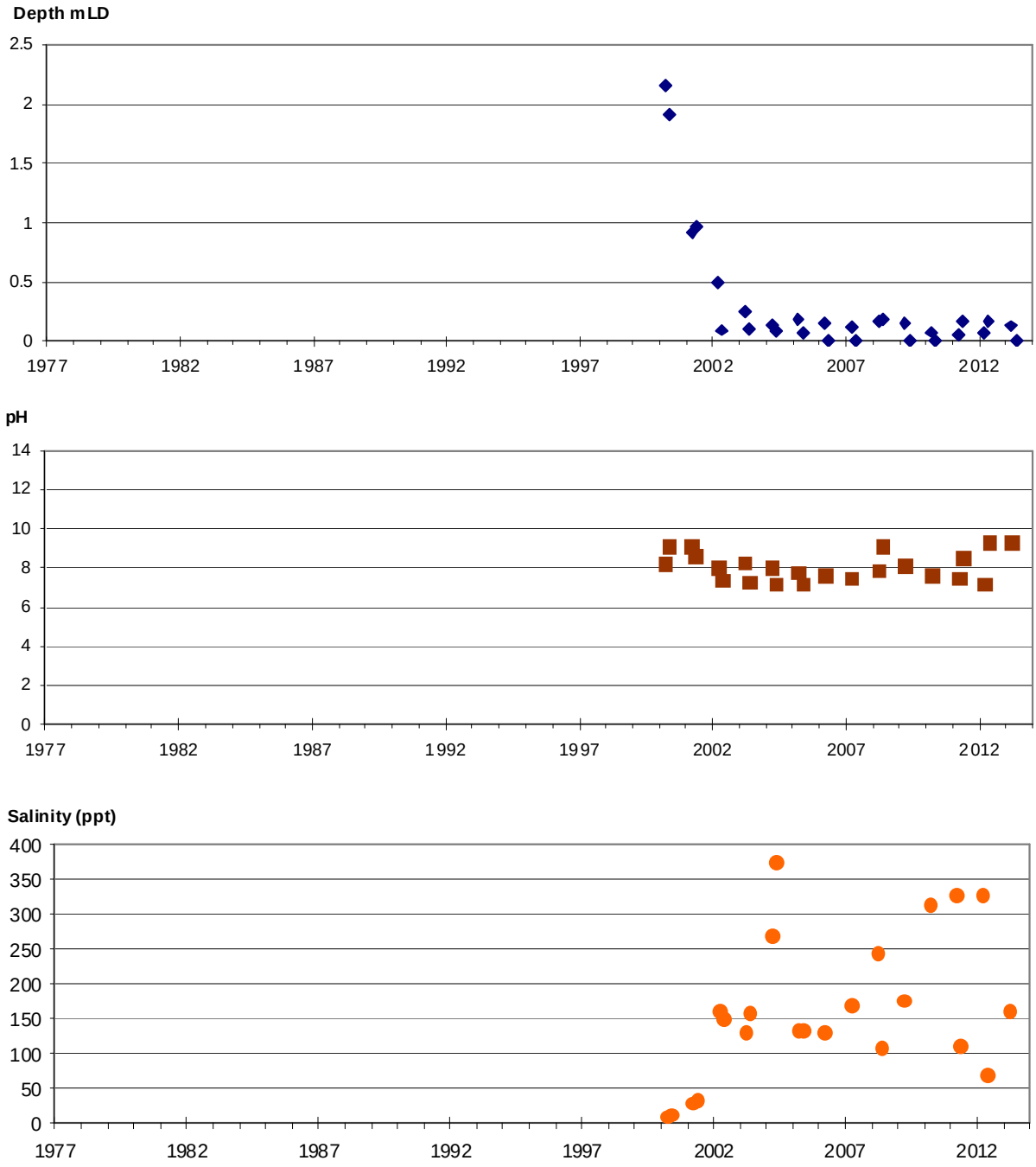




Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Red (Bruce Rock) is in the Central District (headquartered in Merredin) of the Wheatbelt DPaW Region.

RONNERUP [IM]

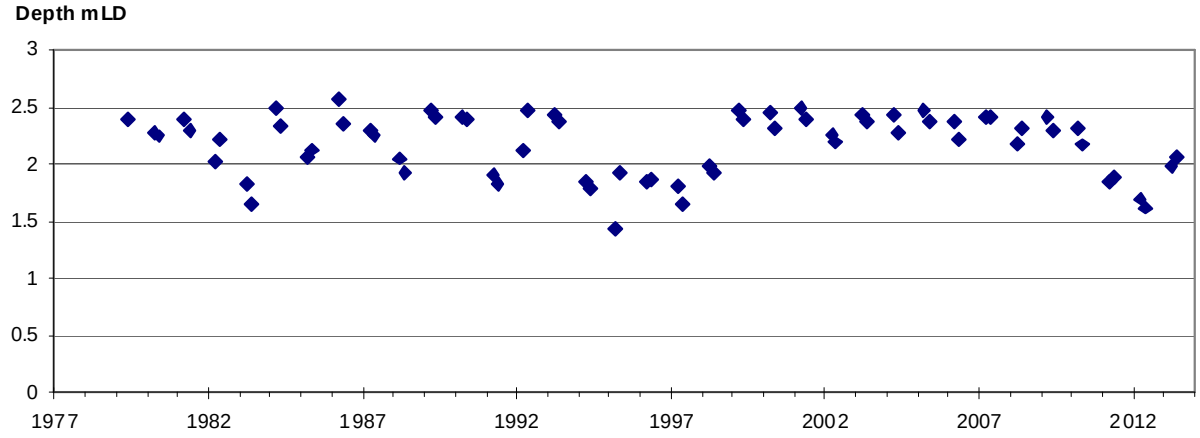


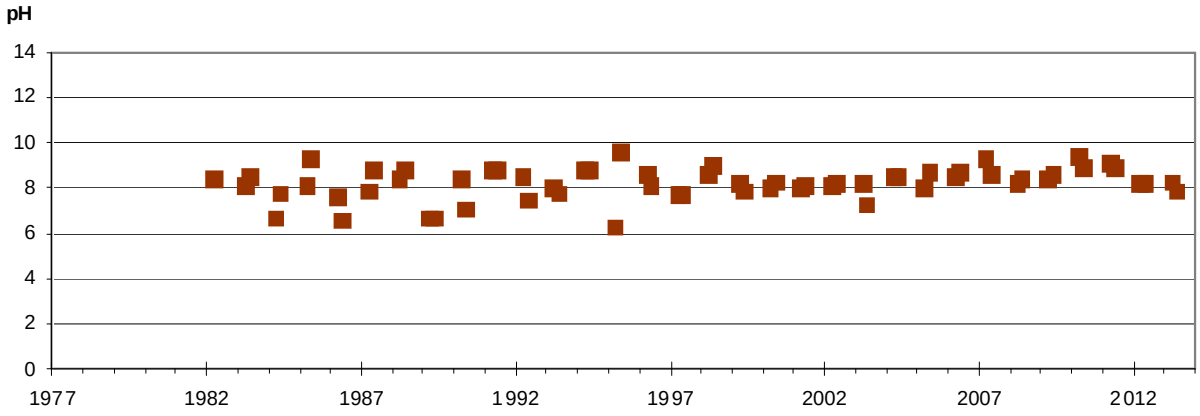
Notes:

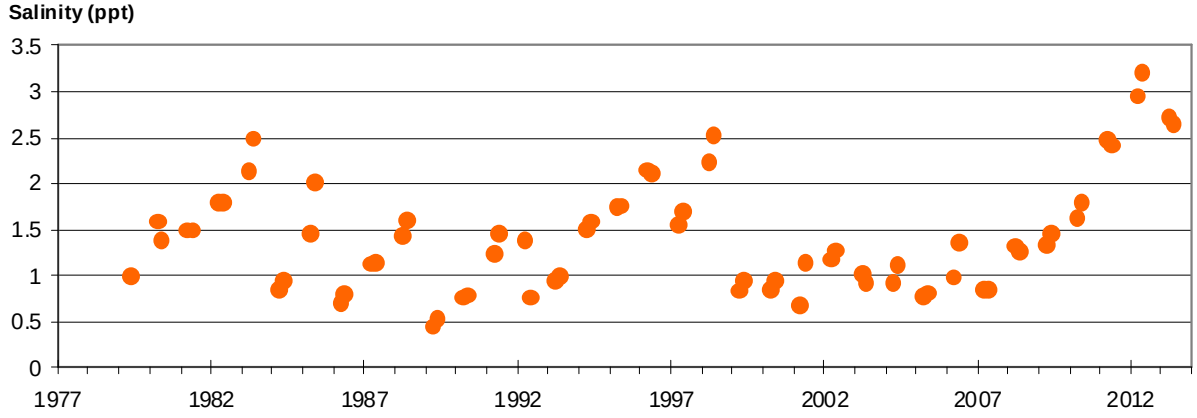
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Ronnerup is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

SHARK





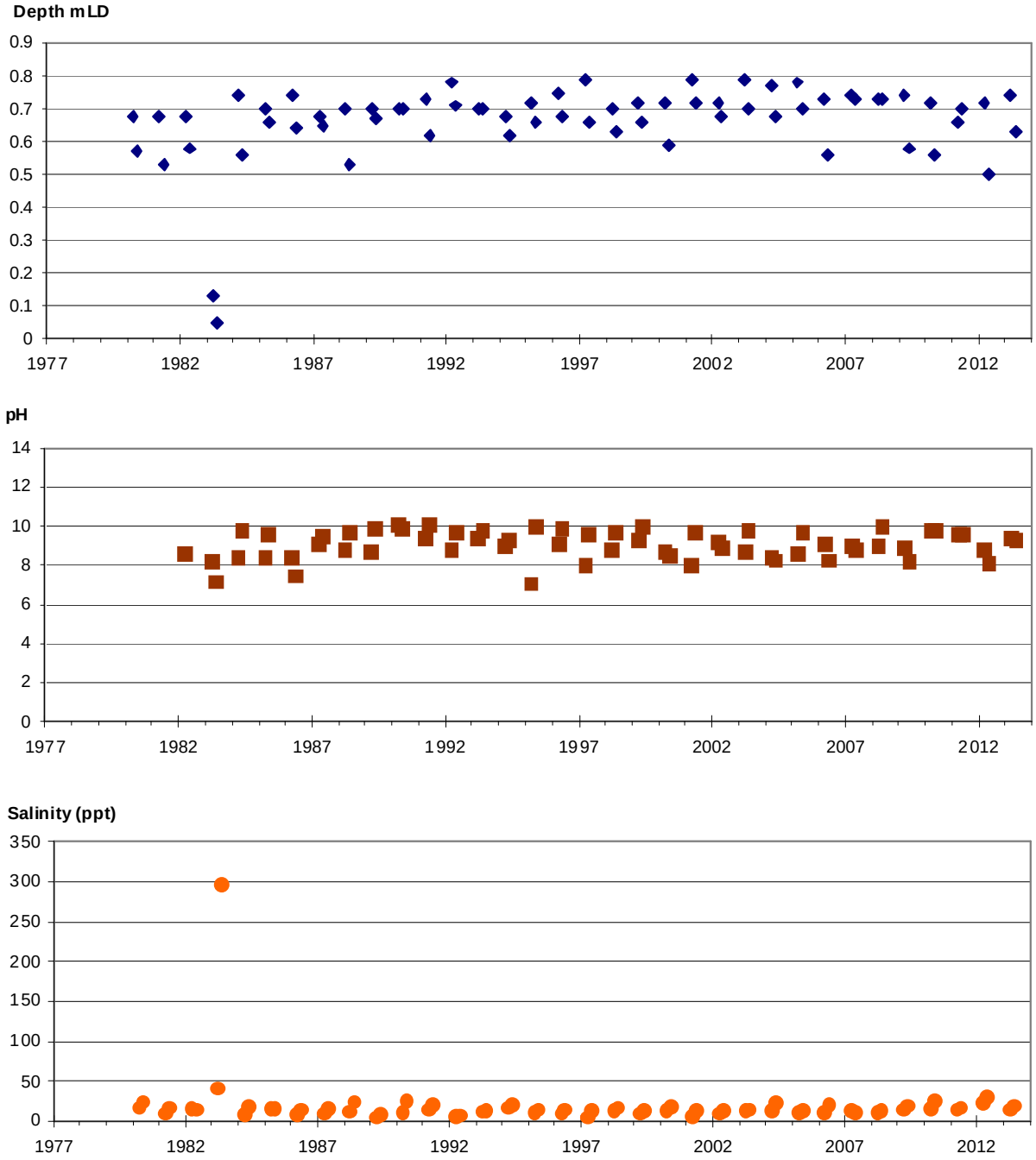


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Shark is within the former Esperance Lakes Natural Diversity Recovery Catchment.

Shark is in the Esperance District of the South Coast DPaW Region.

STATION (with Salinity axis 0-350ppt)



Notes:

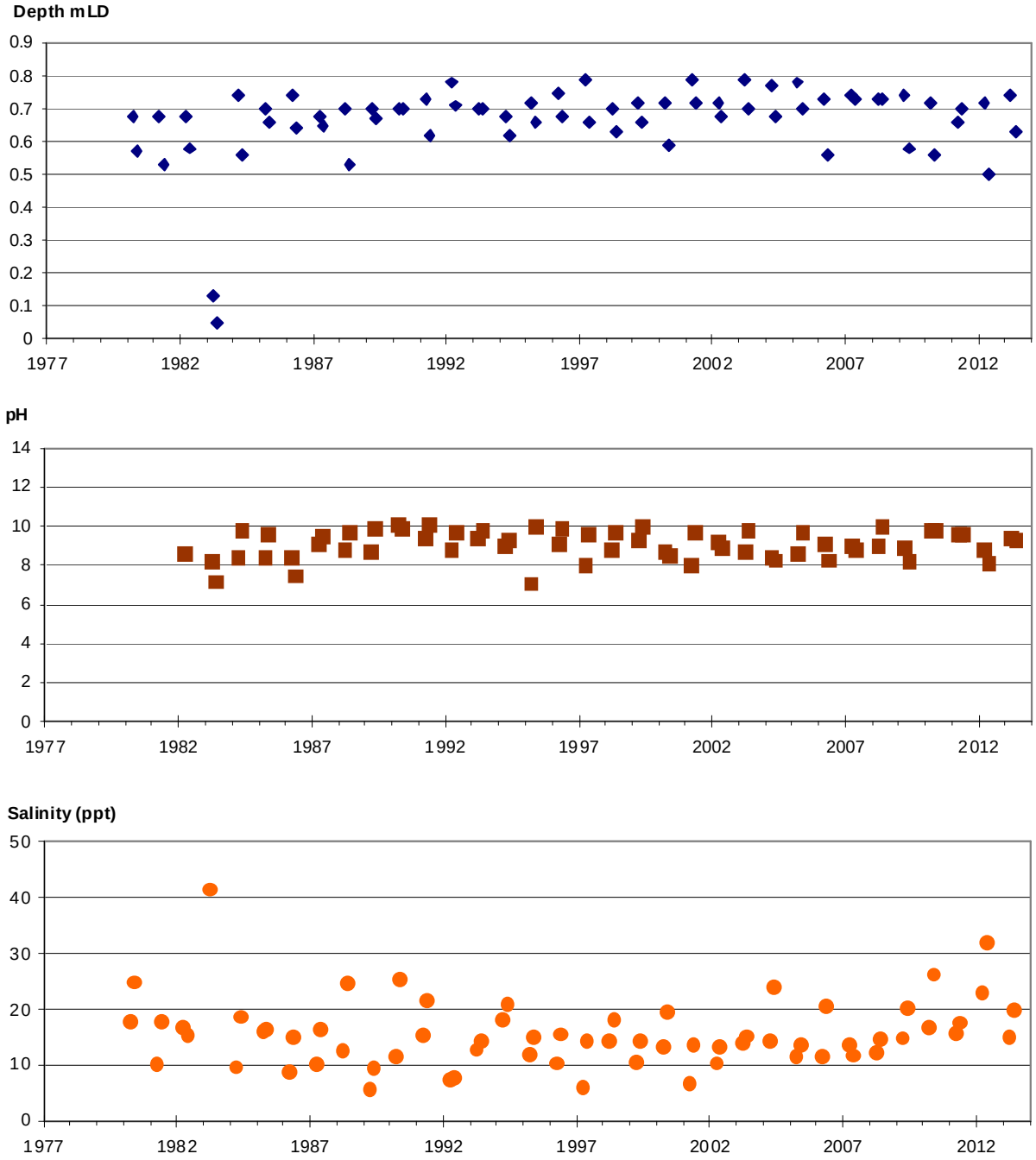
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Station is a component of the 'Lake Warden System', which is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands.

Station is also a component of the 'Lake Warden System' listed in the 'Directory of Important Wetlands in Australia'.

Station is within the former Esperance Lakes Natural Diversity Recovery Catchment and is in the Esperance District of the South Coast DPaW Region.

