Assessment of conservation status of wetlands in the Trayning area in relation to disposal of saline deep drainage water

Prepared for
Avon Catchment Council
by Bennelongia Pty Ltd

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Report 2007/10

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1.0 Introduction

One of the most significant threats to wetlands in south-west Western Australia is salinisation (Halse et al. 2003). Salinisation lowers species richness at wetlands and tends to lead to specialized, higher conservation value species being replaced by widespread species with broad environmental tolerances. However, the impact of salinisation is not restricted to wetlands: it also has significant impacts of both the conservation values (Cramer & Hobbs 2001) and the agricultural productivity (Short & McConnell 2000) of terrestrial ecosystems. One of the recent advances in reducing the impact of salinisation in terrestrial ecosystems has been wider use of deep drainage (Ruprecht et al. 2004).

The greatest environmental concern regarding deep drainage is where the water goes (Halse 2004). It will usually be hypersaline and often acidic (Ali et al. 2004). There are several available methodologies for assessing the ecological effect of disposing of the water in wetlands (e.g. Coleman et al. 2000, 2004) but they are costly to implement and, in late 2004, the Cabinet Standing Committee on NRM and Salinity endorsed a new approach that would simplify the propose by tailoring the level of assessment to the likely level of impact (CALM 2004)

The "Evaluation Framework for Assessment of Impacts to Wetlands Receiving Water from Engineering Solutions Designed to Reduce Salinity" (CALM 2004) assigns wetlands to three drainage categories that reflect their suitability for receiving drainage. Category 1 wetlands, which are those in near natural condition, must be referred to the EPA. Category 3 wetlands, where considerable anthropogenic disturbance has occurred (usually salinisation), can be drained into provided there will be no adverse impact on downstream wetlands.

Work is currently underway within the Department of Environment and Conservation (DEC), funded by the Avon Catchment Council (ACC) and the State Strategic Reserve Fund, to assign all wheatbelt wetlands to a drainage category. While CALM (2004) described the characteristics of wetlands in each drainage in terms of the level of disturbance, it did not provide much information about how to assign a wetland to a particular category. The principal document used by government agencies for this purpose is the "Framework for mapping, classification and evaluation of wetlands in Western Australia" (DEC 2007). It is aimed at assessing the conservation values of wetlands through scoring biological, geomorphic and hydrological values, rather than inferring the loss of values through measurements of disturbance. Full use of DEC (2007) requires wetlands to be previously studied, so that assessment can be done as a desktop exercise, or requires detailed on-ground assessment.

The more specific aim of this report is to assess the conservation values of a series of wetlands downstream of a deep drain at Trayning (Gent's Drain) to inform decisions about disposal of water from this drain. A secondary objective is to develop a pragmatic framework for rapid assessment of the conservation values of wetlands to feed into the evaluation framework of CALM (2004). The approach to assessment is that, in a disturbed landscape such as the wheatbelt, there are only two fundamental issues for assessment of conservation value:

1. How do the current values of the wetland compare with its original ecological, hydrological and geomorphic values?
2. Are the current values significant in their own right (independent of any decline that may have occurred)?

2.0 Methods

Seven wetlands were nominated by the ACC as part of a project dealing with "Assessment of wetlands impacted by proposed deep drainage activities (Trayning)" (Table 2.1, Figure 2.1). Five of the wetlands (#s 1, 2, 3, 4, and 5) were visited on 20 and 22 August 2007 and the remaining two (#s 6 and 7) were visited on 5 September 2007. All contained some water, although in the case of wetland #s 3, 4 and 7 it was only a film.

The information collected at each wetland is summarized in Table 2.2. Information on vegetation health, anthropogenic disturbance, grazing, erosion and other geomorphic disturbance, flooding regime and water salinity and pH, and salt crust development, algal mats and macrophytes were used to estimate the departure of the wetland from natural condition. To a large extent, this methodology requires an expert assessor or panel, which was provided for wetland #s 1-5 by Grant Pearson and Stuart Halse and for wetland #s6 and 7 by Grant Pearson. The context they used for assessment was detailed knowledge of wetlands throughout the wheatbelt gained over the past 20-30 years during projects such as vegetation surveys in wetland nature reserves (Halse et al. 1993), Annual Waterfowl Counts (Halse et al. 1995), the State Salinity Strategy biological survey (Halse et al. 2004) and DEC's wetland monitoring programs (Cale et al. 2004; Lane et al. 2004, Lyons et al. 2007).

Interpretation of the current values of a wetland has four elements: whether the wetland supports a rare species or community (e.g. perhaps a declared rare plant species, DRF), hosts large numbers of species, has an important ecological or hydrological function (e.g. is a drought refuge and supports large numbers of common waterbirds at the end of summer), or has high representative value in terms of being a typical and good example (or one of the few) of a geomorphic type of wetland, hydrological process or biological community.

In most applications of the assessment scheme proposed in this report the importance of the current biological values of a wetland would be inferred from the parameters used to estimate departure from natural condition, except that waterbird values might be assessed on the site visit. At the Trayning wetlands, however, the species of riparian vegetation present at the entry point to the wetland (Table 2.1) were identified and aquatic invertebrates were collected from four of the wetlands to check whether inferred wetland values matched measured biological values.

