

ON-FARM AND COMMUNITY SCALE SALT DISPOSAL BASINS ON THE RIVERINE PLAIN

UNDERLYING PRINCIPLES FOR BASIN USE

Evan Christen, Ian Jolly, Fred Leaney, Kumar Narayan and Glen Walker



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Foreword

The medium to long-term viability of large irrigated areas in the Riverine Plain region of Victoria and NSW is closely linked with management of high water tables. Restrictions imposed by the Murray-Darling Basin Salinity and Drainage Strategy have led to reductions in the export of salt from the area where it originated. These restrictions have resulted in an increase in the number of local on-farm and community disposal basins in irrigation areas. The existing design and management of both types of basin vary widely as they have been developed under different administrative frameworks. Currently there are no generic guidelines for the use of disposal basins which could be applied across varying settings and administrative boundaries.

For the last two years, CSIRO Land and Water in collaboration with the CRC for Catchment Hydrology, the Murray-Darling Basin Commission (Strategic Investigation and Education Program, Project I7034 Managing Disposal Basins for Salt Storage Within Irrigation Areas) and other agencies have been investigating the siting, design and management conditions under which local basins can be successfully used by individual landowners or groups of landowners. The biophysical and other technical information obtained in this project have been used to define a robust set of guiding 'principles' for responsible basin use.

A workshop entitled "The Use of On-Farm and Community Scale Salt Disposal Basins in Irrigation Areas of the Murray-Darling Basin" was conducted in March 1999 at Tatura, Victoria. The workshop was attended by about 40 people representing a wide range of stakeholder groups such as government resource and policy agencies, community and environmental groups, water supply corporations and local government. A set of principles on disposal basins was put forward by the project team and the thrust of this was generally accepted by the workshop. In addition, several new issues were raised, some of which were broader than the scope of the project. The workshop also proved to be an effective forum in which technical information from the project was transferred to prospective clients. A list of workshop participants, slides from the formal presentations and a summary of workshop comments are given in the Appendices.

The principles developed in this document should be considered, where appropriate, within the framework of existing Catchment Land and Water Management Plans, and State, Federal and Local Government regulations. However, it should be emphasised that these principles define desirable conditions for basin use in a general manner and should not in any way be considered as specific policy, regulation or law.

Dr. Glen Walker
Leader, Salinity Program

About this Report

This report describes the background and development of a set of principles which are a first step towards the development of guidelines for the effective and environmentally safe use of local salt disposal basins in irrigation areas.

At present, there is no framework in place which guides the siting, design and management of on-farm and small community basins. It is not possible to account for every combination of the complex array of soils, geology and land use in areas where disposal basins may be used. However, it is certainly possible to define a set of guiding principles for responsible basin design and management in the Riverine Plains region of the Murray-Darling Basin. Once defined, more detailed guidelines providing prescriptive information on how to implement the principles can be formulated. These will be the subject of a future report.

The specific aims of this report are to:

- identify issues which need to be considered in disposal basin systems,
- define a set of disposal basin principles that set out a responsible philosophy towards development and use of local on-farm and community basins.

The intended audience for these principles are government organisations, irrigation companies, and catchment land and water management planning groups.

It is important to note that these principles have been developed by the authors, in consultation with a broad group of stakeholders, as a basis for developing guidelines. They should not be considered as regulation or law as they have not received endorsement from any of the jurisdictions they encompass.

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1. Introduction

1.1 Background

The Murray-Darling Basin is one of Australia's most important water and land resources. Approximately 73% of all water used in Australia is harvested from the Basin (Fleming, 1982) and approximately 80% of land irrigated in Australia (1.8 million hectares) is located within its boundaries. Approximately 90% of cereal, 80% of pasture, 65% of fruit and 25% of vegetable production in Australia is derived from irrigated agriculture within the Basin (Murray-Darling Basin Ministerial Council, 1987). Meyer (1992) estimated that the annual value of irrigated agriculture in Australia exceeded \$4.6 billion (including more than \$2.7 billion in export income), the majority of which is from the Murray-Darling Basin. The majority of irrigation occurs in the south-central part of the Basin known widely as the Riverine Plain (see Figure 1).