STATION (with Salinity axis 0-50ppt)



Notes:

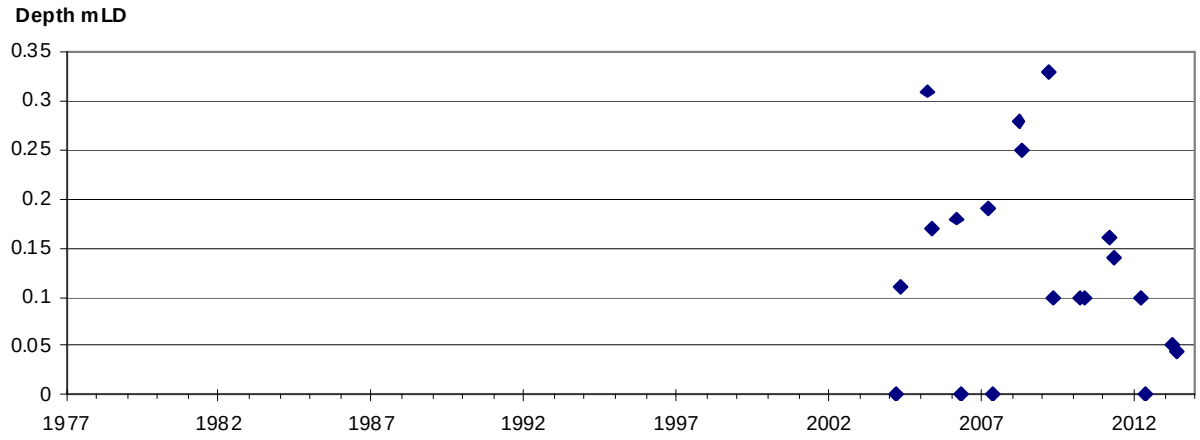
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

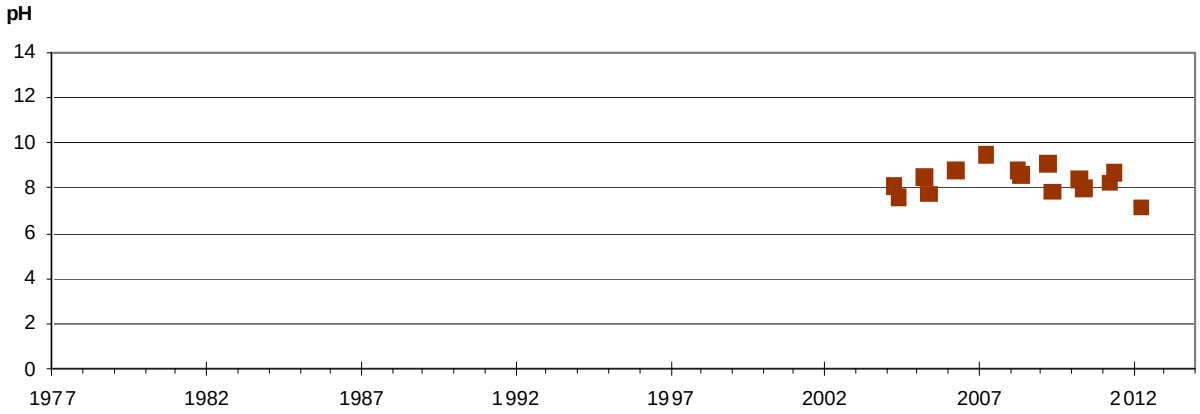
Station is a component of the 'Lake Warden System', which is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands.

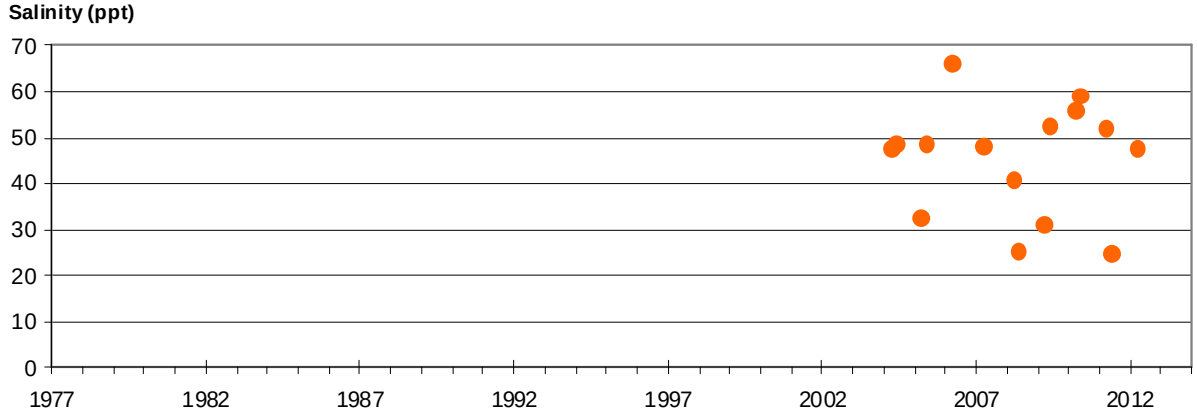
Station is also a component of the 'Lake Warden System' listed in the 'Directory of Important Wetlands in Australia'.

Station is within the former Esperance Lakes Natural Diversity Recovery Catchment and is in the Esperance District of the South Coast DPaW Region.

TAARBLIN (NORTH)





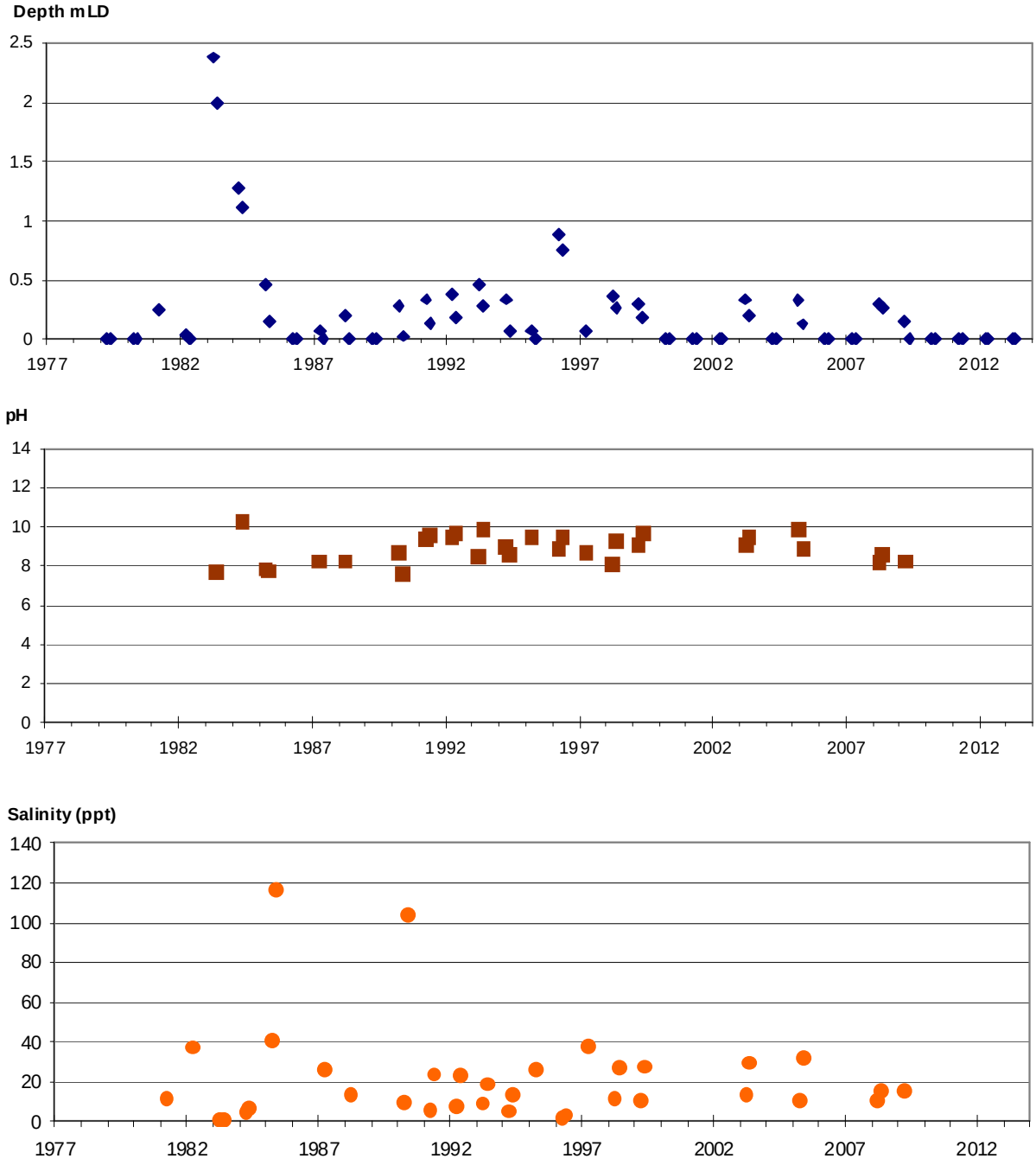


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Taarblin (North) is a short distance downstream from, and receives pumped, bypassed and potentially overflow water from, the Toolibin Lake Natural Diversity Recovery Catchment.

Taarblin (North) is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

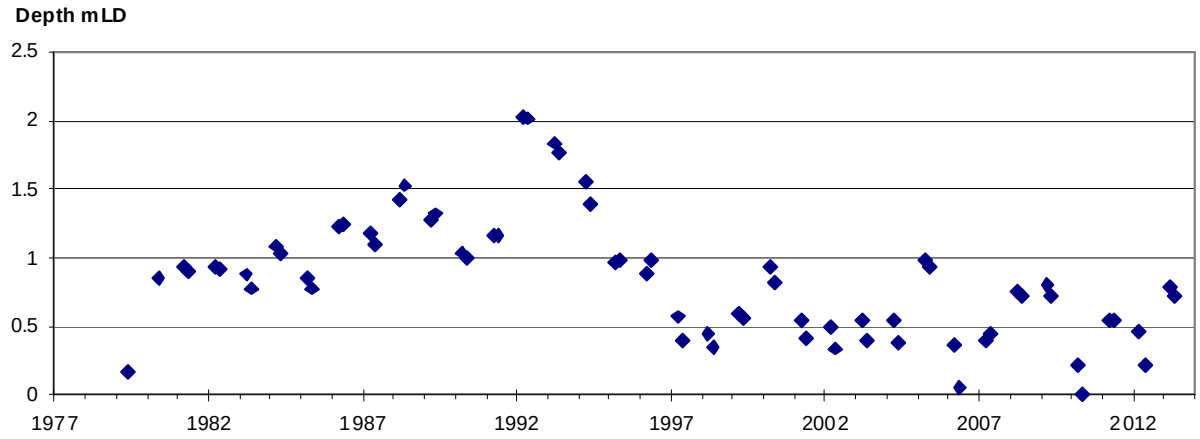
TAARBLIN (SOUTH)

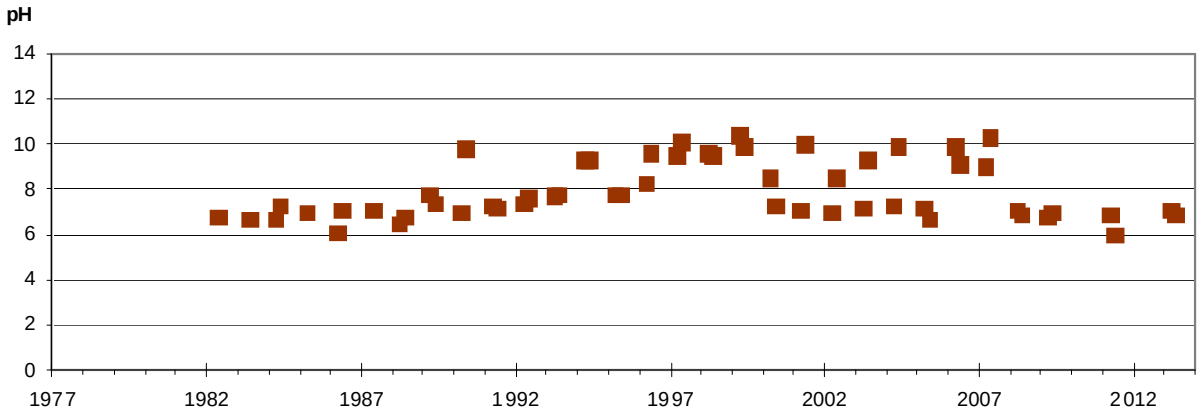


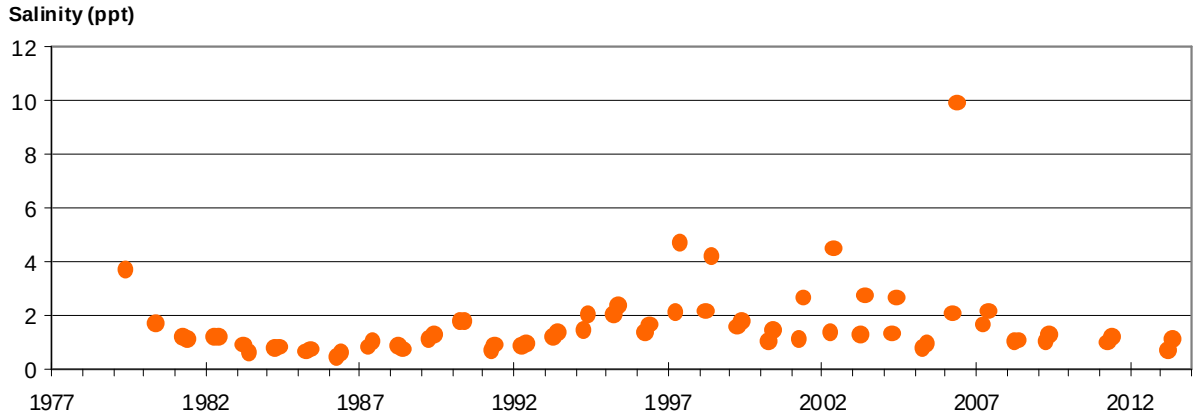
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Taarblin (South) is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

THOMSONS





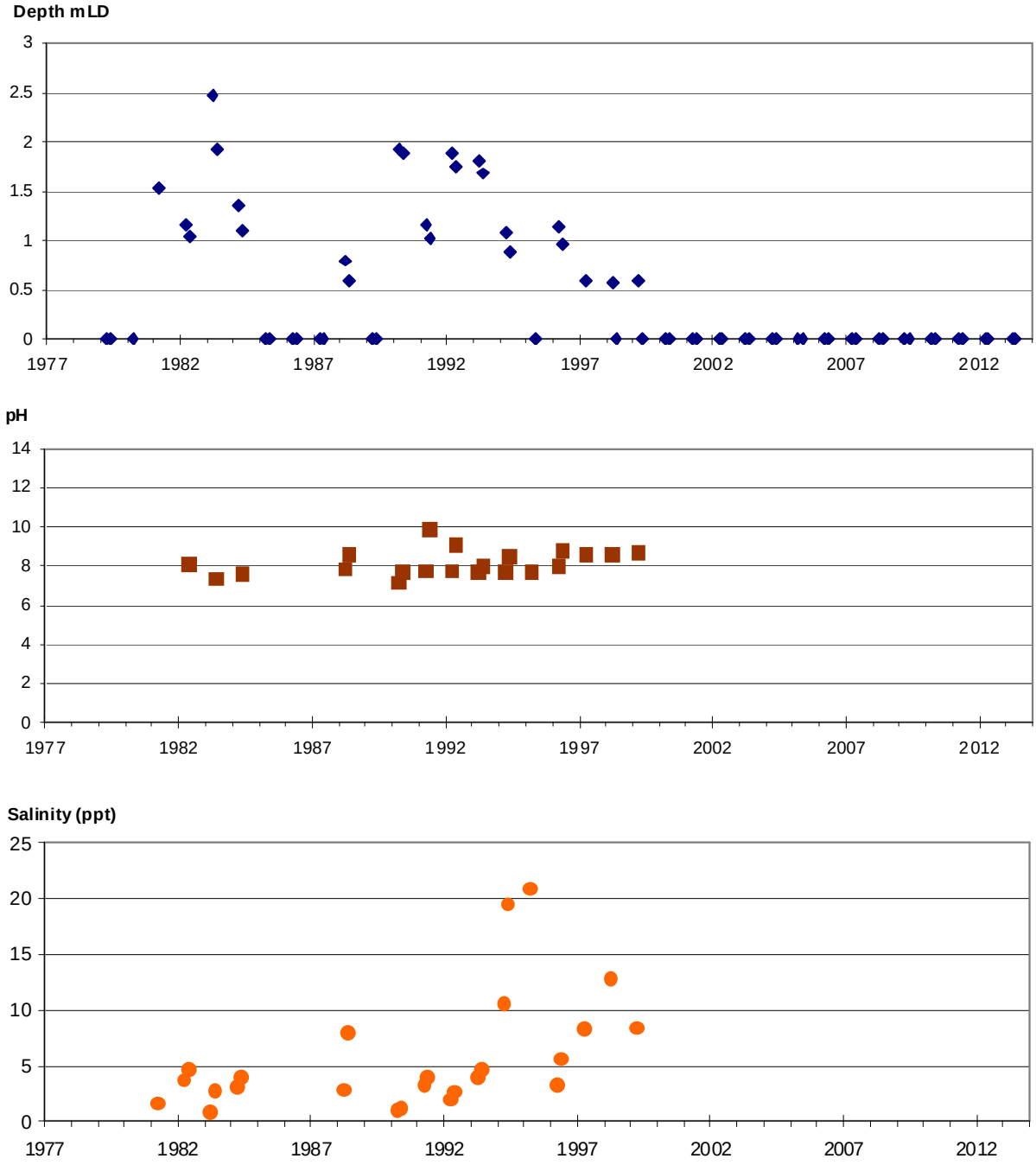


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Thomsons Lake is a component of the 'Forrestdale and Thomsons Lakes' system, which is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands, and is also listed in the 'Directory of Important Wetlands in Australia'.