Table 2.1. Locations where water quality measurements were taken from the seven wetlands assessed at Trayning. Information for Gents Drain in included for comparison. Areas are approximate

Lake #	Date	Latitude	Longitude	Area	E. cond. mS/cm	pH	Depth (m)
1	220807	31°10'38.84"	117°50'49.81"	6	19.27	2.9	0.2
2	220807	31°10'50.86"	117°51'06.88"	7	10.34	3	0.26
3	220807	31°11'47.66"	117°51'51.50"	8	24.48	5.6	0.01
4	220807	31°12'45.42"	117°52'35.32"	115	25.52	3.7	0.02
5	220807	31°15'35.47"	117°55'24.65"	170	25.89	3.5	0.06
6	050907	31°12'02.66"	117°51'30.45"	8	219.8	2.65	0.02
7	050907	31°11'41.86"	117°51'17.33"	4	177.9	2.50	0.10
Drain	220807	31°09'14.10"	117°51'40.70"	-	10.82	3.2	0.5

Figure 2.1. Location of the seven wetlands in relation to the town of Trayning. Gents runs through the drainage in which the wetlands occur but ceases north of wetland #2.

Table 2.2. Types of information used in wetland assessment ([1] includes photographs of the wetland)

Types	Parameter
Disturbance measures	Visual assessment of level of anthropogenic disturbance to the wetland and immediate hinterland [1] health of wetland riparian vegetation, incl. death due to salinisation or other causes extent of grazing and associated loss of plant communities erosion/sedimentation and other geomorphologic change depth of salt crust (also measurement)
Value	Estimated percentage cover of submerged macrophytes Visual assessment of percentage cover and development of algal mat
Interpretat-ion measure	Water salinity (as electrical conductivity) pH depth (to assist interpret salinity values) Turbidity (visual assessment)
Value	Representativeness (i.e. is it good example of wetland type) Waterbird diversity and significance of species and numbers present Aquatic invertebrate diversity and significance of species present Riparian and aquatic plant diversity and significance of species present Geomorphologic rarity Unusual water chemistry or hydrological significance

3.0 Results

All seven wetlands represented highly degraded systems with little residual ecological value (Table 3.1). Cropland occurred in very close proximity (<100 m) to all of them except wetlands #s 6 and 7. These were located in a small shire reserve but cropland occurred within 1 km of the wetlands. In consideration of this, and the significant impact of salinisation on the landscape within the reserve, the degree of anthropogenic disturbance in the hinterland of all wetlands was scored as high.

It is interesting to note that, although most wetlands contained little water and the water present was mainly derived from surface run-off from recent rain, all wetlands were acidic (pH was very low everywhere except wetland #3). The invertebrates occurring in the wetlands reflected low pH and included acidophilic ostracods, brine shrimps and chironomids (*Australocypris bennetti*, *Diacypris* sp. 523, *Parartemia contracta*, Orthocladiinae S03 sp. C; see Geddes 1981; Pinder et al. 2004; Halse & McRae 2004).

Condition of each wetland is described in the annotated accounts below, with a synopsis provided that relates wetland values to the key criteria used by CALM (2004) for assessment of suitability to receive drainage water. Plant and invertebrate species lists are presented as Appendices 1 and 2

Table 3.1 Measurements of the condition and values of the Trayning wetlands (adapted from ND001 Avon Baselining wetland component, Sim et al. 2007). Note that all parameters are scores on a scale of 1-3, with 1 representing natural condition, except for those in italics where raw data are presented.

Wetland	1	2	3	4	5	6	7
Assessor	GP/SH	GP/SH	GP/SH	GP/SH	GP/SH	GP	GP
Disturbance							
Anthropogenic change in hinterland (<1 km)	3	3	3	3	3	3	3
Anthropogenic change in wetland	3	3	3	3	3	3	3
Riparian health	3	3	3	3	3	3	3
Erosion/sedimentation	3	3	3	3	3	3	3
Grazing	3	3	3	2	2	3	3
Weeds	2	2	2	2	2	2	2
Indicator of values							
Extent of macrophytes	3	3	3	3	3	3	3
Extent of algal mats	3	3	3	3	3	3	3
Thickness of salt crust (cm)	*0.5*	*0*	*0*	*0*	*2.5*	*2.0*	*0.5*
Values							
Complexity of vegetation structure	3	2	3	2	3	2	3
Plant species richness	*4*	*10*	*5*	*12*	*20*	*13*	*13*
Plant conservation value	3	3	3	3	3	?2	?2
Waterbird species richness	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Waterbird conservation value	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Aquatic invertebrate species richness	*5*	*4*	*2*	*n/a*	*1*	*n/a*	*n/a*
Aquatic invertebrate conservation value	3	3	3	n/a	3	n/a	n/a
Geomorphology	3	3	3	3	2	2	3
Water chemistry	3	3	3	3	3	3	3
Ecological function	3	3	3	3	3	3	3

3.1 Wetland # 1

A small saline, acidic lake with no visible connection to the main drainage channel (Figure 3.1.1). The wetland is characterized by a very high level of anthropogenic influence that has severely degraded the biological values of the wetland and riparian vegetation. Overstorey and understorey shrub species of riparian zone have been almost eliminated, as has the original salmon gum woodland around the perimeter of the lake (Figure 3.1.2). Grazing by stock and rabbits has substantially suppressed recruitment of native and introduced plants.