The Basin, in its pre-European state, contained vast amounts of salt which were stored in the soils and groundwater. The use of irrigation, the leakage of water from the associated network of water distribution and drainage channels, and the clearance of deep-rooted perennial plants and their replacement with shallow-rooted annual crops, has altered the water balance causing water tables to rise throughout the Basin. This has resulted in mobilisation of the stored salt and when the water table comes close to the soil surface soil salinisation and waterlogging result, with detrimental effects on agricultural production. In addition, raised water table levels can increase hydraulic gradients between the groundwater and surface water resources, leading to increased movement of salt to drains, streams and rivers.

To maintain productivity in irrigation areas with shallow groundwater, water table reduction and control is carried out using measures such as sub-surface tile and deep open drains, and groundwater pumping from bores. This, however, creates the problem of disposing of large volumes of saline drainage water.

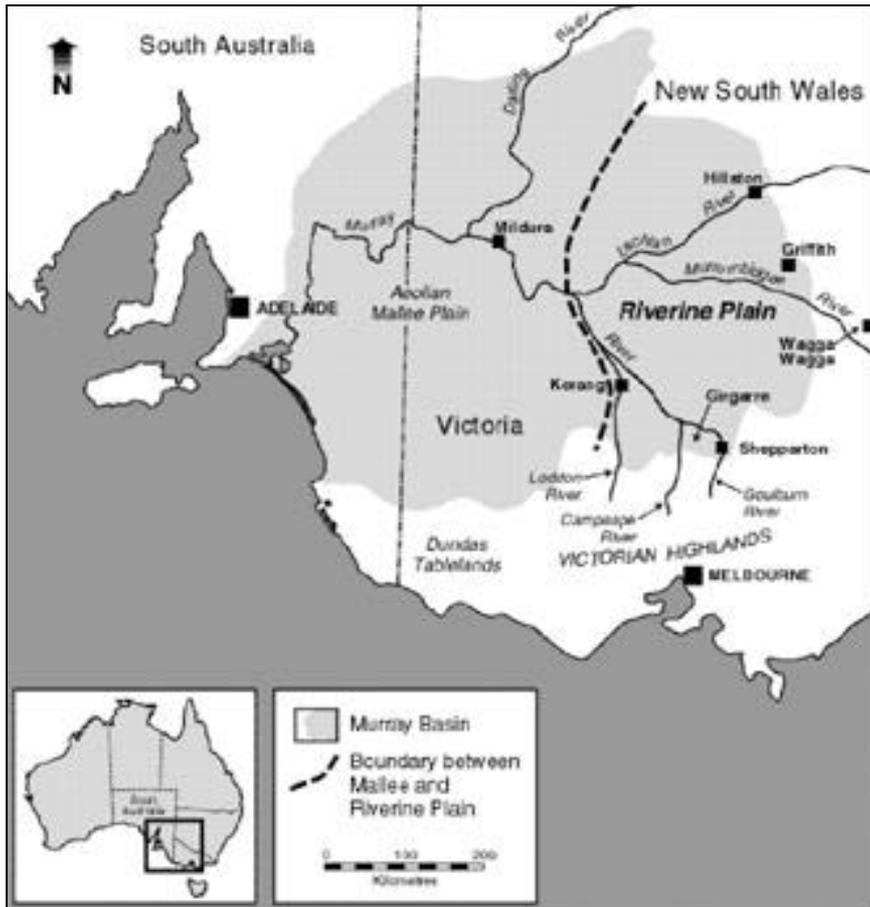


Figure 1 Map showing location of the Riverine Plain of the Murray Basin

While a large range of saline water disposal options for the Murray-Darling Basin were identified some time ago (Evans, 1989), a lot of emotion and misinformation still surrounds the disposal issue. There has always been debate over the environmental, social and economic implications of any disposal option. One thing that is unanimously agreed upon is that adequate and comprehensive saline water disposal is necessary to ensure the continued viability of irrigated agriculture, and to protect the quality of the surface water resources of the Basin. Disposal is therefore one of the most important components of Land and Water Management Plans for irrigation areas.

1.2 Disposal Options

There are three main disposal options:

- disposal to streams and rivers on an opportunistic basis,
- disposal using a pipeline to the sea,
- evaporative disposal to land.