Thomsons is in the Swan Coastal District (headquartered in Wanneroo) of the Swan DPaW Region.

TOOLIBIN [IM]

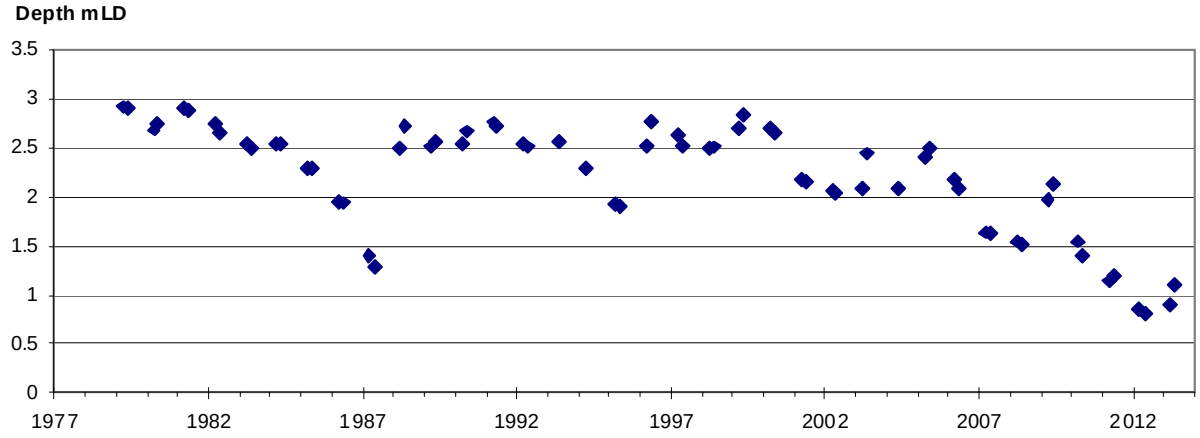


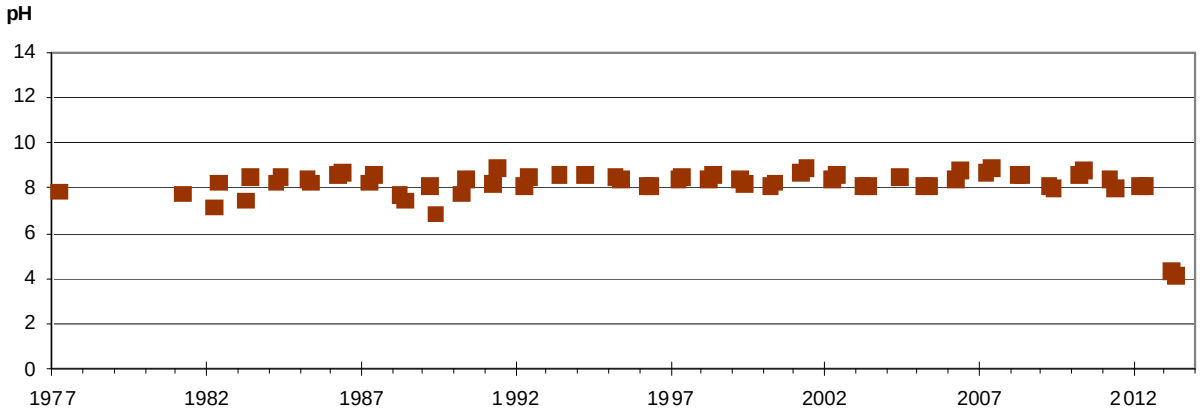
Notes:
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

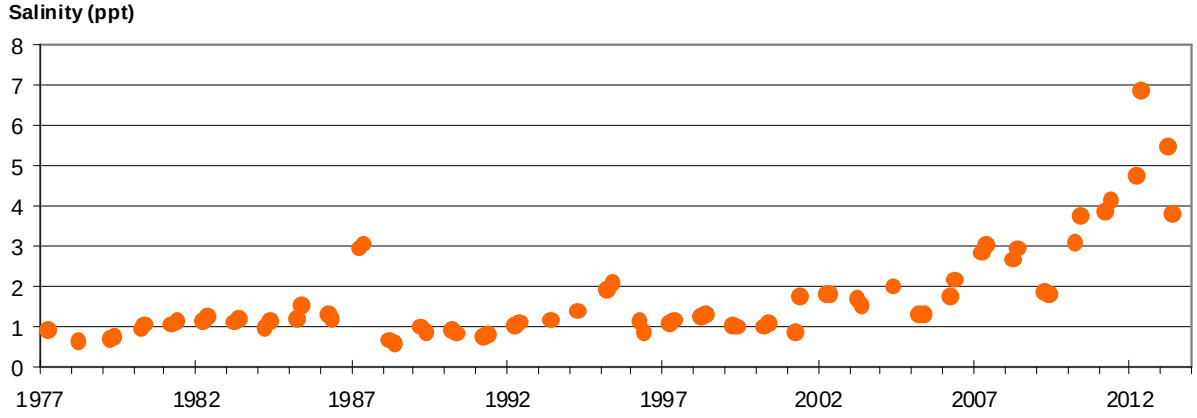
Toolibin Lake is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands and is also listed in the 'Directory of Important Wetlands in Australia'.

Toolibin is in the Toolibin Lake Natural Diversity Recovery Catchment and is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

TORDIT-GURRUP





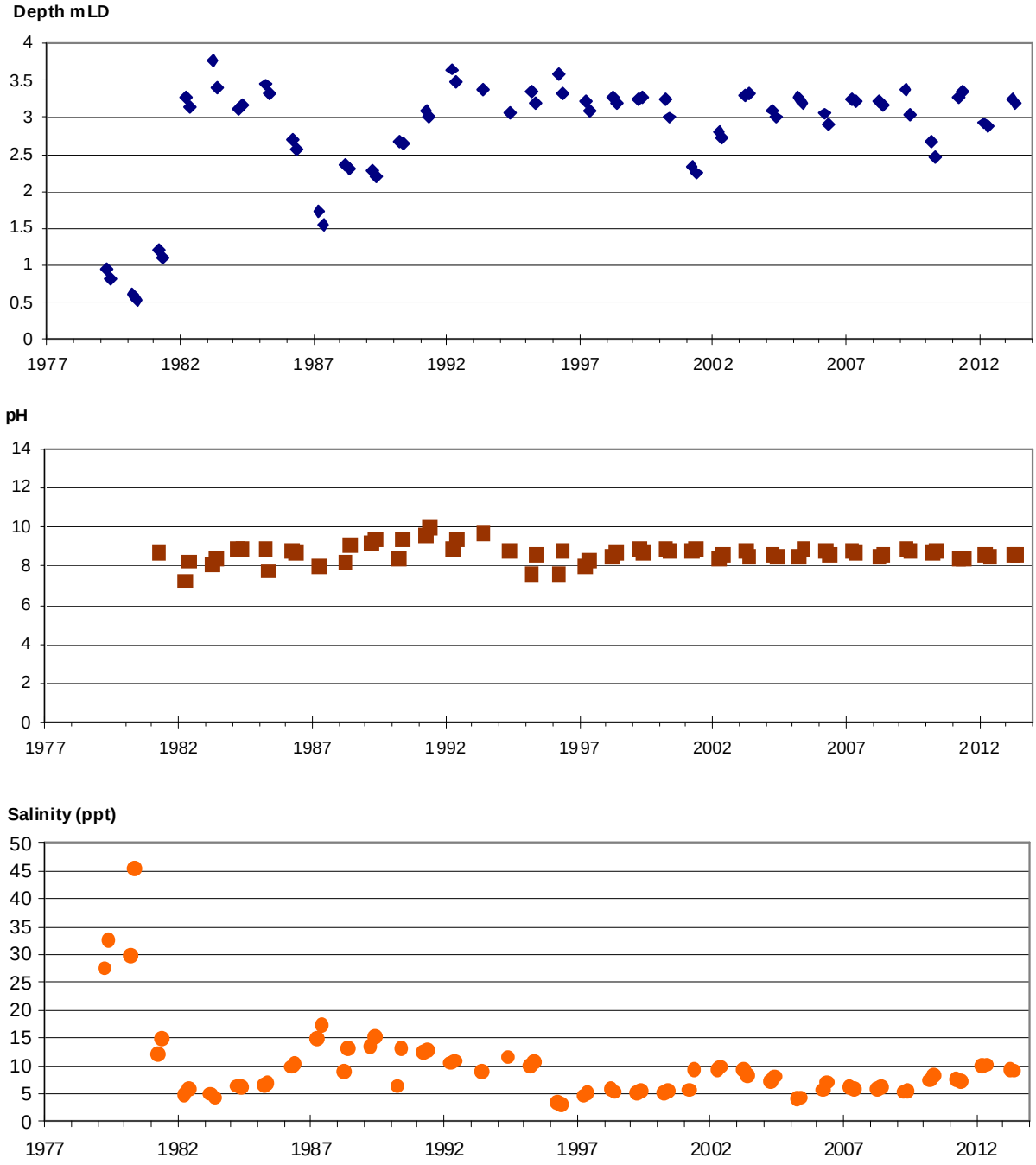


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Tordit-Gurrup is a component of the 'Muir-Byenup System', which is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands, and is also a component of the 'Byenup Lagoon System' listed in the 'Directory of Important Wetlands in Australia'.

Tordit-Gurrup is within the former Muir-Unicup Natural Diversity Recovery Catchment and is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

TOWERRINNING [IM]

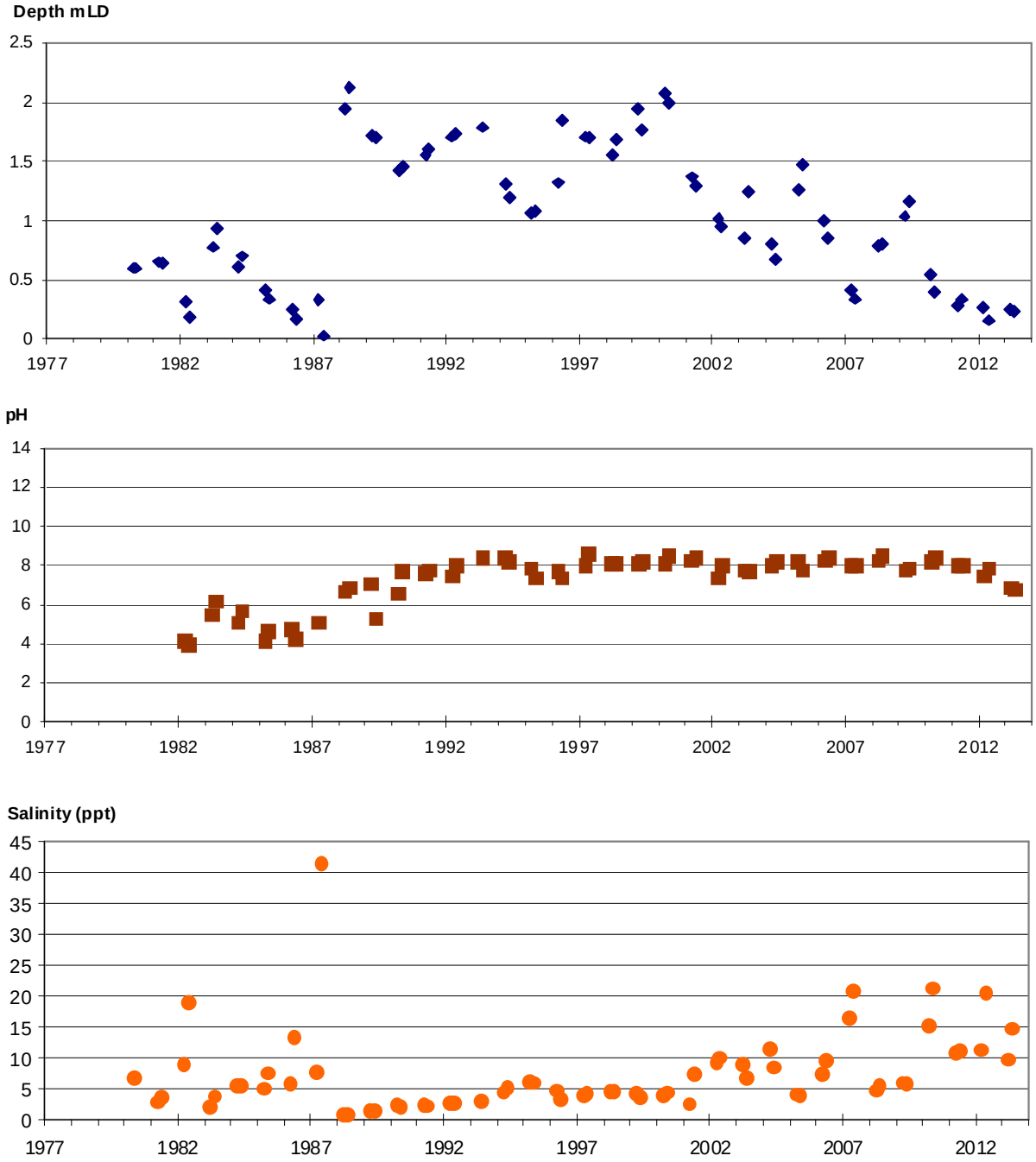


Notes:

1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Towerrinning is in the Wellington District (headquartered in Collie) of the South West DPaW Region.

UNICUP

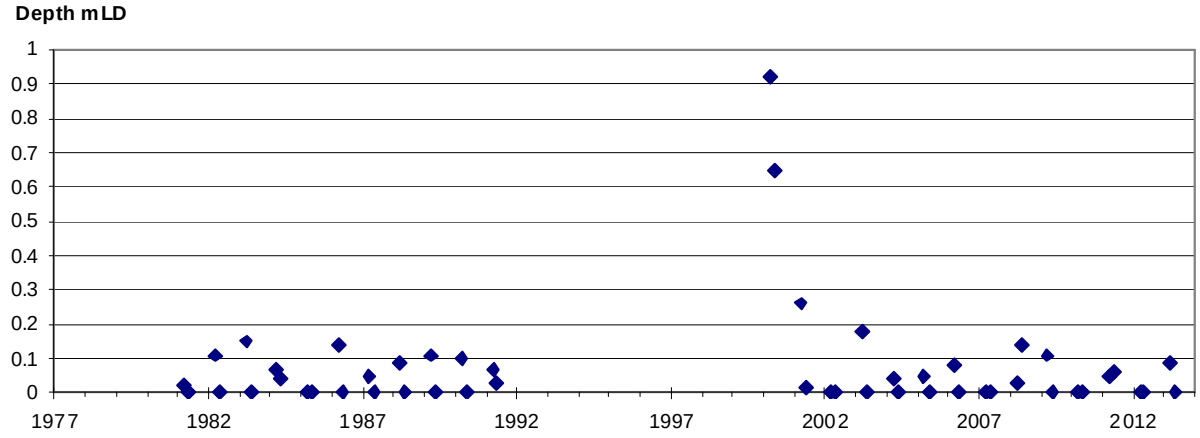


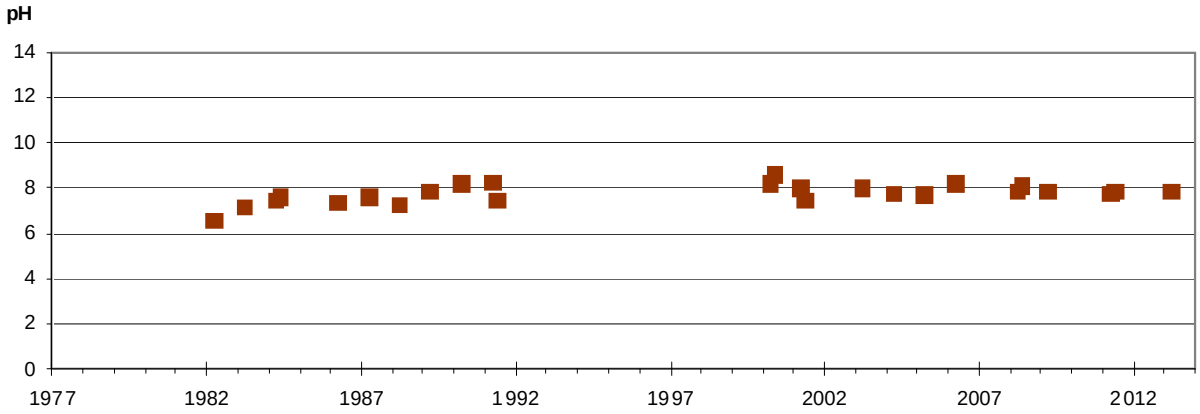
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

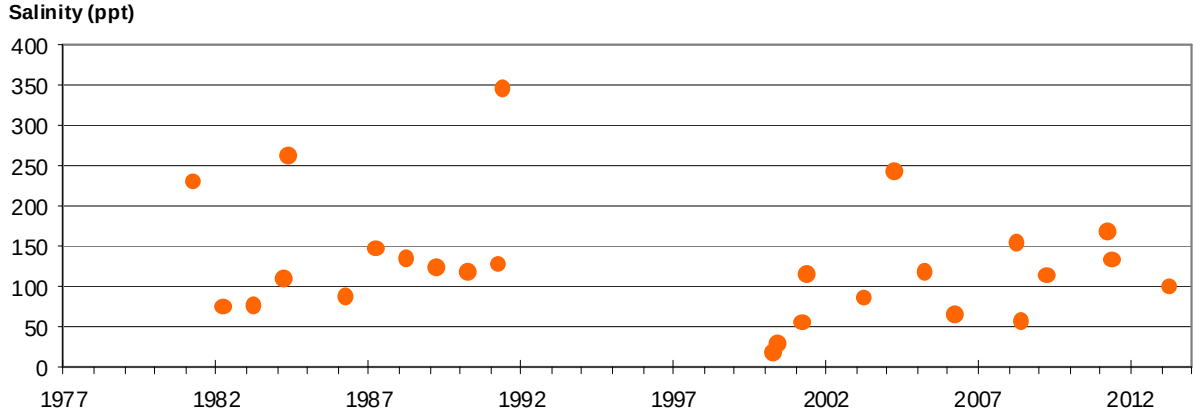
Unicup is a component of the 'Byenup Lagoon System', which is listed in the 'Directory of Important Wetlands in Australia'.