On the eastern side of the wetland there is a low sand dune, sparsely vegetated with an open acacia shrubland that has been trapping recently windblown sand. Closer to the wetland on the eastern side, the soil is severely wind eroded and is devoid of live vegetation. Numerous stags of relic shrubs and trees are visible in this erosion zone.

The hinterland is currently under crop.

Figure 3.1.1. Lake #1, showing proximity to river system, and Lake #2 to the south east. The area of acacia where sand is being trapped is visible to the south-east of the wetland, with eroded bare sand between it and the sparse riparian vegetation

Figure 3.1.2. Wetland #1, looking south-west towards cropland. Remnant salmon gum woodland over callitris understory is highly degraded. Riparian wetland vegetation is highly degraded, with erosion of the wetland bank and accumulated sediment on the lake-bed visible

Figure 3.1.3. Looking east from wetland #1 at the low sand dune between it and the drainage channel. In the mid-ground is a sparse *Callitris canescens* woodland and one remnant *Santalum acuminatum* (Quandong). Wind erosion and grazing (sheep and rabbits) has prevented plant recruitment

Wetland #1 was highly disturbed, suggesting that it retained no significant wetland values. The biological surveys confirmed this. Only 4 plant, 5 aquatic invertebrate, and no waterbird species were present. While relatively low water level (0.2 m) may have reduced the number of animal species present (especially waterbirds), the importance of the wetland is unlikely to increase significantly when deeper.

Within the "Evaluation Framework for Assessment of Impacts to Wetlands Receiving Water from Engineering Solutions Designed to Reduce Salinity" (CALM 2004), wetland #1 clearly falls into Category 3.

Table 3.1.1 Relevant characteristics of wetland #1 in relation to the framework in CALM (2004)

Category	Condition	Vegetation	Salinity	Lakebed	Comments
3	Considerable anthropogenic disturbance	Extensive death extending well beyond the flood level	Salinity is very high but will vary with rainfall	Lakebed has thin salt crust.	No evidence of benthic mats or aquatic plants, low biological values

3.2 Wetland # 2

A small saline, acid in-line wetland showing high levels of impact from salinisation and the influence of inundation by floodwater (Figure 3.1.2). Overstorey and understorey shrub species of riparian zone have contracted substantially in distribution but still remain at higher elevations. There is evidence of considerable death of vegetation within the last year (some within the last few months), apparently as a result of inundation (Figures 3.2.1 and 2). Water levels had been substantially higher prior to field inspections. Currently, the wetland is characterized by a fringe of dead samphire and small patches of deteriorating melaleuca shrubland on slightly higher ground. Cropland occurs within a short distance of most of the wetland. A small eroded dune to the east supports the remnant of an acacia shrubland.

Wetland #2 was highly disturbed, suggesting that it retained no significant wetland values. The biological surveys confirmed this. The lake was relatively fresh compared with nearby wetlands (ca. 10 mS/cm) but supported only 10 plant and 4 aquatic invertebrate species. No waterbird species were present, despite more water occurring in this wetland than others. The importance of the wetland is unlikely to increase significantly when it becomes deeper.

Within the "Evaluation Framework for Assessment of Impacts to Wetlands Receiving Water from Engineering Solutions Designed to Reduce Salinity" (CALM 2004), wetland #2 clearly falls into Category 3.

Table 3.2.1 Relevant characteristics of wetland #2 in relation to the framework in CALM (2004)

Category	Condition	Vegetation	Salinity	Lakebed	Comments
3	Considerable anthropogenic disturbance. Considerable wind erosion	Extensive death of all plant species, extending well beyond flood level	Salinity is very high but will vary with rainfall events	No aquatic plants or mats	Algal bloom, condition deteriorating condition, low biological values

Figure 3.2.1. Wetland #2, salt/acid damaged samphire plants in the foreground and samphire plants that had succumbed to inundation in the middle distance

Figure 3.2.2. Wetland #2 where flooding had killed much of the low samphire marsh, especially along drainage lines. Compacted pathways created by sheep provided an additional impediment to recruitment of native plants. The melaleuca shrubland in the background was thinned and severely affected by inundation with saline/acidic water

3.3 Wetland #3

A small circular saline, slightly acidic wetland that lies about 700 metres east of the main river system, off a less incised channel. The lake has a single drainage connection to the river system on the west side that allows entry of river water during flood events and exit when the lake is full. Cropland occurs very close to the eastern boundary of the lake and sheep grazing has impacted severely on the recruitment and survival of native vegetation around the entire lake. Overstorey and understorey shrub species of the riparian zone have contracted substantially in distribution but there are occasional remnants at higher elevations. To the west, is a severely degraded salmon gum woodland occurs.

Wind and water erosion has undercut the wetland's banks and lead to substantial siltation of the lakebed. The film of water on the lakebed at the time of the survey was saline, but only slightly acidic (pH 5.6), unlike other wetlands which had strongly acidic water. The remnants of an old fence line through the lake are still present.

Wetland #3 was highly disturbed, suggesting that it retained no significant wetland values. Although salinised, the damage appeared to be related principally to clearing of riparian vegetation for cropping and grazing in remnant vegetation, which had led to erosion. The biological surveys confirmed the low value of the wetland, although there was so little water present that waterbird and aquatic invertebrate usage could not be assessed properly.

Within the "Evaluation Framework for Assessment of Impacts to Wetlands Receiving Water from Engineering Solutions Designed to Reduce Salinity" (CALM 2004), wetland #3 clearly falls into Category 3.