Some saline water is currently disposed of into river systems in periods of high flows but the salinity of pumped groundwater and drainage effluent is

such that continuous unmanaged disposal to rivers and streams may result in unacceptable downstream impacts. There appears to be a trend in political and community attitudes towards less disposal to the river system. Since the river system has limited capacity to export salt from the irrigation catchment, the remaining options are export using a pipeline to the sea and land disposal to natural or engineered surface storages (saline disposal basins). Previous studies (State Rivers and Water Supply Commission, 1978; Earl, 1982; Gutteridge Haskins and Davey, 1990) have indicated that the pipeline option was uneconomic compared with other disposal options available at the time. This leaves evaporative land disposal as the most likely option available, at least in the short to medium term (50 years). As was shown by Evans (1989), saline disposal basins are the lowest cost option for high salinity drainage water.

Overseas experience with land disposal using basins is fairly limited. They have been used in the San Joaquin Valley in California (Tanji et al., 1993; Grismer et al., 1993), along the Indus River in Pakistan (Trehella and Badruddin, 1991) and have been proposed for the Shapur and Dalaki River Basin in southern Iran (Shiati, 1991). The use of dryland evaporative "sinks" (low points in the landscape which are not ponded with water but have high rates of groundwater discharge) has also been proposed for the Indus Basin in Pakistan (Gowing and Ashghar, 1996).

The Murray-Darling Basin Ministerial Council recognised over a decade ago that disposal basins had a role to play in storing salt if they are properly designed and maintained (Murray-Darling Basin Ministerial Council, 1986). At present there are in excess of 180 saline disposal basins in the Murray-Darling Basin, mostly located in the Riverland (South Australia) and Sunraysia (Victoria) regions (Hostetler and Radke, 1995).

1.3 Saline Disposal Basins—Issues of Size

In the past, use of regional scale basins has been the most common approach. These generally accept drainage water from multiple farms and irrigation districts which in some cases may be located many kilometres away (hence salt is exported from the area in which it is produced). These basins most commonly use natural depressions in the landscape (e.g. Lake Tutchewop near Swan Hill), however they can be engineered storages (e.g. Wakool Basin near Deniliquin). Many have occurred by default or have been developed on an ad-hoc basis.

In many instances, regional basins were developed on the most convenient sites from an engineering standpoint, where environmental, socioeconomic and aesthetic impacts or any other community concerns were sometimes ignored. In addition, various unforeseen side-effects (leakage to adjacent farmland, insect and bird problems, odour) experienced by a number of regional scale basins has led in many cases to poor community perception of disposal basins. Moreover, under the Murray-Darling Basin Salinity and

Drainage Strategy (Murray-Darling Basin Ministerial Council, 1988) severe constraints have been imposed on salt export from a given area. This policy was designed to ensure that the beneficiaries of irrigation are responsible for their own drainage management on the assumption that this would help minimise other environmental effects. While disposal to regional basins will continue in the future, there is a view in some quarters that there is a need to depart from the existing "export the problem" mentality. It may become mandatory that the option to manage drainage effluent at the source be closely examined before resorting to export.

The above concerns have led to the use of local basins. These can take the form of on-farm basins, which occupy individual properties (such as those being used for new horticultural developments in the Murrumbidgee Irrigation Area) or community basins, which are shared by a small group of properties (such as the Girgarre Basin near Shepparton). The design and management of both types of basin varies widely and currently there are no set guidelines for their use. It is local on-farm and community basins which are the subject of this report.

There are a number of issues related to the choice between on-farm and community basins. With on-farm basins the costs can be more easily passed back to the farmer, the ownership of the basin remains with the beneficiary and the impact is localised. Thus, distribution of costs, especially in terms of lost land, is easier. However, on-farm basins are more difficult to supervise, and monitoring systems need to be applied that ensure impacts on non-beneficiaries and the environment are within acceptable limits.