Unicup is within the former Muir-Unicup Natural Diversity Recovery Catchment and is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

VARLEY



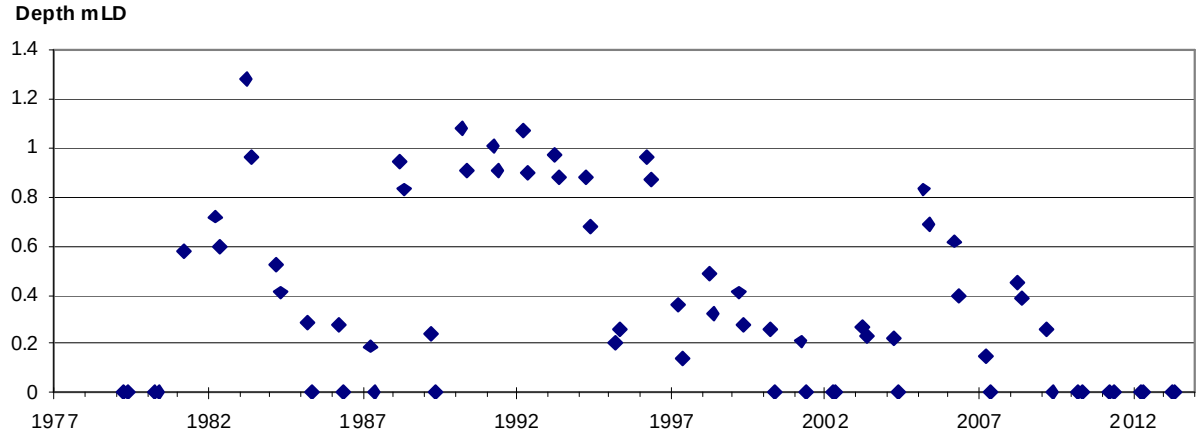


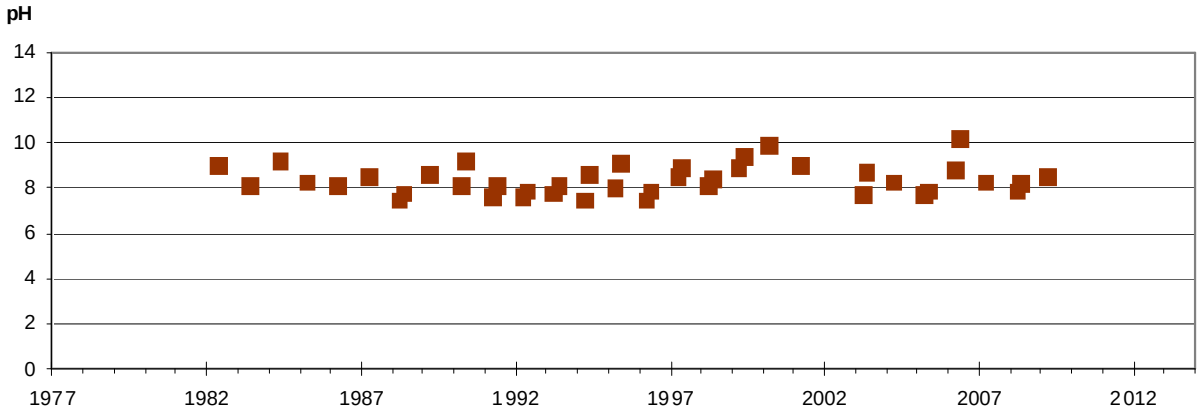


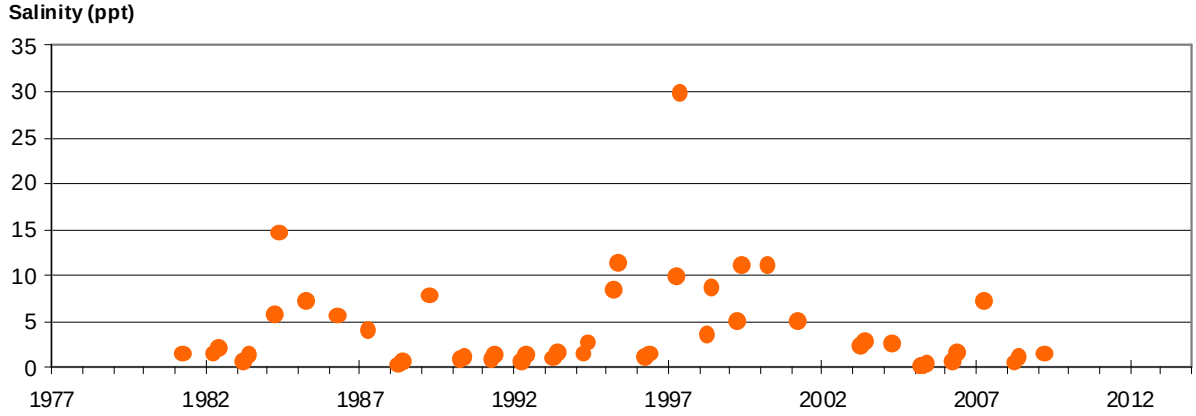
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Varley is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

WALBYRING





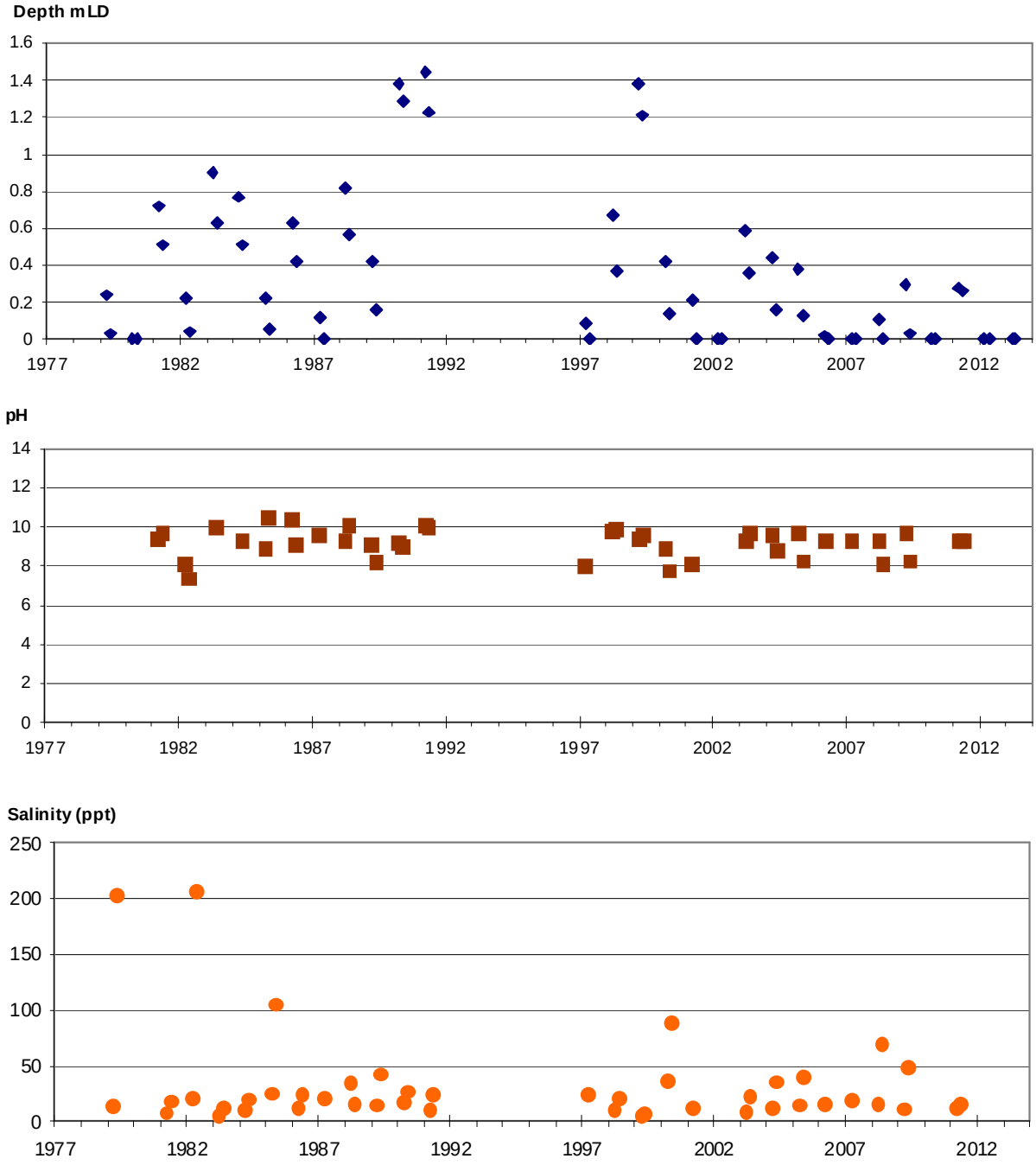


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Walbyring is a short distance downstream from, and potentially receives overflow water from, the Toolibin Lake Natural Diversity Recovery Catchment.

Walbyring is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

WALYORMOURING [IM]

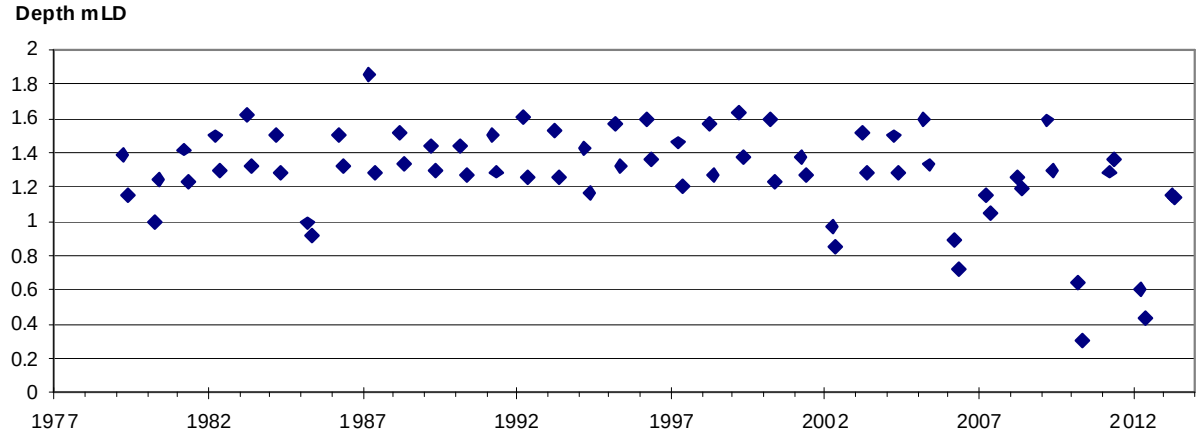


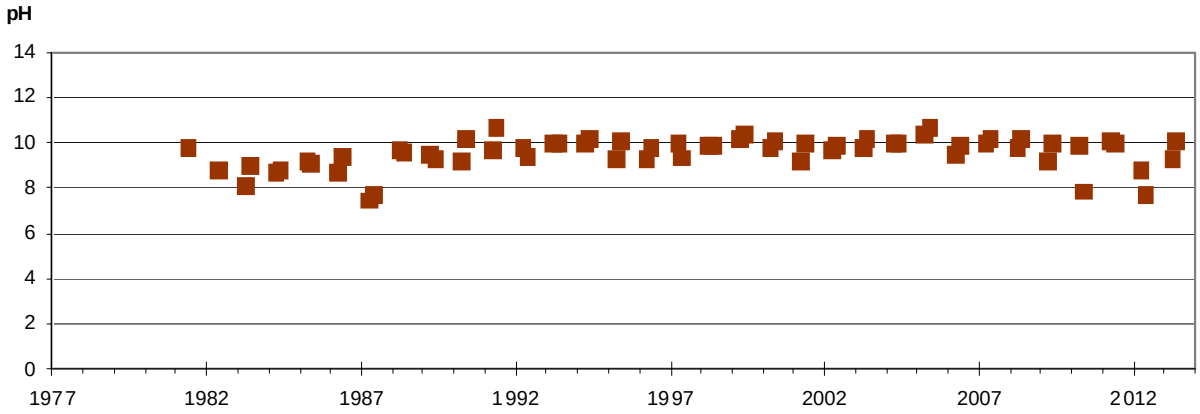
Notes:

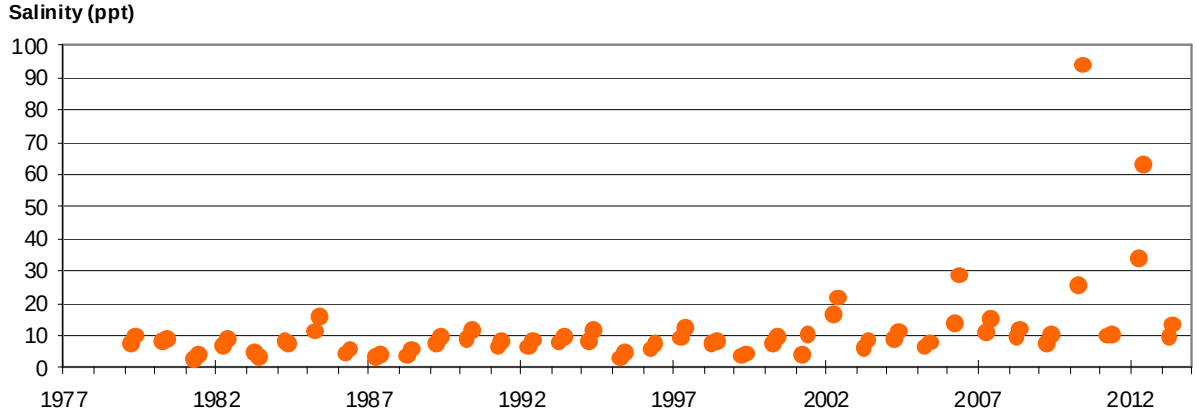
1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Walyormouring is in the Central District (headquartered in Merredin) of the Wheatbelt DPaW Region.