Table 3.3.1 Relevant characteristics of wetland #3 in relation to the framework in CALM (2004)

Category	Condition	Vegetation	Salinity	Lakebed	Comments
3	Considerable anthropogenic disturbance through loss of vegetation because of clearing and grazing	Extensive loss of vegetation structure, extending well beyond the riparian zone	Salinity is high but will vary stage of the hydrological cycle	No salt crust evident, no aquatic plants or algal mat present	Significant wind and water erosion and sedimentation, low biological values. Waterbird values unlikely to be realized unless pH rises

Figure 3.3.1. Wetland #3, showing connectivity to the drainage line and proximity of eastern half of wetland to farmland. Wetland 4, showing its connection on the western side to the drainage line and the extent of cropping around it

Figure 3.3.2. Wetland #3, showing siltation of the lake from wind and water erosion of the lake shore, which has been exacerbated by grazing

Figure 3.3.3. Wetland #3 where cropping to the edge of the wetland and grazing of stock has removed native vegetation

3.4 Wetland #4

A medium-sized circular saline, acid wetland that is connected to the main river system by one channel on the south west corner. While water levels were extremely low at the time of the survey (0.02 m), flooding in the recent past has killed much of the salt marsh community along the drainage channel and around the edge of the wetland. The melaleuca woodland at higher elevation on the southern shore shows signs of stress that is probably the result of inundation of the root zone with saline acidic water.

Wetland #4 was highly disturbed, with extensive areas of dead vegetation and erosion along the drainage channel and western bank of the wetlands. On the western and northern shores, much riparian and all upland vegetation that might provide a buffer for the wetland has been cleared. The wetland values of #4 were low although, if pH rises a couple of units, it may support moderate numbers of waterbirds in the wetland and drainage channel when water levels are high (few waterbird species occur in significant numbers at pH less than about 5.5, see Goodsell 1990). No invertebrate survey was undertaken because of the low water level but 12 riparian plant species were collected.

Within the "Evaluation Framework for Assessment of Impacts to Wetlands Receiving Water from Engineering Solutions Designed to Reduce Salinity" (CALM 2004), wetland #4 falls into Category 3, although it appears to have gone through a transition from 2 to 3 recently.

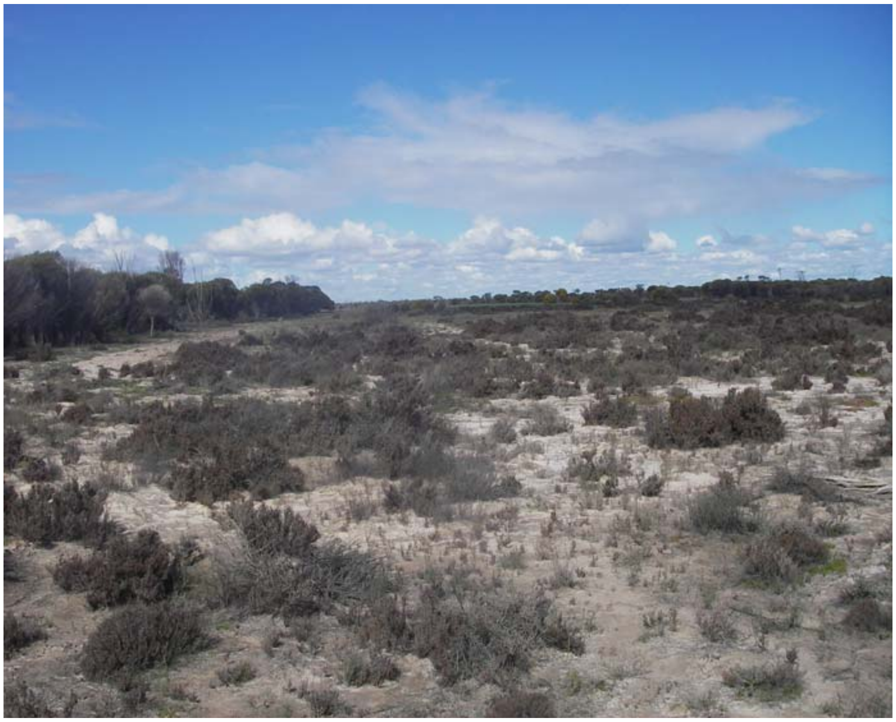

Figure 3.4.1. Wetland #4, showing that flooding or rising groundwater has killed much of the samphire community in the swale behind the first dune on the south side of the lake. The melaleuca woodland on the low dune marking the usual shoreline (when flooded) is showing significant stress. Little recruitment of saltmarsh plants was observed

Figure 3.4.2. Looking south along the dune within the lake on the western side, illustrating the loss of overstorey riparian vegetation and the poor health of remnant saltmarsh communities

Table 3.4.1 Relevant characteristics of wetland #4 in relation to the framework in CALM (2004)

Category	Condition	Vegetation	Salinity	Lakebed	Comments
3	Considerable anthropogenic disturbance through salinisation	Extensive death of plant species extending through much of the riparian zone	Salinity is high	No salt crust evident, no aquatic plants or algal mat	Water level was too low to assess invertebrates and waterbirds

3.5 Wetland # 5

A medium to large saline, acidic wetland with a single direct connection to the main river system. The lake has a well developed dune system with three dunes with two swales between them. The last dune rises to upland that has been cleared. However, much of the beach vegetation and first dune is dead and vegetation on the lower parts of the other two dunes is also dead, with the remainder looking as though it is dying back (although some recruitment was occurring on the back edge of the middle dune). Much of the samphire in the swales is also dead or unhealthy, while a thick salt crust (2.5 cm) occurs on the lakebed, suggesting there is discharge of groundwater is occurring. As in most of the wetland system, pH is very low (3.5).