The distribution of costs of community basins presents problems, and the siting of such basins may lead to land equity and other legal disputes (although this may be overcome by authority ownership of the land and basin). Community (and regional) basins present better opportunities for optimisation of sites and thus can be more easily managed than numerous on-farm basins. The greater technical complexity of drainage transport and basin operation, combined with the complex ownership and management issues, means that community basins require a long term commitment on the part of the participating landowners. Factors such as long-term maintenance, change of land use and ownership, and decommissioning need to be considered before community basins are considered. On the other hand, if other disposal options become available in the future, decommissioning and reclamation of a small number of community basins may be more viable than for numerous on-farm basins. Furthermore, where possible, basins should be located on the least productive land to minimise loss in productivity and maximise the return on the remaining area (but only where the least productive land is a suitable site for a basin). For a required evaporative capacity, it is important to consider the relative land values and total area of land that would be lost by using one large community basin as compared to that lost by using a number of small basins.

1.4 Integration of Sub-Surface Drainage and Disposal Basin Systems

The aim of sub-surface drainage is to lower water tables to levels which maintain crop productivity by controlling waterlogging and land salinisation and to minimise salt movement to drains, streams and rivers. Sub-surface drainage is generally carried out with buried horizontal (tile) drains, deep open drains or by groundwater pumping from bores (also known as tubewells) or spear points. The use of tile drains and tubewells for water table control is shown in Figure 2.

Figure 2 also shows surface runoff, which often occurs as a result of irrigation. This is generally collected in shallow surface drains. In general, water quality in these drains is relatively good ($<1\text{dS/m}$) and volumes are usually higher than tile drains, particularly following rainfall.

In this report we use the term 'drainage system' to mean any form of sub-surface drainage for water table control, such as tile drains, deep open drains, tubewells or spear points. A number of disposal options for sub-surface drainage are shown in Figure 2. In this report we are concerned with disposal to on-farm or community evaporation basins. Common to both type of basins is the possible interaction between the basin and the sub-surface drainage system via leakage of water, and hence salt, from the basin. The role that the sub-surface drainage system has in either inducing or controlling leakage is such that it is best to consider both systems together when siting, designing and managing local disposal basins.

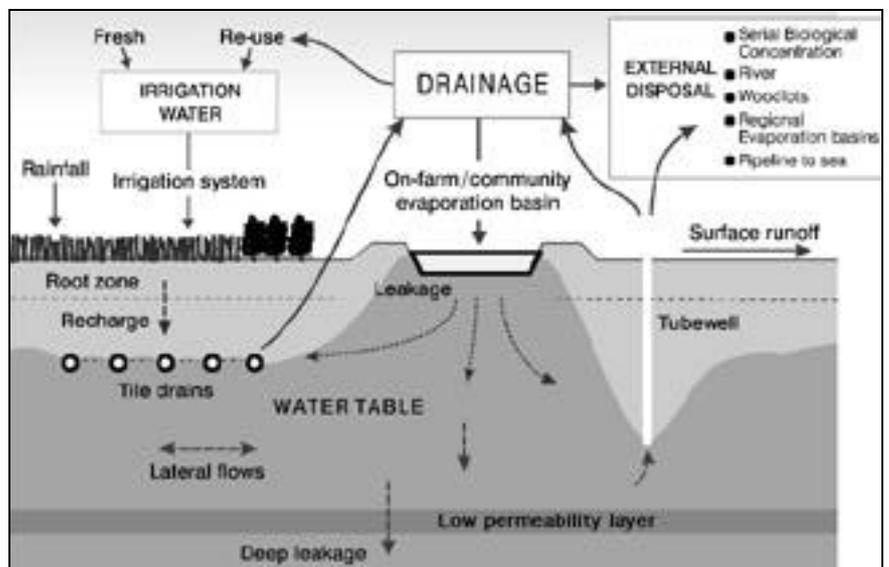


Figure 2 Schematic of sub-surface drainage and disposal basin systems.

The primary purpose of a disposal basin is to store and evaporate drainage effluent. Continuous disposal and evaporation will increase the salinity of the stored water. Salt accumulation in the disposal basin is controlled by both the rates of evaporation and leakage of concentrated saline water into the sub-soil and groundwater system beneath the storage.

When the input drainage water to a basin is derived from the surrounding groundwater system and the disposal basin concentrates the salt, there is merely a change from salt in a diffuse state to a point source. However, disposal basins can also be a potential source of environmental pollution caused by the following factors:

- rising saline water tables leading to waterlogging and salinisation of adjoining lands,
- greater flow of saline groundwater to the surface drainage systems due to increased local hydraulic gradients,
- concentration of agricultural chemicals together with salt.