WANNAMAL





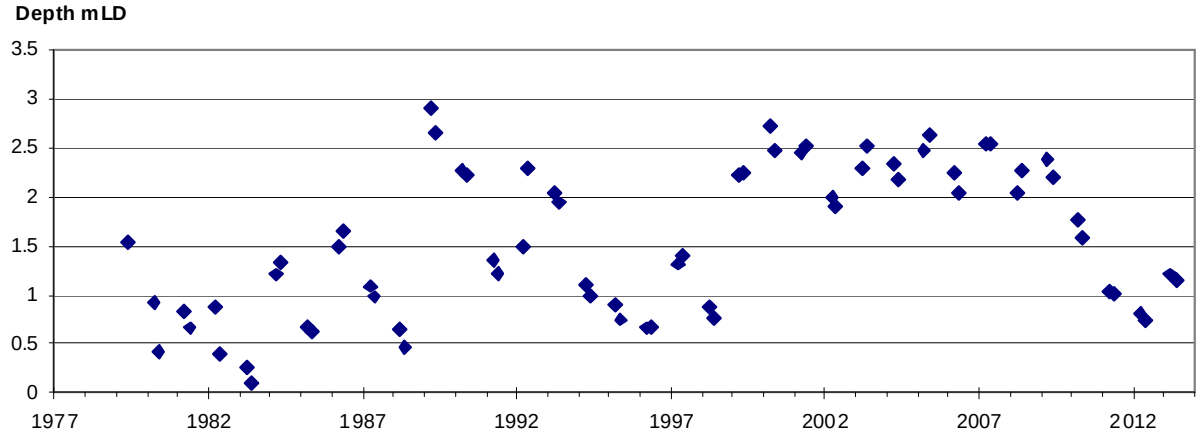


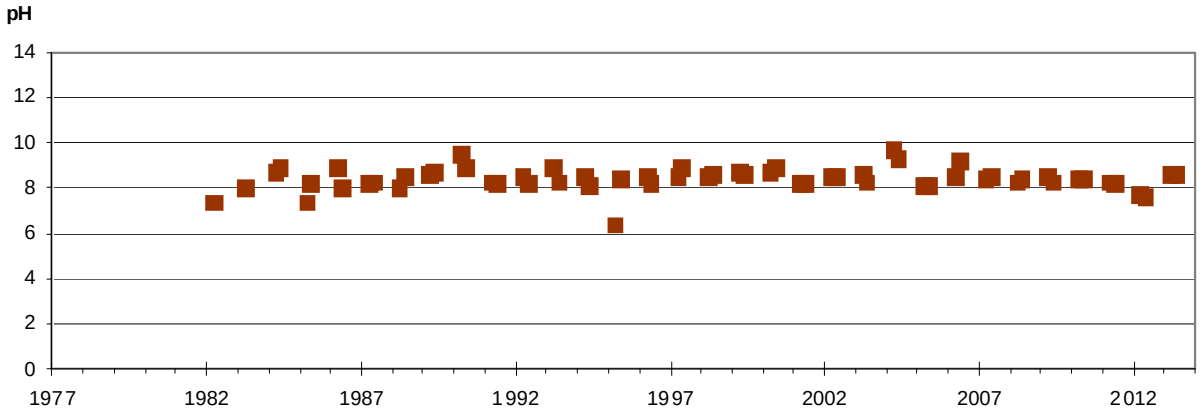
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

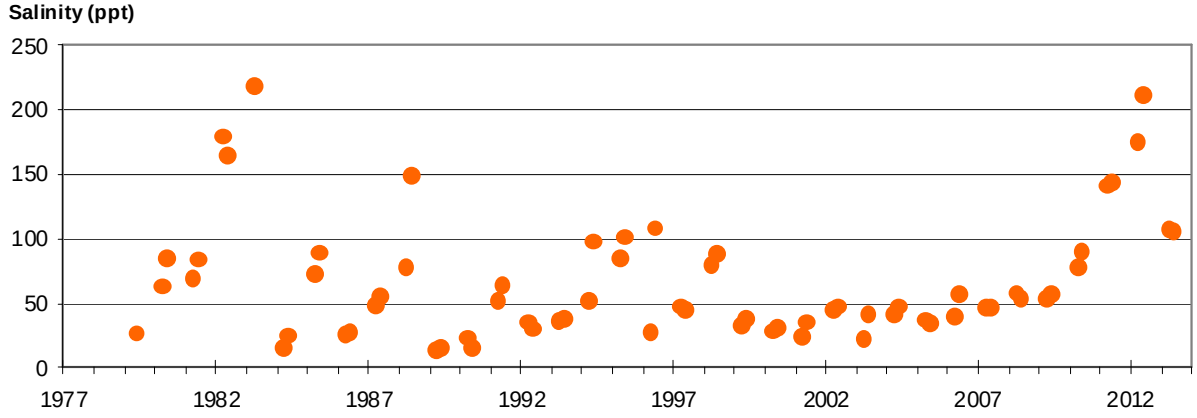
Wannamal is a component of the 'Wannamal Lakes System', which is listed in the 'Directory of Important Wetlands in Australia'.

Wannamal is in the Swan Coastal District (headquartered in Wanneroo) of the Swan DPaW Region.

WARDEN







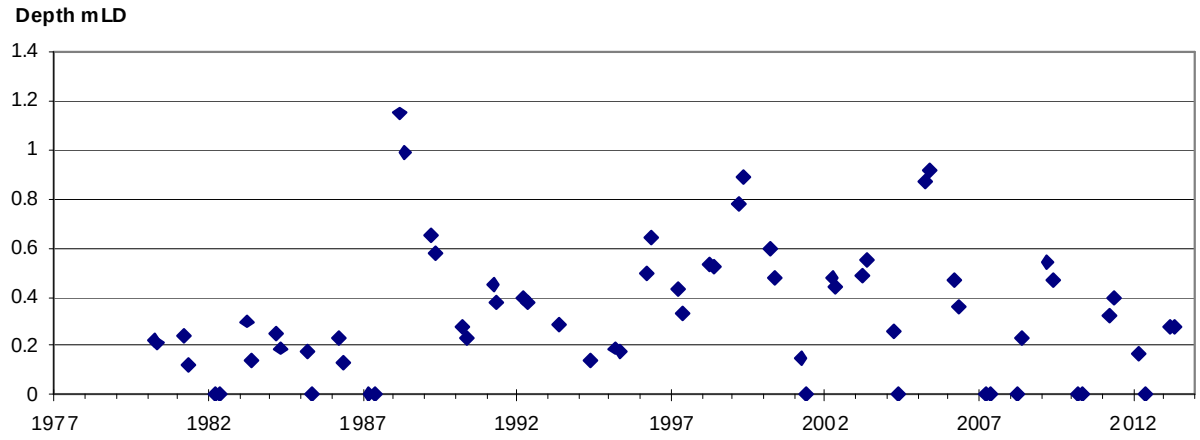
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

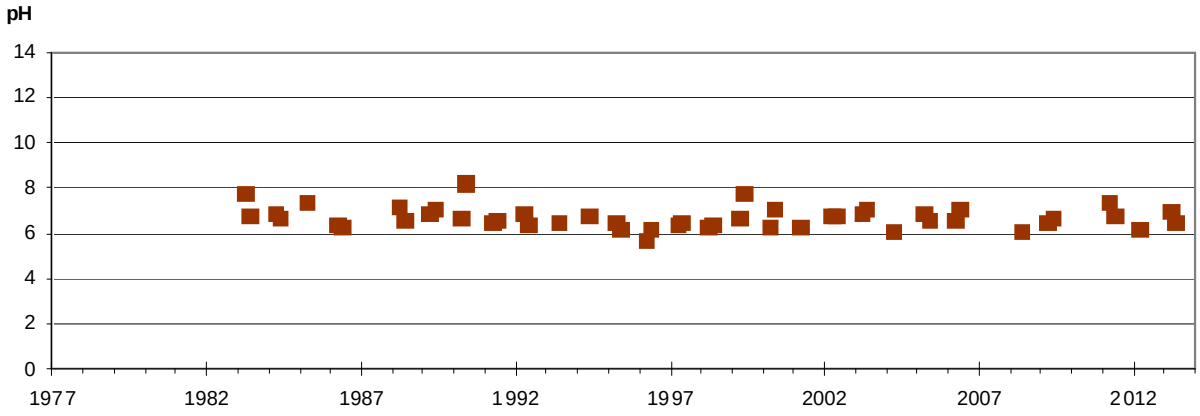
Warden is a component of the 'Lake Warden System', which is listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands.

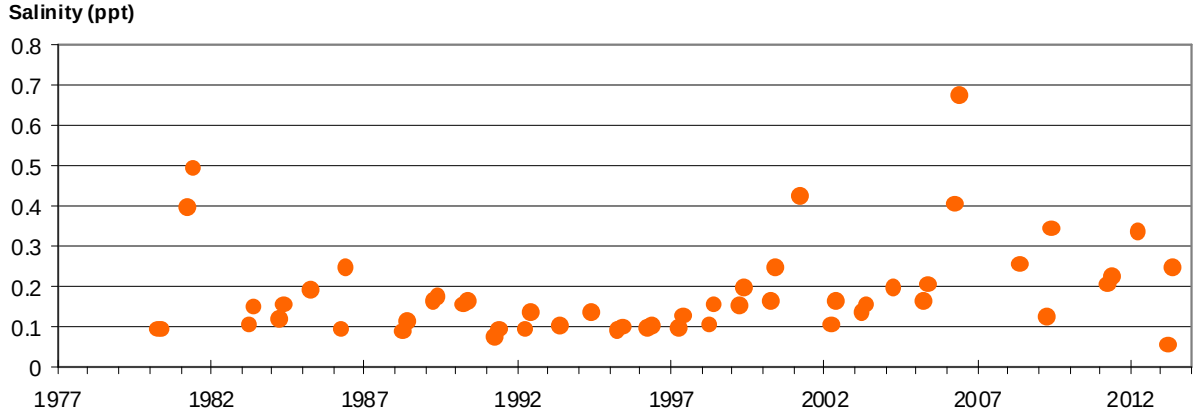
Warden is also a component of the 'Lake Warden System' listed in the 'Directory of Important Wetlands in Australia'.

Warden is within the former Esperance Lakes Natural Diversity Recovery Catchment and is in the Esperance District of the South Coast DPaW Region.

WARRINUP



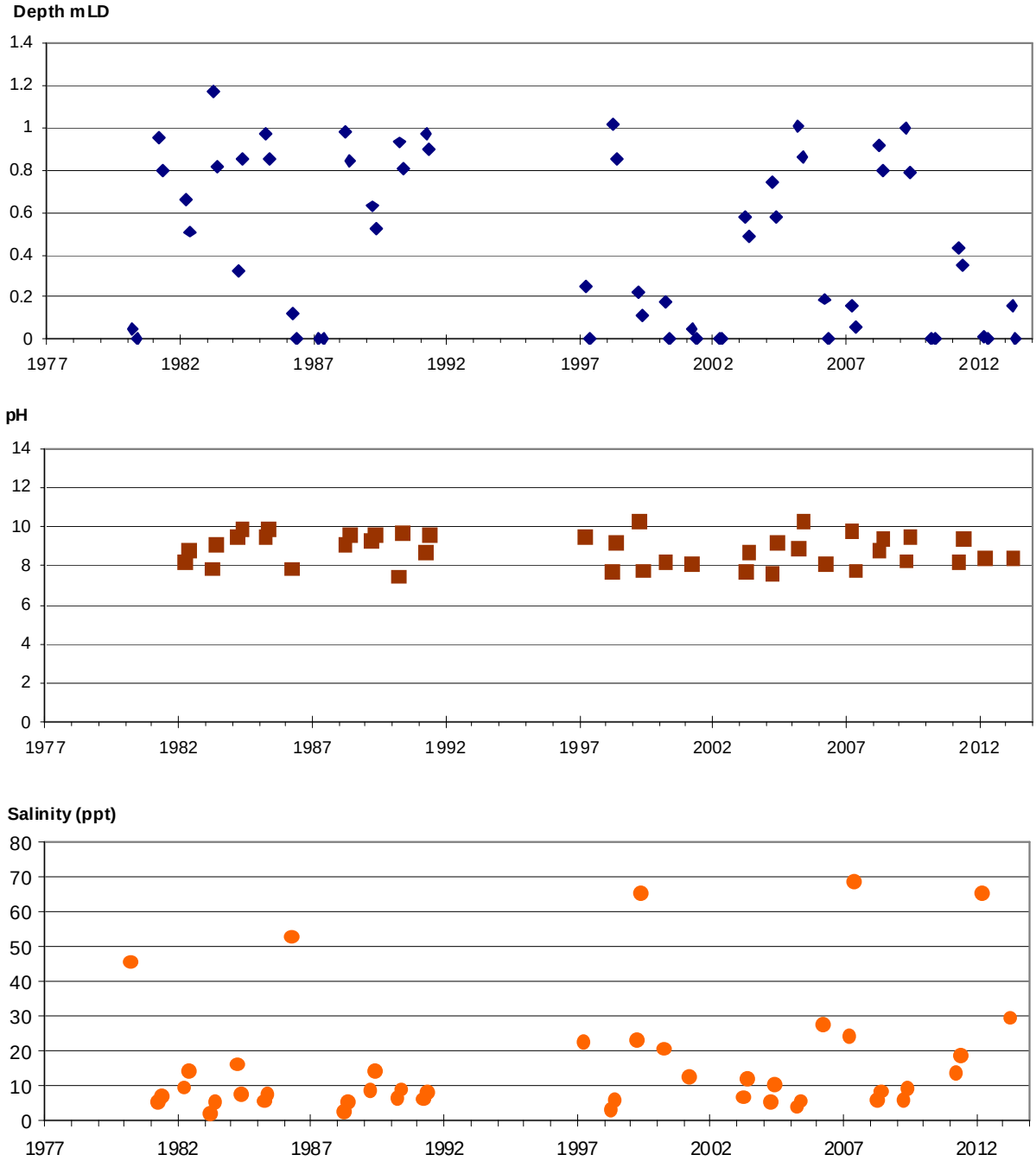




Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Warrinup is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

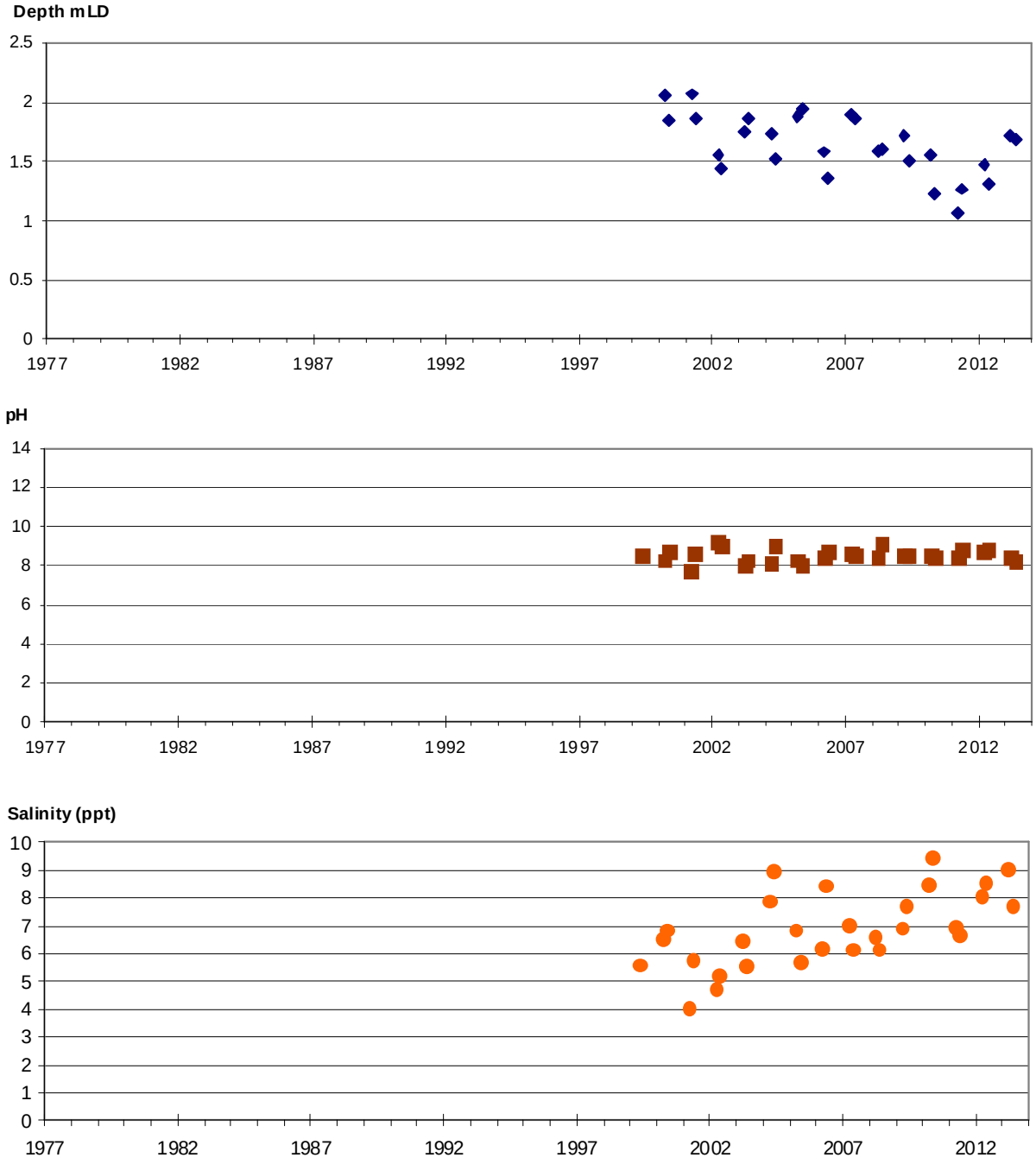
WEST ARTHUR 5456



Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

West Arthur 5456 is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

WHEATFIELD [IM]