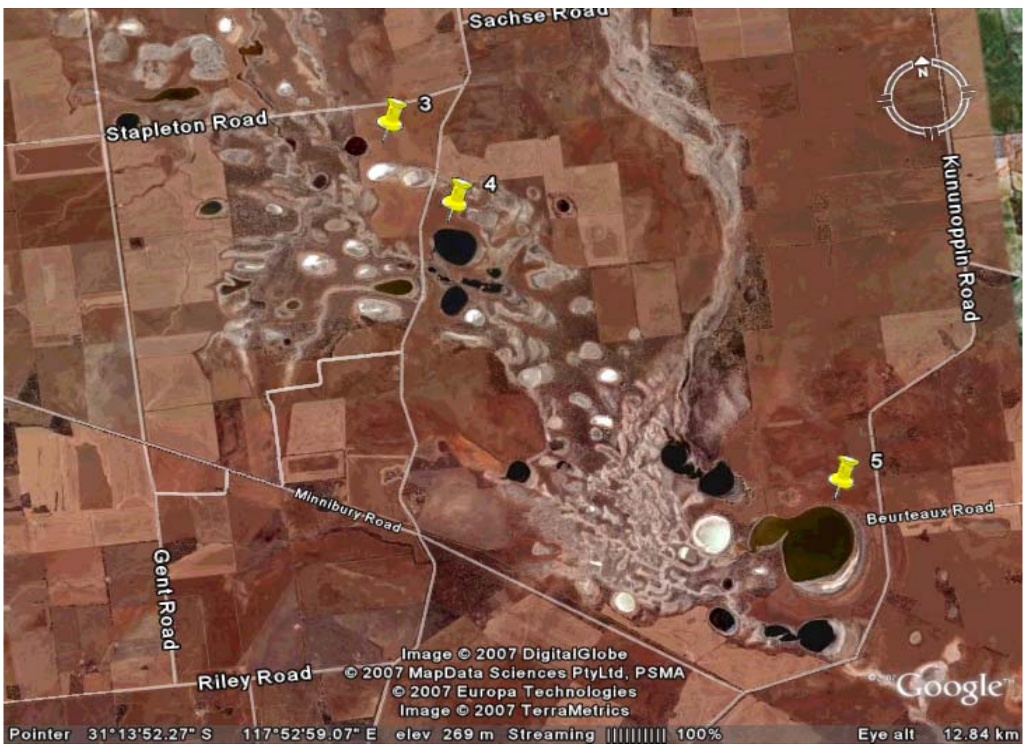

Figure 3.5.1. Wetland #5 connection to the main river system and proximity to wetland #4

Figure 3.5.2. Wetland #5, showing the loss of the melaleuca community on the face of the first dune and beach

Figure 3.5.3. Wetland #5, showing the extent of plant death on the back of the second dune. The saltmarsh community in the swale are also sparse and unhealthy

Wetland #5 was highly disturbed, suggesting that it has no significant wetland values. Although well-developed, the dune system (which is eroding) is replicated in many wheatbelt wetlands in better condition. Surveys revealed no waterbirds (although water was shallow, 0.06 m), a single invertebrate which is only semi-aquatic, and 20 plant species. None of the plants species had conservation significance and most were in poor condition.

Within the "Evaluation Framework for Assessment of Impacts to Wetlands Receiving Water from Engineering Solutions Designed to Reduce Salinity" (CALM 2004), wetland #5 falls into Category 3.

Table 3.5.1 Relevant characteristics of wetland #5 in relation to the framework in CALM (2004)

Category	Condition	Vegetation	Salinity	Lakebed	Comments
3	Considerable anthropogenic disturbance through loss of vegetation because of clearing and grazing	Extensive loss of vegetation structure, extending well beyond the riparian zone	Salinity is high but will vary stage of the hydrological cycle	No salt crust evident, no aquatic plants or algal mat present	Significant wind and water erosion and sedimentation, low biological values. Waterbird values unlikely to be realized unless pH rises

Figure 3.5.4. There is the severe erosion around the beach and first dune of wetland #5, as shown by the exposed roots of dead casuarinas. In some areas there is very little vegetation.

3.6 Wetland #6

A small acidic, saline lake that receives water from the main river system. Riparian overstorey and understorey shrub species have contracted substantially in distribution but still remain around the wetland margins at higher elevations. Much of this vegetation is, however, highly impacted by prolonged inundation within the last 5 years or so and on the north side the shrubland of melaleucas remains only as dead stags, while the area of samphire has contracted. Recruitment of succulents and introduced weed species is occurring in higher parts of the dune around the wetland.

Salt accretion was evident along the foreshore and a thick salt crust occurred on the lake bed, suggesting the discharge of groundwater is occurring at wetland #6. A channel on the southern side suggests that water levels have been sufficiently high to breach the southern dune and drain out of the lake to the south.