Where disposal water contains toxic materials, the issue of creating a point source of pollution needs to be carefully considered in terms of danger to wildlife and the surrounding environment (see the recommended national water quality guidelines (National Water Quality Management Strategy, 1992)) and guidelines for groundwater protection (National Water Quality Management Strategy, 1995). It should be recognised that, in this instance, the pollutant is a concentrated form of salt, herbicides and pesticides that were already present in the shallow groundwater prior to the development of the basin. Under most circumstances, if the principles from this report are adhered to, chemicals external to the drainage system are not added to disposal basins. The concentration process within the basins may, however, lead to toxicity problems with certain chemicals, especially herbicides and pesticides. However, the potential for herbicide and pesticide toxicity is reduced if surface drainage is excluded from the basin. This should minimise the possibility that unforeseen toxicity problems, similar to that found with selenium in basins in California (Tanji et al., 1993), do not occur.

The extent of the above effects is highly variable depending on site conditions and basin design and management. In view of these potential undesirable environmental effects, any use of disposal basins as a useful salt management tool must be carefully considered. The success of any disposal basin depends very much on the local environmental, physical, legislative, economic and social constraints of the specific site. It is important that disposal basins be efficiently designed, properly sited and effectively managed under controlled conditions. If this is achieved, a basin may in fact be seen as an environmental asset (Roberts, 1995).

1.5 Disposal Basins as a Source of Pollution

2. Principles

The intention of the following principles is to define desirable objectives for disposal basin siting, design and management. They should apply unless there are compelling reasons to move away from them. However, it is recognised that in some instances they may contradict each other and so consideration will need to be made as to which is the most important principle in such situations.

It is recognised that current legislation permits disposal of some saline water to the river systems under the EC credit scheme of the MDBC Salinity and Drainage Strategy and the future use of large regional basins will continue where appropriate. However, further development of drainage systems may not have the option of river disposal and so the following principles have been developed under the assumption that no export of saline drainage water is allowed from the evaporation basins to streams, waterways or other bodies of water.

It is also implicitly assumed that best management engineering practices for above ground storages will be employed for siting and design (e.g. Queensland Water Resources Commission, 1984; New South Wales Agriculture, 1999), and that the principles should be considered within the framework of existing Land and Water Management Plans, State and Federal legislation, and Local Government regulations (viz. EPA Vic, 1994; EPA NSW, 1997), where appropriate. These principles may not apply to basins where there is an additional beneficial use such as salt harvesting or aquaculture.

The geographic area for which these principles have been developed is the Riverine Plains region of the Murrumbidgee and Murray Rivers, although some of these principles may still apply outside of this geographic region.

Principle 1
“Evaporation basins should only be used for the disposal of saline drainage effluent, after all potential productive uses have occurred or the water is shown to be economically and environmentally unsuitable for use.”

This principle has been developed in order to minimise the volume of disposal, thereby minimising the basin size and cost; and to ensure the best use of water as a resource.

Disposal basins are expensive to construct, will generally occupy land which would otherwise be used for agricultural production or other commercial and recreational purposes, and usually will not generate any revenue. To minimise the volume of disposal water, and hence the basin size, the basin should only be used as a terminal point for drainage water that cannot be used elsewhere. This will also maximise the economic benefits to be gained from diversions for irrigation purposes.

Opportunities for re-use of both surface run-off and sub-surface drainage water should be carefully considered, especially if the water is not too saline. Re-use of this water by mixing with groundwater (Bethune et al., 1997) or surface water supplies should be considered. For example, in the Shepparton Irrigation Region there are already in excess of 2650 re-use systems in operation (Irrigation Committee, 1996). For greater levels of salt concentration prior to basin disposal, serial biological concentration schemes could be considered (Heath et al., 1993).

This principle has been developed in order to maximise and maintain disposal capacity.

Disposal basins can be used to store salt in a confined area above ground in the basin and in the soil and aquifer system immediately below and in the adjacent area (in an environmentally responsible manner—see Principle 4). If storage is to be confined only to the basin then leakage must be prevented by lining the basin with impermeable materials such as plastic membranes. Widespread experience has shown that it is very difficult to maintain the impermeability of any type of lining after several years of operation.