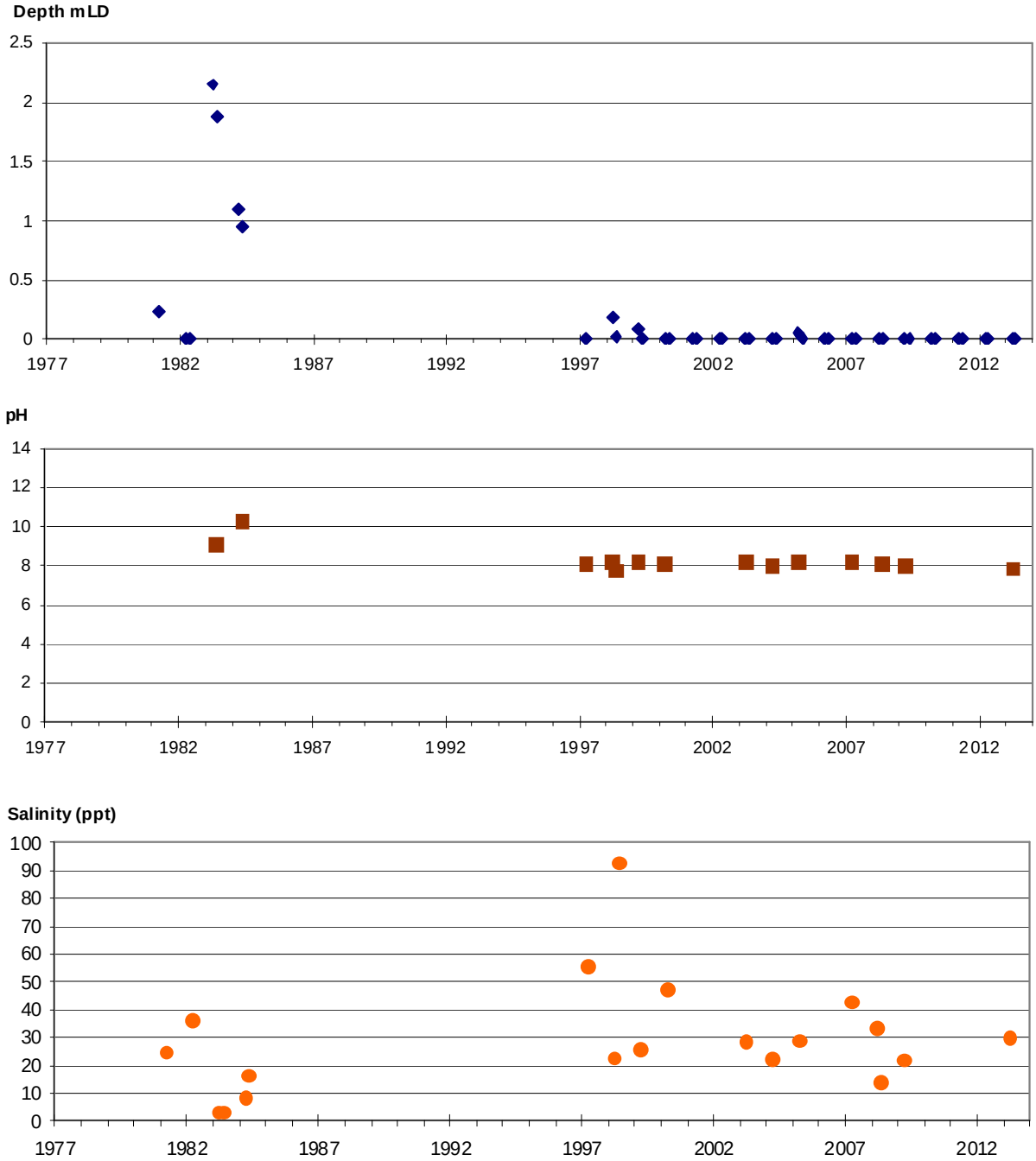
Notes:

1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Wheatfield is part of the 'Lake Warden System' listed as a Wetland of International Importance under the 'Ramsar' Convention on Wetlands and is also part of the 'Lake Warden System' listed in the 'Directory of Important Wetlands in Australia'.

Wheatfield is within the former Esperance Lakes Natural Diversity Recovery Catchment and is in the Esperance District of the South Coast DPaW Region.

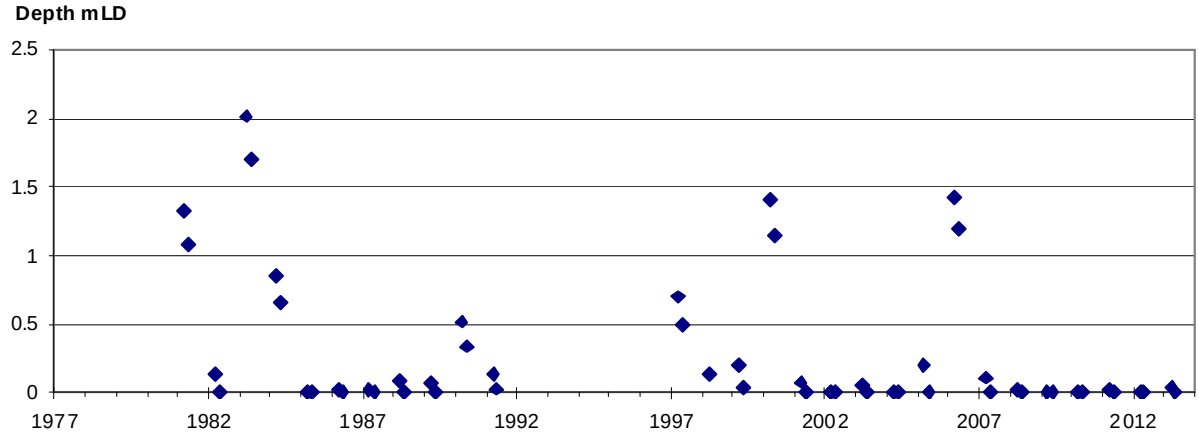
WHITE (NARROGIN)

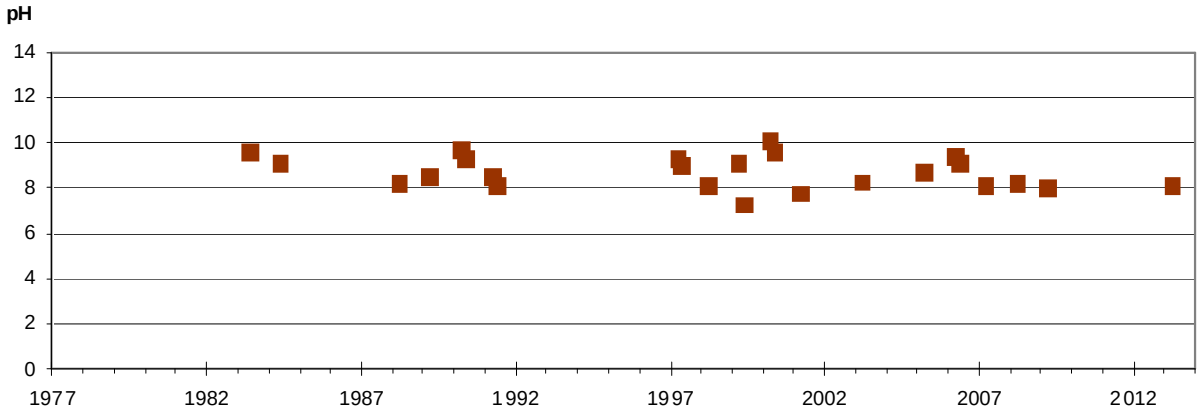


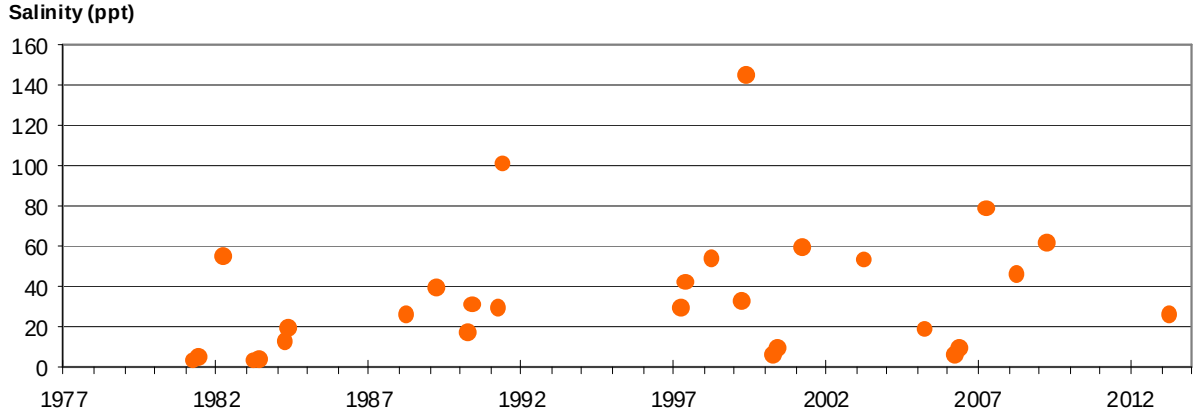
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

White (Narrogin) is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

WHITE WATER





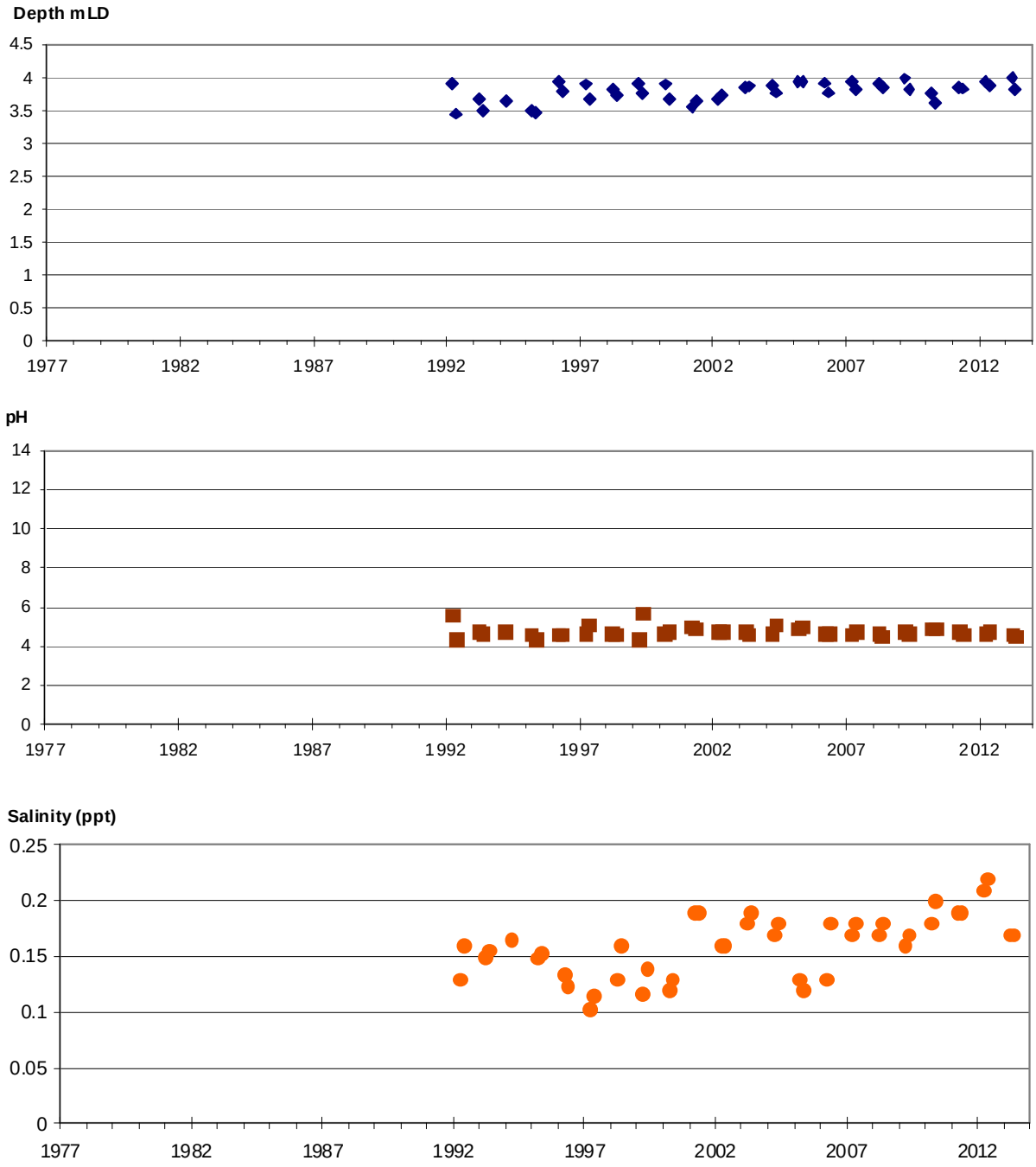


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

White Water is a component of the 'Yealering Lakes System', which is listed in the 'Directory of Important Wetlands in Australia'.

White Water is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

WILSON

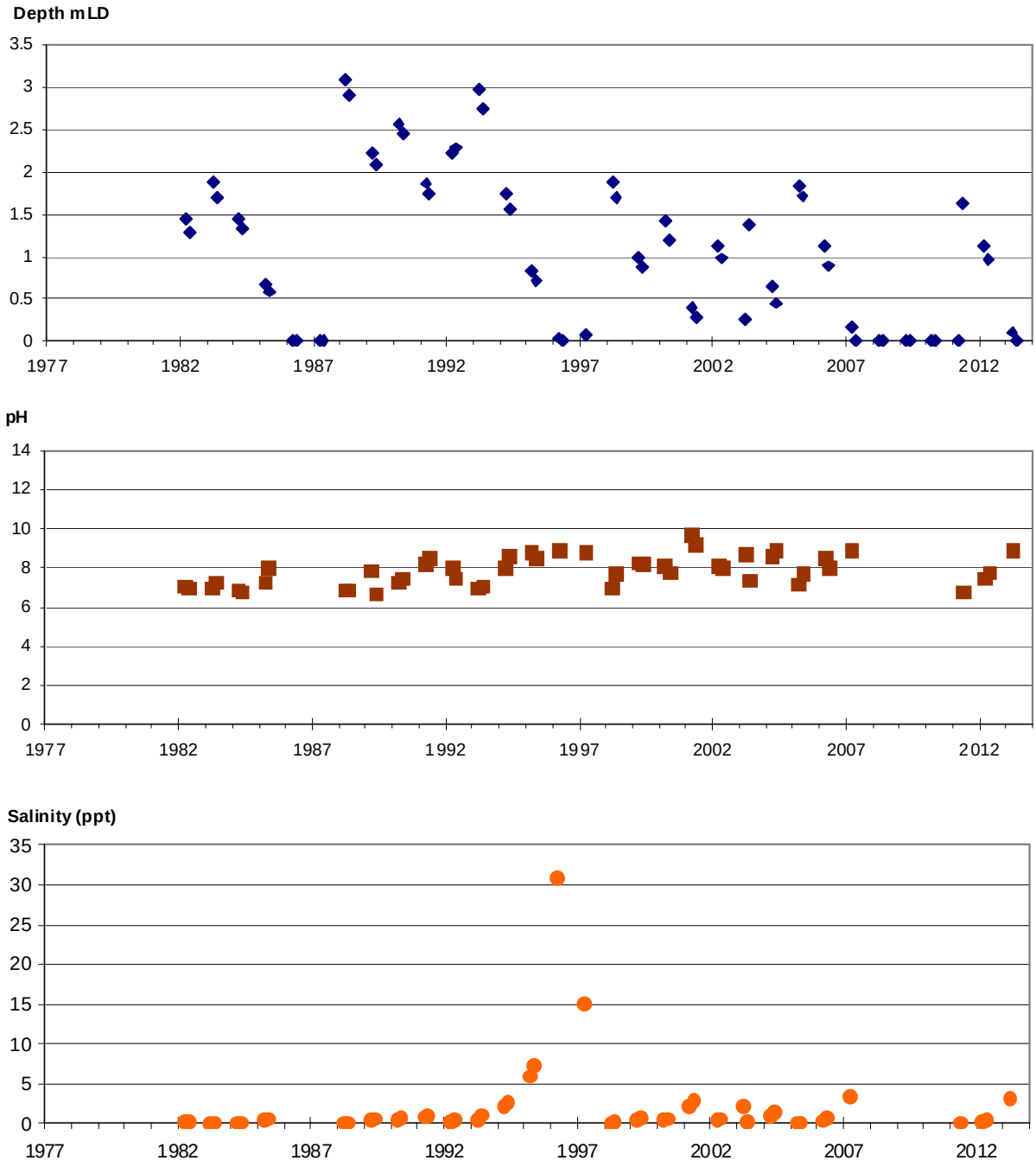


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Wilson is a component of the 'Gingilup-Jasper Wetland System', which is listed in the 'Directory of Important Wetlands in Australia'.