Figure 3.6.1. The location of wetland # 6 in relation to the main drainage and wetlands #3 and 7. Note wetland #6 is usually a terminal basin and overflows only during periods of significant flooding

Figure 3.6.2. Wetland 36, illustrating the heavy salt deposits and impact on the riparian vegetation of flooding with acidic saline flood water

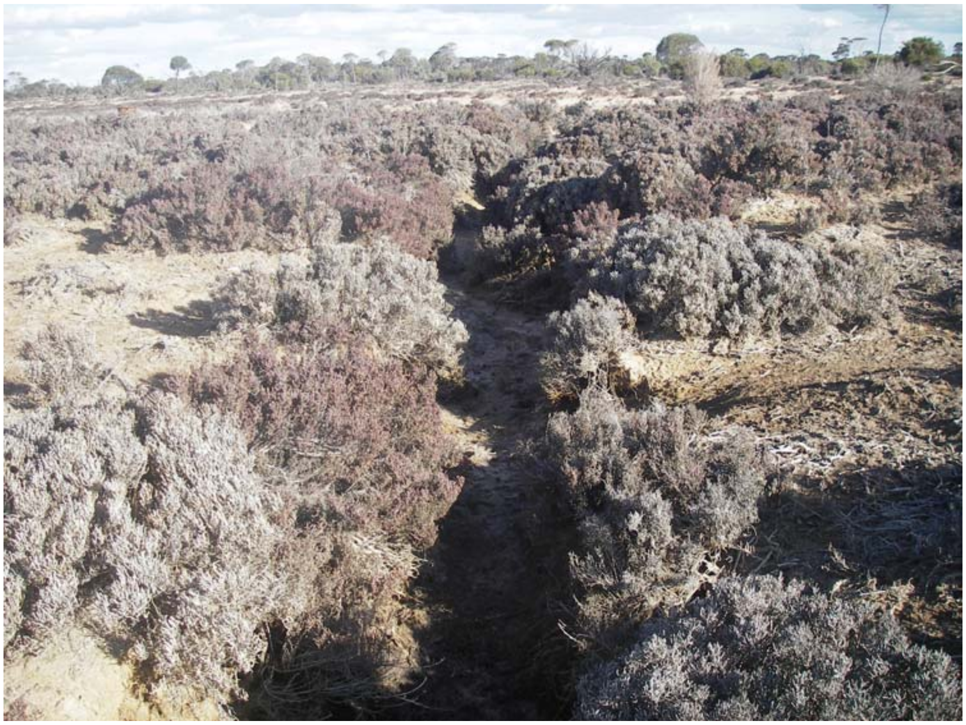

Figure 3.6.3. A deep channel has been cut out of wetland #6 by floodwaters. The channel leads to a narrow drainage line to the south. Riparian vegetation in this area is heavily salt-affected. No recruitment is evident

Figure 3.6.4. The entrance of the river into wetland #6. In the foreground are dead stags of melaleuca and samphire, with recruitment of succulents on the higher parts of the dune. In the background is the contracting riparian zone of samphire, low melaleuca and acacia that leads to a salmon gum woodland on the uplands

Wetland #6 shows evidence of substantial disturbance, much of it relatively recent, that has lead to a decline in wetland values. Although quite well developed, the delta system at the inflow of the drainage line (which is eroding) is a common feature of wheatbelt wetlands in braided drainage lines, including those in better overall condition. The wetland was hypersaline at the time of survey (219.8 mS/cm), which further suggests that groundwater is discharging into it. No survey of aquatic invertebrates was undertaken but no waterbirds were present and the wetland appeared to have no significant floristic values (13 species) other than the possible occurrence of a Priority 3 plant species (*Brachyscome halophila* – see Discussion).

Within the "Evaluation Framework for Assessment of Impacts to Wetlands Receiving Water from Engineering Solutions Designed to Reduce Salinity" (CALM 2004), as a result of relatively recent decline in condition, wetland #6 falls into Category 3.

Table 3.6.1 Relevant characteristics of wetland #6 in relation to the framework in CALM (2004)

Category	Condition	Vegetation	Salinity	Lakebed	Comments
3	Substantial disturbance from increased flooding and/or groundwater discharge	Considerable death of vegetation extending beyond the flood level.	Hypersaline. Is a terminal wetland and accumulates salt	Lakebed has thick salt crust and no macrophytes nor algal mat	The lake has lost ecological value through recent salinisation of the riparian zone

3.7 Wetland #7

A small acidic, saline river pool that that is connected to wetland #6. Overstorey and shrub species of riparian zone have contracted substantially in distribution but still remain around the wetland margins at higher elevations. Much of this remnant vegetation is highly degraded. The acacia woodland on the west side of the pool beyond the riparian zone is contracting. There was a small shallow pool on the southern end of the wetland, with a thin salt crust, when visited.

Wetland #7 is highly disturbed, showing evidence of salinisation and grazing. It supports no significant wetland values: no waterbirds were seen and the 13 species of plant found had no significant conservation values except for the possible occurrence of *B. halophila*. Invertebrates were not sampled.

Within the "Evaluation Framework for Assessment of Impacts to Wetlands Receiving Water from Engineering Solutions Designed to Reduce Salinity" (CALM 2004), as a result of relatively recent decline in condition, wetland #7 falls into Category 3.