There are two problems associated with basins in which leakage is prevented. Firstly, the basin water will continually increase in salinity causing an associated decline in evaporation rate (and hence disposal capacity), therefore necessitating a much larger basin for a given disposal volume. Secondly, precipitation of salts will occur in the basin, which will need to be removed and disposed of. The only situations where this would be appropriate is if salt production of commercial quality is desired, or when export to the sea or to a location where any adverse impacts would be acceptable, and is technically and economically feasible.

A basin in which limited leakage is allowed will concentrate salt in the basin water to a lesser extent and so there will be minimal loss in evaporative potential, and hence disposal capacity. There will not be precipitation of salt in the basin under normal conditions.

It is important to note that leakage from a basin creates a localised concentration of salts in the underlying soils and aquifer system which is simply a redistribution of the mass of salt already stored within the soil and groundwater system. Provided leakage is contained to within the area of the drainage system this does not represent an external pollutant. However, it should be noted that the basin will still have a finite life, but instead of it being only a few years or decades (as in the case of a basin which is not allowed to leak) it may be of the order of hundreds of years.

Principle 2

“Salts remaining in a basin due to evaporation may be stored in the ponded water and also in the soil and aquifer system below and adjacent to the basin.”

Principle 3
“Salt stored below the basin should remain in the area of influence of the drainage system, or within a specific salt containment area around a basin located outside the limits of a drainage system.”

This principle has been developed in order to ensure that salt is not exported to adjoining land outside the drainage area benefiting from the drainage water disposal.

The principal consideration in disposal basin design is the containment of salts accumulating in a basin. The salt leaking from the basin needs to be kept local so that it does not salinise adjacent land and to ensure that there is no export of salt from the area. Thus, it is preferable that a basin be located within the area of influence of the drainage system (see section 2.4 for definition of a drainage system). The option to locate a basin within the area of drainage influence should always be considered first. This will result in the salt remaining in the area from which it was extracted and ensures that ownership of the drainage and its control, remains with the beneficiaries of the drainage system.

Under exceptional circumstances, where no suitable disposal site exists within the drainage system, the basin may be located outside the area of influence of the drainage system. However, this effectively exports the salt from the area of extraction and so there must be more stringent restrictions on design, location and management to ensure that the salt stored in and below the basin will be contained in close proximity to the basin. Increased buffer zones (referred to as ‘impact zones’ or ‘attenuation zones’ in environmental protection agencies) and effective interception drains or tubewells may be required in these cases.

If well managed, a fully operational drainage/basin system can contain salt within the drainage system. However, if the drainage system or basin is no longer required or if other salt disposal options become available in future, salt containment may be compromised. Therefore, basins require a decommissioning plan, which should be developed before implementation of the basin. These sites should be registered and managed under existing EPA guidelines (EPA NSW, 1997; EPA Vic., 1994), if appropriate, or other specifically formulated guidelines.

This principle has been developed in order not to pollute usable groundwater resources.

Leakage to the groundwater below the basin is only acceptable if the leakage will not pollute a resource beyond a defined impact (attenuation) zone, as measured by change in usability (usefulness) of that resource. To minimise the risk of polluting good quality groundwater, disposal basins should, if at all possible, not be sited in areas underlain by groundwater which has a high beneficial use.

Broad indications of groundwater quality can be obtained from various maps covering the Riverine Plain (Woolley, 1991; Woolley et al., 1992; Williams and Woolley, 1992; Woolley and Williams, 1994 and O'Rorke et al., 1992). While there is no agreement between the States regarding the exact definition of beneficial use, these maps broadly indicate water uses which are suitable for the range of salinity classes presented. However, it should be noted that these maps are on a very broad spatial scale and groundwater quality and the presence of aquifers can vary over short distances. Hence, more detailed local information should be acquired as part of site investigations for any prospective basin to assess any site specific changes and to determine the potential impact of these changes on the resources and bio-diversity of the area.

This principle has been developed in order not to pollute fresh surface water resources

For on-farm and community basins located on or close to the areas where the drainage is generated, there is no real advantage in allowing periodic emptying to surface drains or streams. The historical practice of periodic emptying of regional basins located near rivers during high river flows is not desirable for these types of basins.