Wilson is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

YAALUP [IM]

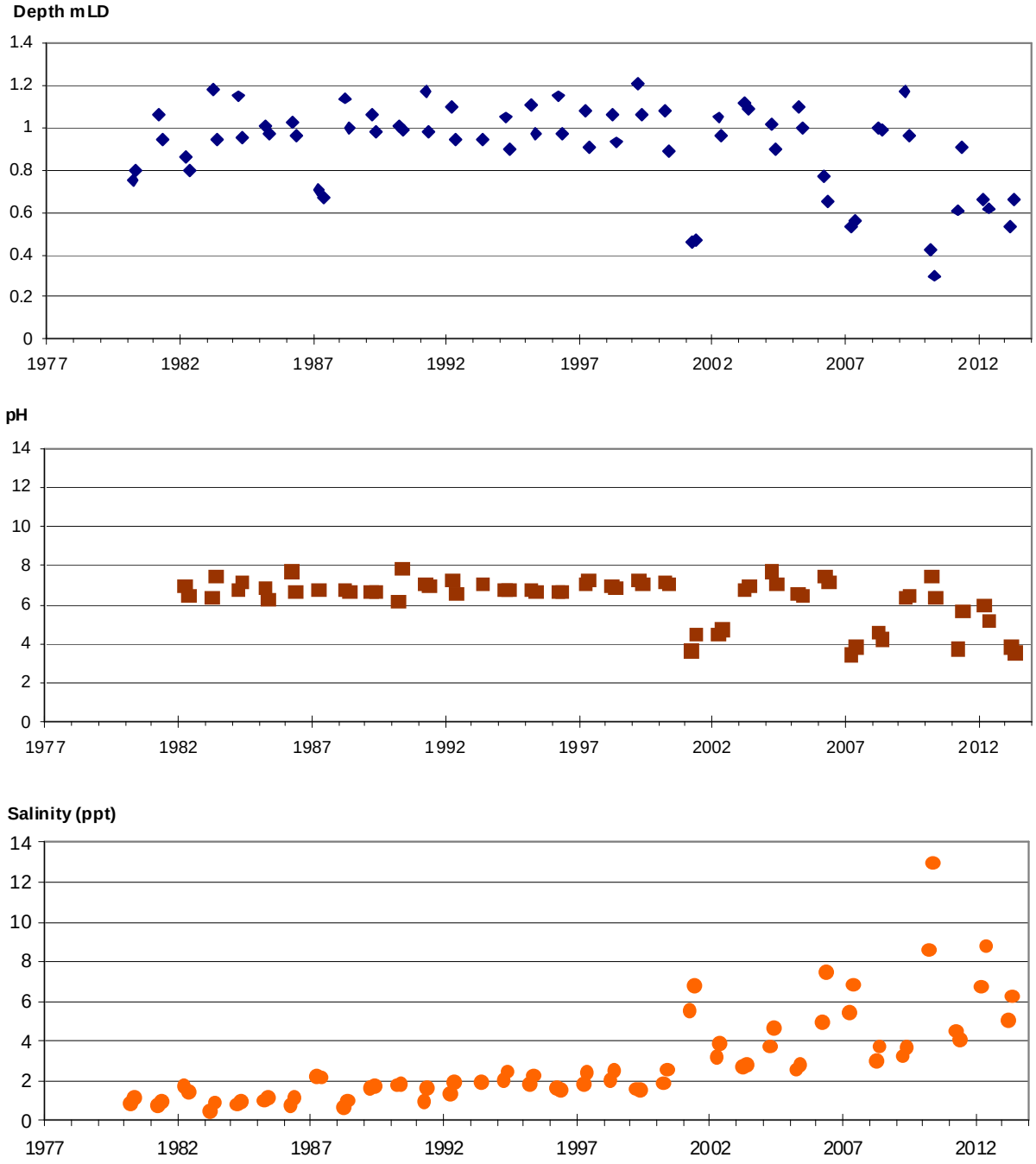


Notes:

1. [IM] indicates this is one of 25 wetlands Intensively Monitored for additional biological and physico-chemical attributes.
2. Year labels are positioned at 1st July each year.
3. Data are from September and November routine monitoring periods only.

Yaalup is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

YARNUP



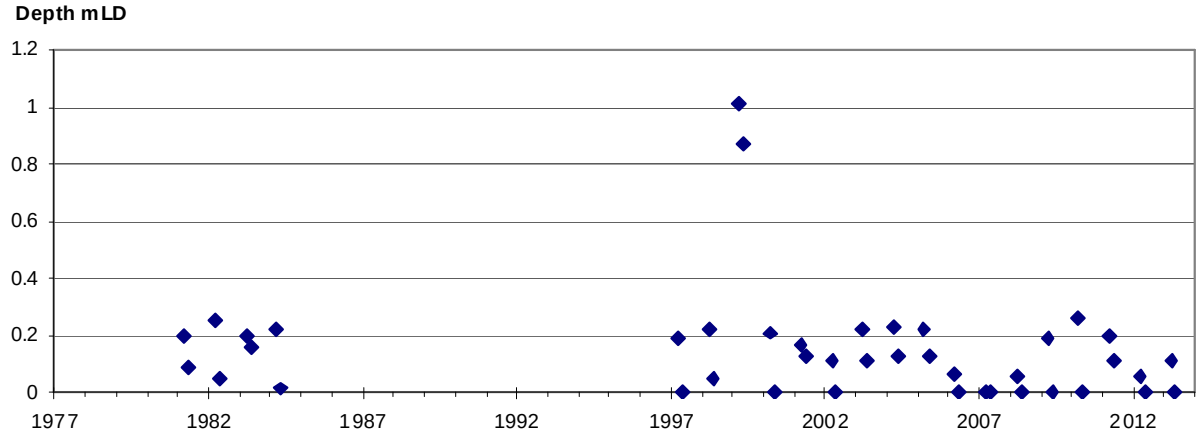
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

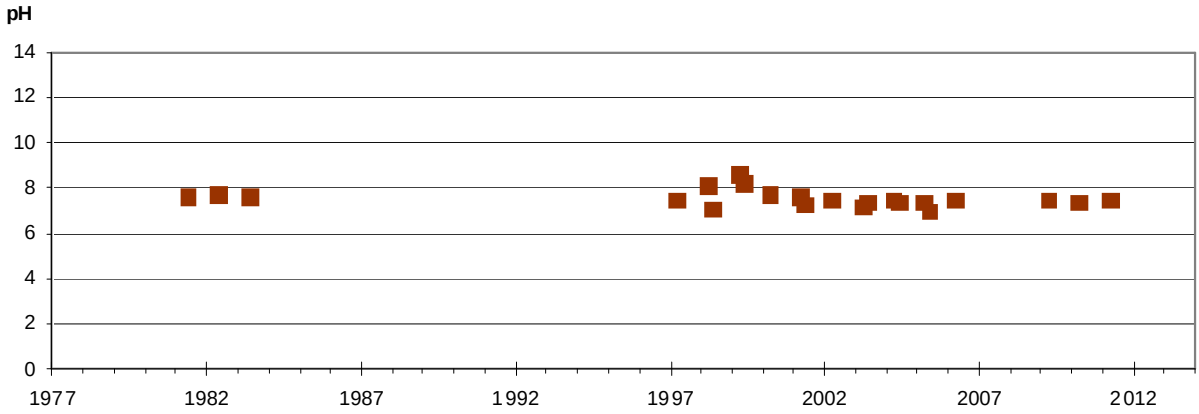
Yarnup is a component of the 'Byenup Lagoon System', which is listed in the 'Directory of Important Wetlands in Australia'.

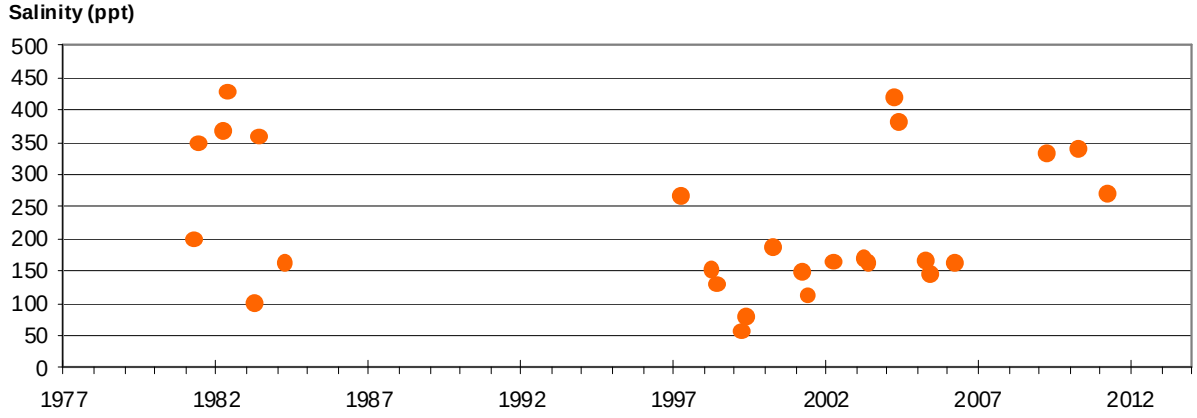
Yarnup is within the former Muir-Unicup Natural Diversity Recovery Catchment.

Yarnup is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

YARRA YARRA



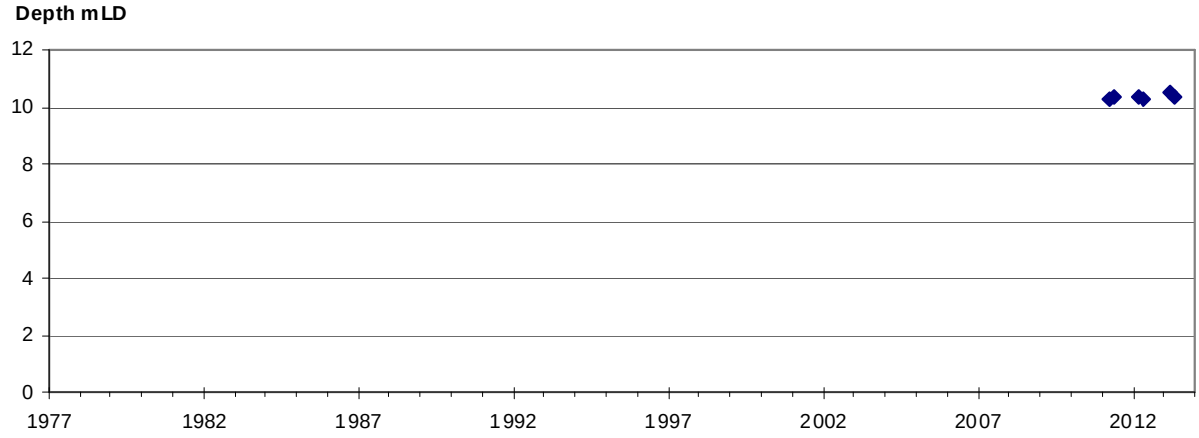


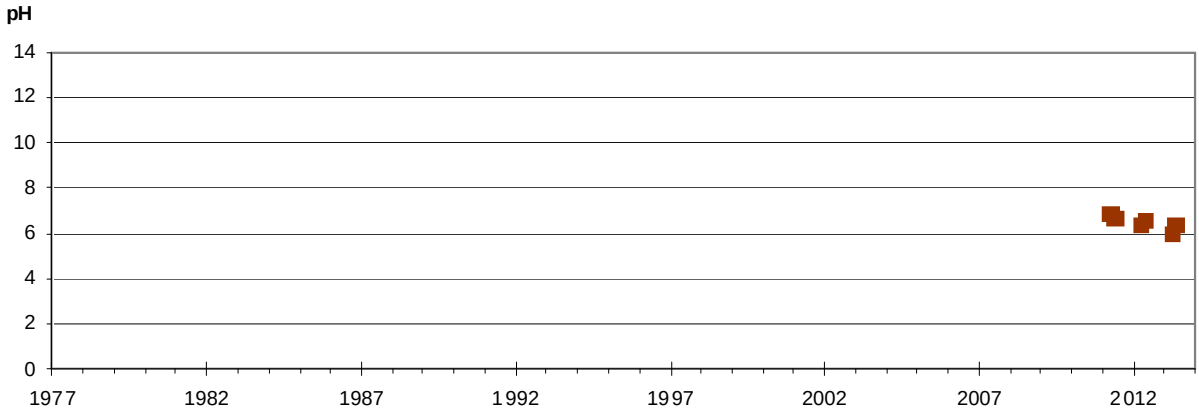


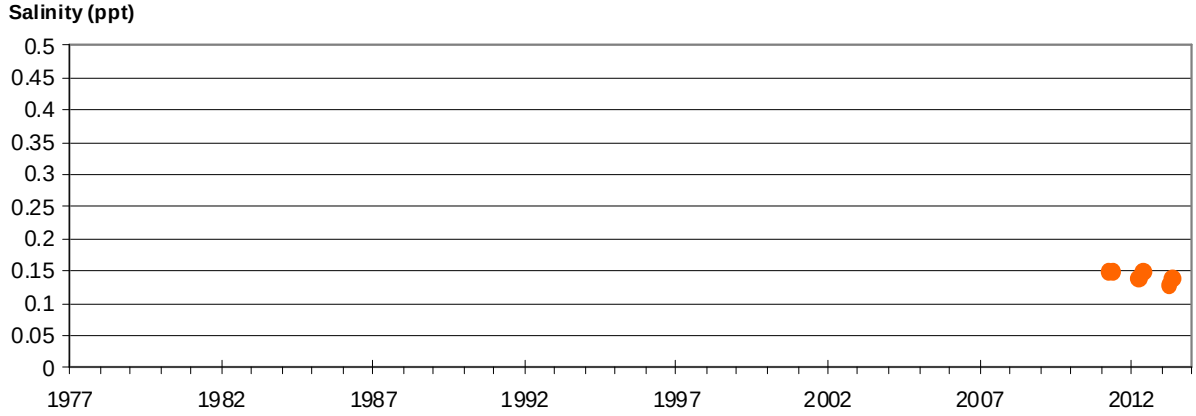
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Yarra Yarra is in the Moora District (headquartered in Jurien Bay) of the Midwest DPaW Region.