Table 3.7.1 Relevant characteristics of wetland #7 in relation to the framework in CALM (2004)

Category	Condition	Vegetation	Salinity	Lakebed	Comments
3	Considerable disturbance from increased flooding	Considerable death of vegetation extending beyond the flood level	Hypersaline	Thin salt crust present, no macrophytes nor algal mat	The pool has lost ecological value through recent salinisation of the riparian zone and fringing woodland

Figure 3.7.1. Wetland #7, illustrating the loss of riparian zone on the west and east sides following prolonged inundation

Figure 3.7.2. Wetland #7, showing sparse acacia woodland beyond the riparian zone

4.0 Discussion

Only limited information about a wetland can be obtained from a single visit when water level is low. While the information was sufficient to assign all seven Trayning wetlands to conservation category 3 of CALM (2004) except for a caveat about Priority Flora discussed below, some of our explanations for wetland decline and our interpretation of the temporal sequence of events may be flawed.

The mechanism by which salinisation acts on vegetation is complex, especially around wetlands. Differentiating the impacts of prolonged inundation, rising groundwater, and water quality on vegetation health is particularly difficult (Froend et al. 1987; Cramer & Hobbs 2002). Furthermore, most interpretation is based on existing studies of the impact of salinisation at wetlands that were originally fresh rather than naturally saline, such as playa wetlands of braided drainage line at Trayning (see Lyons et al. 2007). This provides little guidance to interpreting patterns of decline in playa wetlands within braided channels.

Playa wetlands are usually formed by groundwater discharge and aeolian events (Jankowski & Jacobsen, 1990; George & Coleman 2002: Boggs et al. 2006) and their vegetation structure reflects soil salinity, depth to groundwater and surface flooding history. Many plant species have evolved to grow in this environment where soil salt levels are relatively high even in dunes and there is only a short distance to a saline watertable. Despite the presence of shallow groundwater in naturally saline wetland systems, the low gradients around them and high evaporation rates usually means that discharge of groundwater through the lake-bed is sufficient to prevent watertables rising under riparian vegetation. Thus, at least in the early stages of salinisation, only the lowest parts of the system are impacted and vegetation continues to survive on features with topographic relief of about 0.5 m or more.

Significant loss of vegetation appears to occur mostly after major flood events, such as at Lake Campion in 2000 (Cale et al. 2004), or as a result of substantial piezometric head of groundwater that leads to widespread increases in soil salinity such as has occurred over the past 30 years at Lake Gounter (Halse et al. 1993). As a generalization, increased surface water inundation (whether ultimately derived from rainfall or run-off) is probably the most frequent cause of degradation in naturally saline and braided wetland systems (Halse 2004; Boggs et al. 2007).

Salinisation appears to be well advanced at Trayning and vegetation loss appears to be the result of increased flooding at some wetlands and groundwater rise at others. It is also possible that surface water in the Trayning wetlands has become more acidic as a result of salinisation and that has an additive effect to salinity in impacting vegetation. There has been considerable focus on deep drainage in the wheatbelt as a producer of acidic water (Ali et al. 2004; Ruprecht et al. 2004) but some areas in the wheatbelt have always had acidic saline groundwater. Many of the playa wetlands around Bruce Rock and Esperance were hypersaline and strongly acidic in their natural state (see Lane & Munro 1983).

There have been several past episodes of salinisation and, presumably, acidification in Western Australia's history (George & Coleman 2002; Harper & Gilkes 2004) and a few species of saline wetland fauna appear to have developed acid tolerance. This includes species of brine shrimp, ostracod and copepod and some dipteran larvae (see Pinder et al. 2004). The occurrence of some of these species in the Trayning wetlands (*Australocypris bennetti*, *Diacypris* sp. 523, *Parartemia contracta*, Orthocladiinae S03 sp. C) suggests that the system may always have contained acidic wetlands, although salinisation may have led to increases in acidity at some wetlands and an increase in the overall proportion of acidic wetlands.

Two other aspects of the evaluation deserve comment. Firstly, salinity in wetlands # 6 and 7 was an order of magnitude higher than in the other wetlands visited. The reasons for this are not clear and may be a combination of salt loads, time since the wetland filled, amount of precipitated salt re-entering solution from the salt crust and lake-bed, or amount of concentration by evaporation. Alternatively, the higher salinities may reflect wetlands # 6 and 7 having a closer connection with the hypersaline regional groundwater aquifer, while many of the other wetlands have more input from shallow, more local and less saline aquifers (Jankowski & Jacobsen, 1990).

The second comment about evaluation relates to the occurrence of *Brachyscome* sp. at wetlands # 6 and 7. *Brachyscome halophila* is a halophilic species listed by DEC as a Priority 3. This is an informal system of categorizing species that are candidates for listing as Declared Rare Flora under the Wildlife Conservation Act 1950. Priority 3 species are deemed in need of further survey before decisions are made about listing; they are known from several populations, at least some of which are believed to be under no immediate threat.

If further work showed *B. halophil*a warranted listing as Declared Rare Flora and the *Brachyscome* at wetlands # 6 and 7 is *B. halophila*, then # 6 and 7 would change to Category 1 wetlands. The implication is that any management of these wetlands would need to be assessed to demonstrate it posed no threat to the persistence of *B. halophila*. When surveyed, the *Brachyscome* sp. plants at wetlands # 6 and 7 had only immature flowering buds. Plants with mature seed heads are required for species determination.