Emptying of basins into surface drainage systems introduces high levels of salt to stream flows that may otherwise be replenishing surface water bodies with fresh water. Also, periodic release sends an inappropriate signal to basin users that the use of their basin and drainage management system will be periodically relaxed and thus a high level of irrigation and drainage management is not required. Moreover, this may also lead to other toxic pollutants entering the surface drainage systems, thus leading to the risk of damage to the downstream ecosystems.

If a basin becomes full then drainage pumping must cease, which may lead to serious waterlogging in the farmland. Appropriately sized, well designed and managed basins should not require emptying. Although the effect of extreme rainfall periods may result in slight waterlogging, this is generally a second order effect in comparison to poor irrigation or drainage system management. However, when drainage flows and the flows in the

Principle 4

“Leakage from a basin should not pollute groundwater with existing or potential beneficial use.”

Principle 5

“Water stored in disposal basins should not be released to surface drainage systems or other inland water bodies not designed as disposal basins.”

downstream waterways are both high, and water is not being used or stored for use on sensitive crops, the possibility of pumping directly to the surface drainage could be considered - this is better than releasing the highly saline basin water to the surface drainage system.

Basins should be located and designed to exclude flood waters whilst retaining saline drainage waters. If under extreme events, basins are overtopped and filled with flood waters, the basin owner should cease drainage into the basin and wait until sufficient water has evaporated to enable drainage to resume.

Principle 6
“Basins should be sited, designed, constructed, maintained and managed to minimise detrimental environmental, socioeconomic and aesthetic impacts.”

This principle has been developed in order to ensure that detrimental impacts of basin use are minimised.

Various side effects, such as local salinisation of land around the basin, insect and bird problems, poor aesthetics and unpalatable odours, have led to a poor image of disposal basins with the general public. This community dislike is exacerbated where the basin is not within the property boundaries of those who benefit from it for disposal of their drainage water. Whilst zero impact of a basin on the surrounding area is desirable this may not always be achievable. If there is to be an impact on the surrounding areas then it should be small and its level should be transparently identified and assessed. The relevant stakeholders of the project should consider this impact and compare it to the various compensating benefits before deciding to proceed with a basin.

Basins can be designed and managed to be a community and ecological resource (e.g. Roberts, 1995). To gain greater community acceptance, disposal basins should be sited and constructed in a manner that enhances the local environment by providing wildlife habitat (e.g. bird nesting areas) and reducing the visual impacts by planting trees in buffer zones around the perimeter and installing flatter batters to minimise erosion and exposure of bare soil. On the other hand, adverse environmental impacts on the community surrounding a disposal basin may arise from breeding of insects (e.g. mosquitoes), increased bird population feeding on farmers' crops and airborne salt blown from dried out areas of the basin. These impacts should be minimised in all cases. This will be assisted by not allowing the siting of basins near residential and business areas, community facilities such as schools, hospitals and sporting grounds, and other sensitive land uses.

As discussed in Section 2.3 there are a number of other socioeconomic issues related to the choice between on-farm and community basins. These include: distribution of drainage costs back to the beneficiaries, quality of basin management, land equity and other legal aspects, the need for long-term commitment to basin operation, and the ease of decommissioning.

As with most engineering structures, there are environmental risks associated with the use of saline disposal basins. The movement of salt (and possibly toxic materials) outside the drainage or salt containment area poses the greatest threat. As described above, this can be minimised by siting basins within the drainage system or within a well buffered containment area (both employing interception drains or tubewells). The risk that salt export poses to water quality, stream health and bio-diversity of surface waters can be further reduced by not allowing siting of basins close to streams, rivers, water supply channels, and flood-prone areas.

All basins should have a management plan which clearly identifies the off-site impacts and risks posed by the basin and the monitoring and reporting which will be undertaken to ensure basin integrity. Furthermore, all basins should have an agreed decommissioning plan which details the likely off-site impacts of no longer using the basin and/or the associated drainage system.

This principle has been developed in order to ensure that the basin owner is completely accountable for the safe management of the basin.

As discussed in Principle 6, improperly designed or managed basins have the potential to pose a significant risk, not just to the owner's property, but also to the environment, general community, downstream water users and surrounding land owners.