YEAGARUP



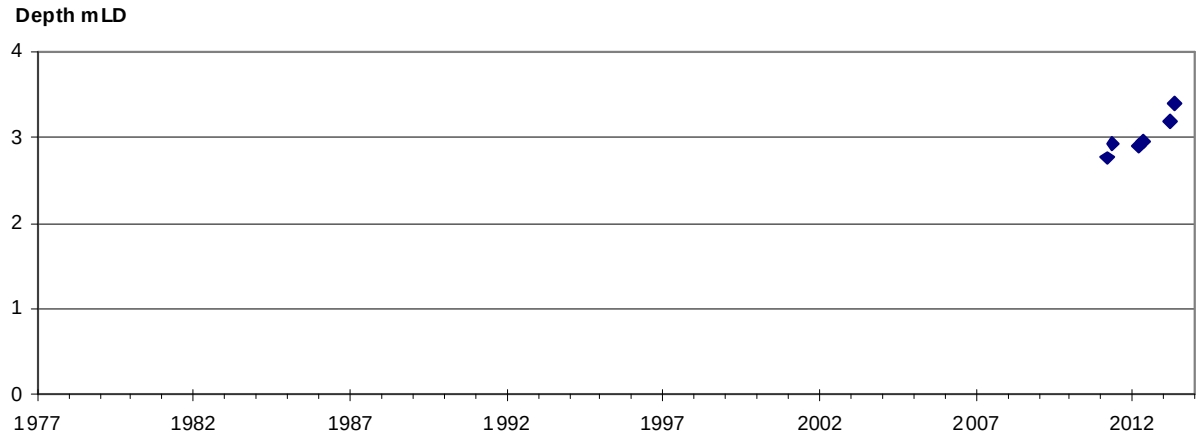


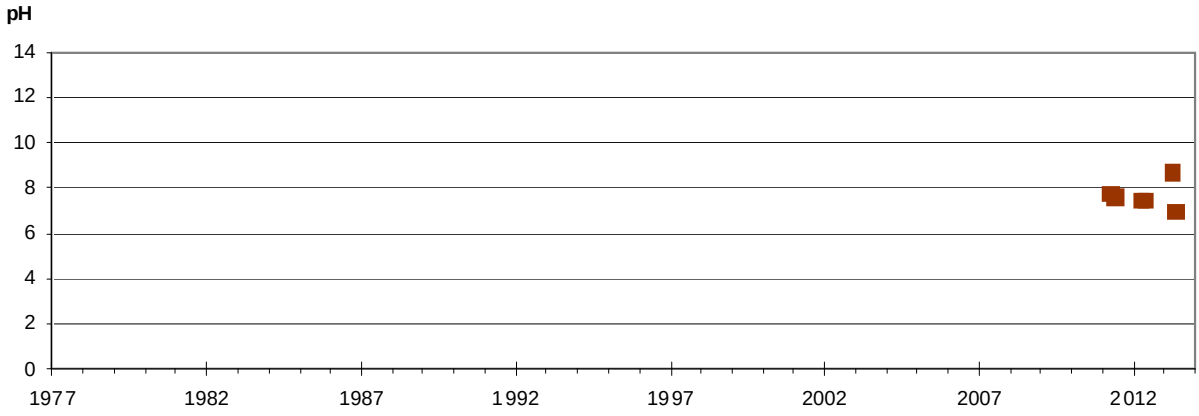


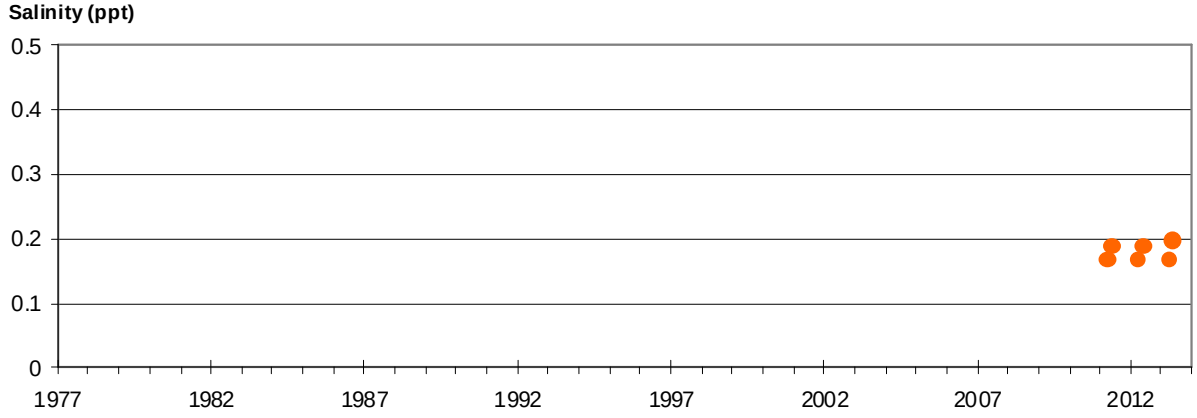
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Yeagarup is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

YEAGARUP SOUTH



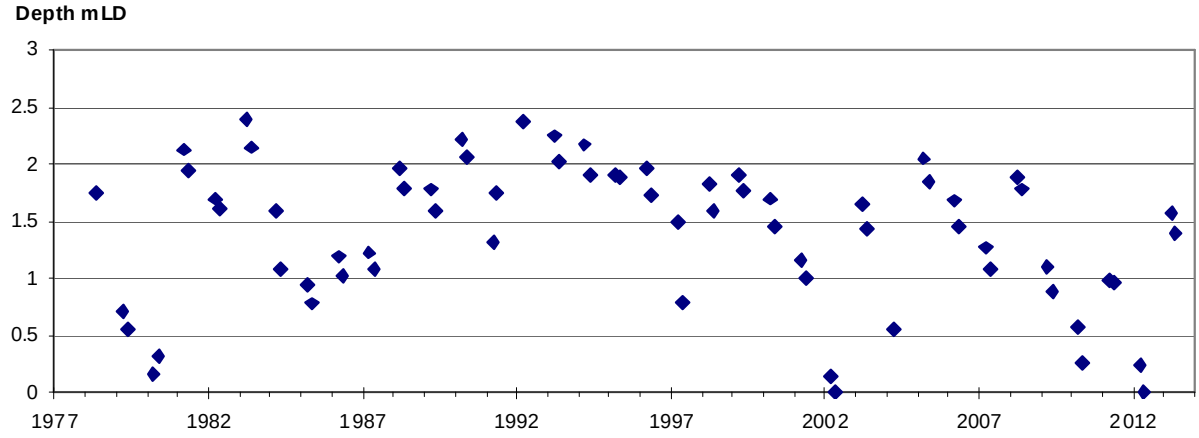


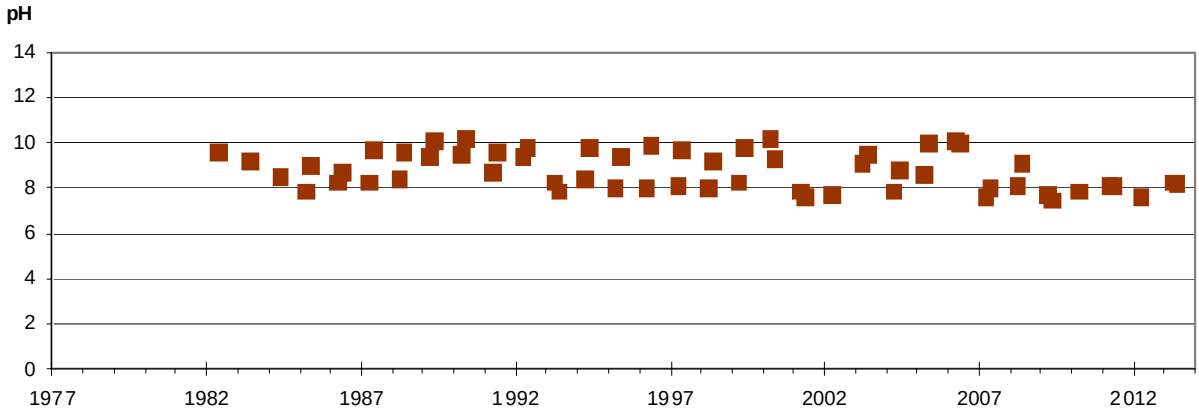


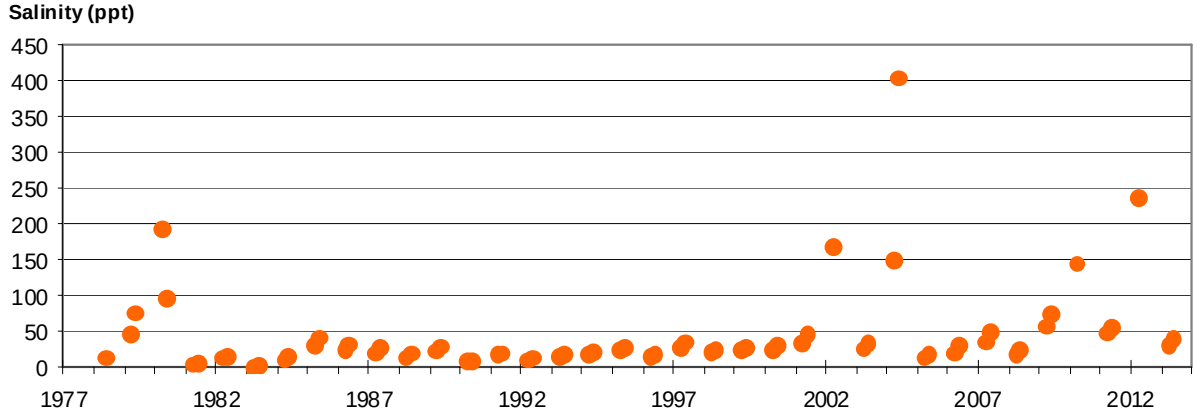
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Yeagarup South is in the Donnelly District (headquartered in Pemberton) of the Warren DPaW Region.

YEALERING





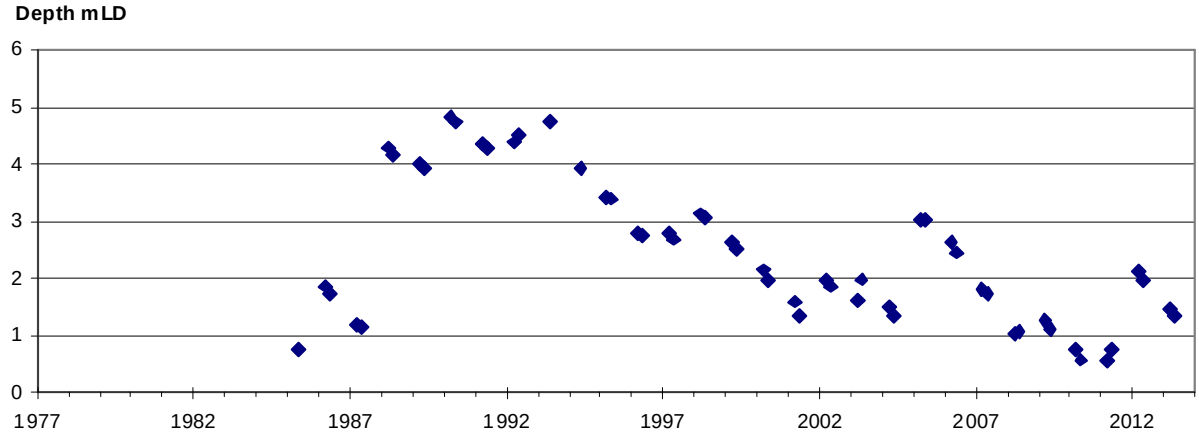


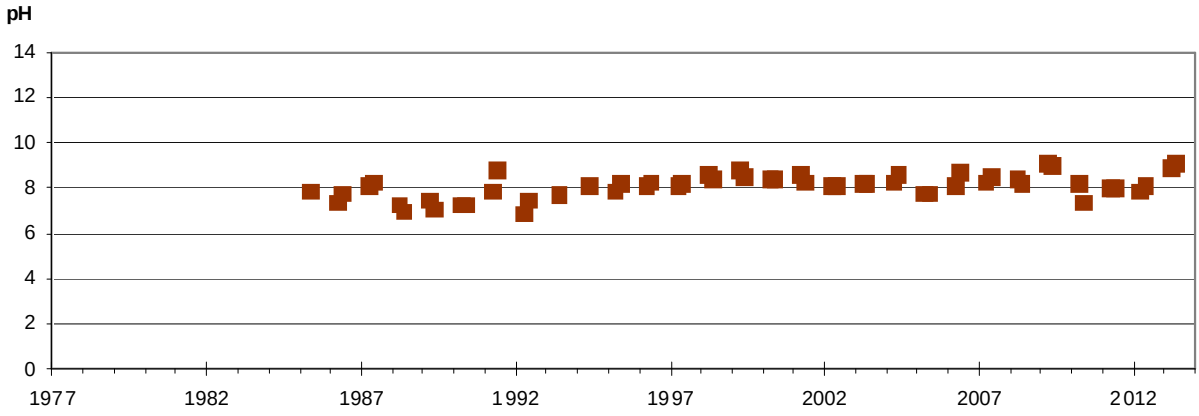
Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

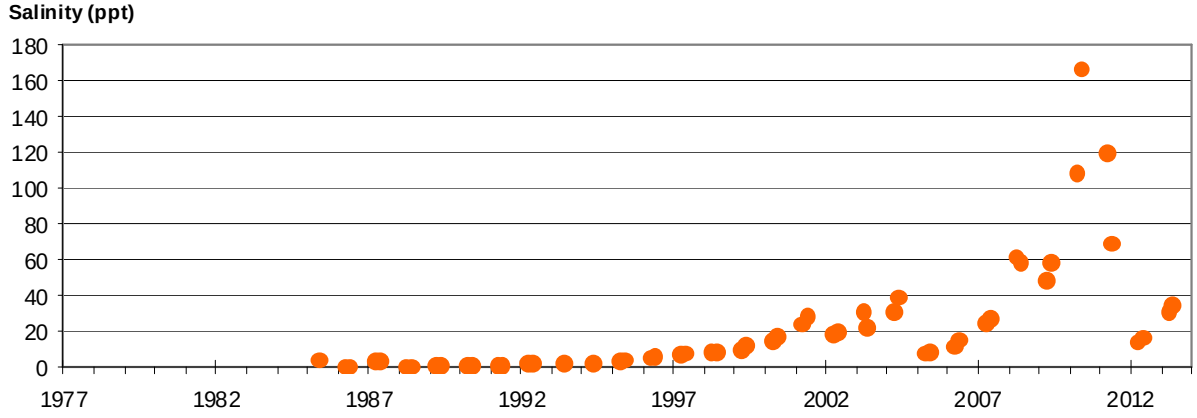
Yealering is a component of the 'Yealering Lakes System', which is listed in the 'Directory of Important Wetlands in Australia'.

Yealering is in the Great Southern District (headquartered in Narrogin) of the Wheatbelt DPaW Region.

YELLILUP





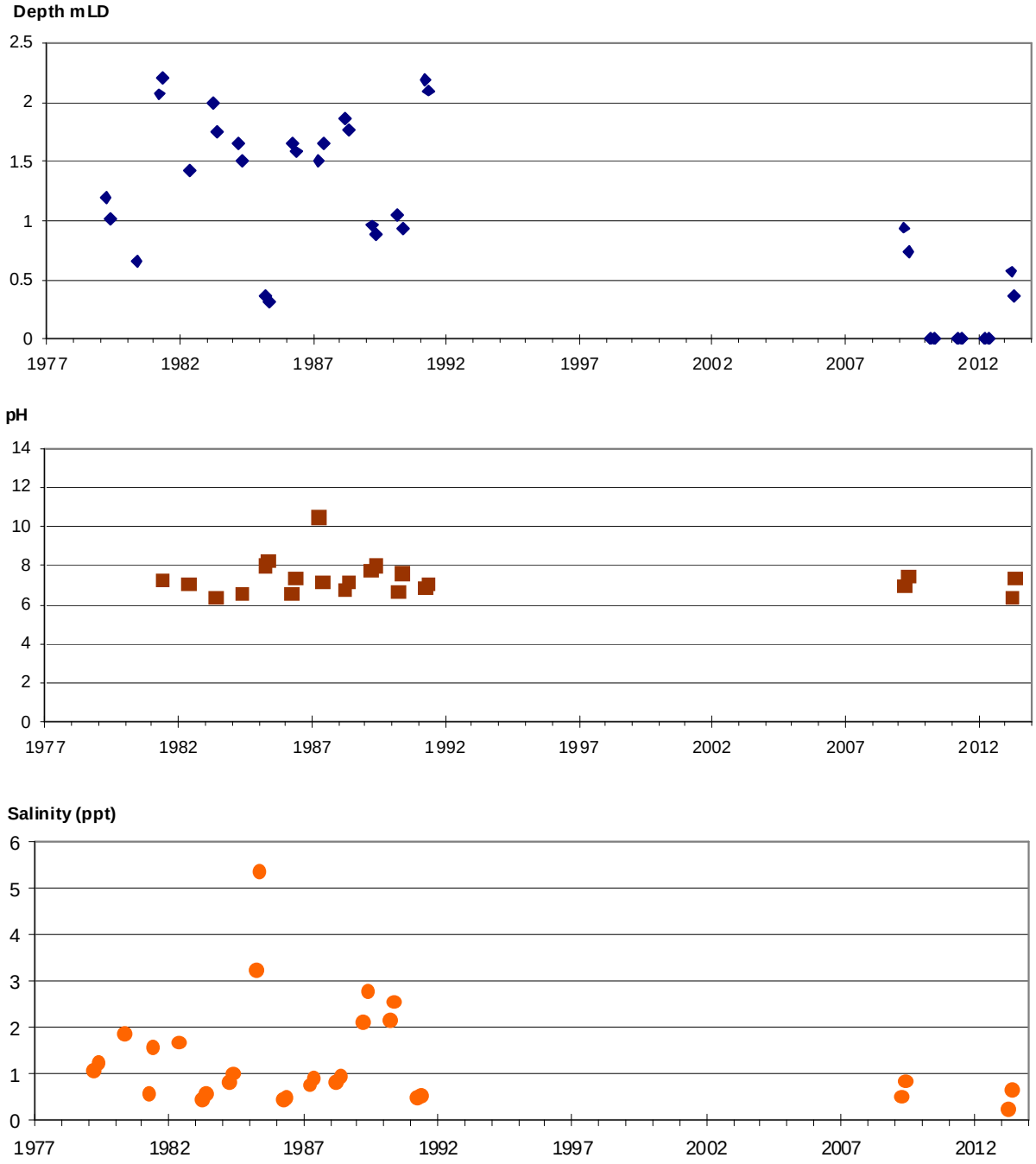


Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Yellilup Lake is a component of the 'Yellilup Yate Swamp System', which is listed in the 'Directory of Important Wetlands in Australia'.

Yellilup is in the Albany District of the South Coast DPaW Region

YURINE



Notes:
1. Year labels are positioned at 1st July each year.
2. Data are from September and November routine monitoring periods only.

Yurine is in the Swan Coastal District of the Swan DPaW Region