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APPENDIX 1

Wetland	Family	species
1	Cupressaceae	Callitris canescens
1	Chenopodiaceaea	Halosarcia lylei
1	Myrtaceae	Melaleuca atroviridis
1	Chenopodiaceaea	Halsosarcia lylei
2	Poaceae	Austrostipa elegantissima
2	Poaceae	Eragrostis dielsii
2	Mimosaceae	Acacia hemiteles
2	Chenopodiaceaea	Maireana sp. Indet
2	Aizoaceae	Disphyma crassifolium
2	Mimosaceae	Acacia colletioides
2	Myrtaceae	Melaleuca thyoides
2	Asteraceae	Podolepis capillaris
2	Chenopodiaceaea	Halosarcia lylei
2	Chenopodiaceaea	Halosarcia lylei
3	Myrtaceae	Melaleuca halmaturorum
3	Asteraceae	Podolepis capillaris
3	Chenopodiaceaea	Enchylaena lanata
3	Myrtaceae	Melaleuca thyoides
3	Chenopodiaceaea	Halosarcia lylei
4	Chenopodiaceaea	Rhagodia drummondii
4	Aizoaceae	Disphyma crassifolium
4	Frankeniaceae	Frankenia sp. Indet. Sterile
4	Aizoaceae	Mesembryanthemum nodiflorum
4	Crassulaceae	Crassula exserta
4	Frankeniaceae	Frankenia aff. Laxiflora
4	Myrtaceae	Melaleuca atroviridis
4	Chenopodiaceaea	Sclerolaena diacantha
4	Chenopodiaceaea	Halosarcia pergranulata sub sp pergranualta
4	Myrtaceae	Melaleuca atroviridis
4	Aizoaceae	Mesembryanthemum nodiflorum
4	Chenopodiaceaea	Halosarcia pergranulata sub sp pergranualta
5	Chenopodiaceaea	Halosarcia sp.
5	Poaceae	sterile indet.
5	Casuarinaceae	Casuarina obesa
5	Chenopodiaceaea	Rhagodia drummondii
5	Chenopodiaceaea	Maireana sp.
5	Chenopodiaceaea	Halosarcia lylei
5	Chenopodiaceaea	Maireana erioclada
5	Poaceae	Eragrostis dielsii
5	Poaceae	Austrostipa elegantissima
5	Myrtaceae	Melaleuca atroviridis
5	Chenopodiaceaea	Halosarcia lepidosperma
5	Casuarinaceae	Casuarina obesa
5	Asteraceae	Podolepis capillaris
5	Myrtaceae	Melaleuca atroviridis
5	Chenopodiaceaea	Halosarcia doleiformis
5	Chenopodiaceaea	Halosarcia halocnemoides
5	Chenopodiaceaea	Halosarcia undulata subsp. Pergranulata

Wetland	Family	species
5	Myrtaceae	Melaleuca lateriflora subsp. Lateriflora
5	Aizoaceae	Mesembryanthemum nodiflorum
5	Aizoaceae	Cleretum papulosum
6	Chenopodiaceaea	Halosarcia lepidosperma
6	Myrtaceae	Melaleuca sp.
6	Chenopodiaceaea	Halsoarcia halocnemoides
6	Aizoaceae	Cleretum papulosum
6	Chenopodiaceaea	Rhagodia drummondii
6	Mimosaceae	Acacia sp.
6	Chenopodiaceaea	Halosarcia pergranulata
6	Frankeniaceae	Frankenia sp
6	Aizoaceae	Mesembryanthemum nodiflorum
6	Asteraceae	Brachyscome sp
6	Chenopodiaceaea	Maireana sp.
6	Myrtaceae	Melaleuca halmaturorum
6	Chenopodiaceaea	Halosarcia lylei
7	Chenopodiaceaea	Rhagodia drummondii
7	Frankeniaceae	Frankenia sp
7	Chenopodiaceaea	Halosarcia lylei
7	Asteraceae	Hyaloclamys globifer
7	Asteraceae	Brachyscome sp
7	Asteraceae	Gnephosis uniflora
7	Chenopodiaceaea	Sclerolaena sp.
7	Chenopodiaceaea	Halosarcia sp. 1
7	Myrtaceae	Melaleuca sp.
7	Chenopodiaceaea	Halosarcia halocnemoides
7	Chenopodiaceaea	Halosarcia pergranulata
7	Chenopodiaceaea	Halosarcia sp 2 (doleiformis?)
7	Mimosaceae	Acacia sp.

Appendix 2. Aquatic invertebrates collected from Trayning wetlands #1, 2, 3 and 5 in August 2007

Wetland	Group	Species	Comment
1	Ostracod	*Australocypris bennetti*	common salt lake acidophile, also in Salt River
	Fly larvae	Muscidae sp A	very common, not a true aquatic
		Orthocladiinae S03 sp. C	salt tolerant acidophile, also in Ardath Lake, Salt River
		Dasyhelea sp	
	Beetle	Staphyliinidae	not a true aquatic, fringe dweller
2	Fly larvae	Muscidae sp A	
		Orthocladiinae S03 sp. C	
		Culicoides sp	
	Beetle	*Necterosoma penicillatus*	salt tolerant beetle
3	Ostracod	*Diacypris* sp 523	acidophile, at Mortlock Salt Lake, Ardath Lake
	Brine shrimp	*Parartemia contracta*	Widespread acidophile
5	Fly larvae	Muscidae sp A	common, not a true aquatic