Basin owners should be held accountable for the consequences of the design, construction, operation and maintenance decisions related to their basin and its associated drainage system.

It should be recognised that basin disposal requires a long term commitment and their use should only be undertaken if this can be reasonably assured.

Principle 7

“Basin owners are responsible for the consequences of the design, construction, operation and maintenance decisions related to their basin and its associated drainage system.”

3. Concluding Remarks

These principles are by nature generalised and non-specific, however by adhering to them, evaporation basins should provide a safe and effective tool for the disposal of saline water in the Riverine Plain. The use of saline disposal basins needs to be within the framework of Land and Water Management Plans and conform with existing environmental guidelines and legislation. Whilst the above principles set out the most desirable set of conditions for the design, siting and management of evaporation basins, there may be exceptional and unforeseen circumstances or issues not identified or covered by these principles. As such, the continued widespread use of saline disposal basins will need to be accompanied by an appropriate policy and regulatory framework which includes design, construction, and management (including risk assessment) guidelines.

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Appendix 1: Summary of Workshop Comments

A one day workshop on "The Use of On-Farm and Community Scale Salt Disposal Basins in Irrigation Areas of the Murray-Darling Basin" was held on 30th March, 1999 at Goulburn-Murray Water, Tatura, Victoria. The primary purpose of the workshop was to provide participants (policy makers, resource agencies, community and environmental groups, irrigators, managers and other stakeholders) with background information on the use of on-farm and community scale disposal basins in irrigation areas, and to obtain their views on this form of drainage management. The invited participants were also asked to discuss a set of draft principles which attempted to set the framework for responsible siting, design and management of such basins. This workshop was an important information exchange between the CSIRO Land and Water/CRC for Catchment Hydrology research staff and prospective users, and generated a great deal of interest amongst the participants.

The major comments and feedback from the workshop sessions are summarised below:

Session 1

Background presentation and discussion on the use of disposal basins in the Murray-Darling Basin

Workshop question to participants: "What do you see as the role/purpose/objective of the local disposal basins?"

It was generally felt that there is a need for local disposal basins in conjunction with improved irrigation management systems. Local disposal will provide a better signal to improve water use. Basins should be used as a last resort and irrigators should be responsible for their salt management on the farm. The basins should be designed and managed as a part of Land and Water Management Plans and not considered in isolation. The basins should be sited and designed so that they are cost effective, can protect agricultural land and satisfy environment constraints.

Other questions or concerns that participants raised during Session 1 were:

- ownership of the principles and guidelines documents
- correctness of the presumption that there will be no further river disposal or regional-scale basins
- concern about the issue of leakage below basins
- handling of surface run-off
- issues of equity and cost sharing of local on-farm and community basins
- salt balance questions on a catchment/regional scale (especially over the longer term).

Workshop question to participants: "Have we got the processes that underpin an effective disposal basin right?"

Responses

In some areas, it may not be possible to control leakage from the basin and therefore proper siting is important. Also risk assessment should be an essential component of basin siting.

The question of what a basin's primary role is was raised (i.e. to what extent should the basin also be used as a resource, e.g. salt harvesting and aquaculture). The effects of saline stratification, basin size and depth, and water temperature on evaporation rate should be investigated further. The basin economics must consider the technical, social and environmental costs associated with it. The effects of odours, insect populations, wildlife, windblown salt on the surrounding environment and other broader regional impacts should be considered.

Many of the general questions raised by the participants were related to basin design and development of guidelines: the use of multiple basins or bays and salinity stratification to maximise evaporation; the location of pumping bores and consideration of aquifer transmissivity; broader regional groundwater impacts; ability to capture and contain saline seepage from the basin; estimation of basin life and sustainability; long term impacts on soil structure; effect of aquatic plants and organic build up on leakage and evaporation; and the question of who should manage and monitor on-farm basins.

Principle 1

Apart from a couple of minor changes in wording there was general agreement on this principle.

Principle 2

There was a suggestion to amalgamate this principle with the principle 3 and to either cross reference or make them subsets of principle 4. The concept that limited leakage to sub-soil and aquifer systems is required to maximise disposal capacity was generally agreed.

Principle 3

Again there was a general agreement on this principle. Some of the comments on policy issues and recognition of impact/attenuation/buffer areas have been incorporated into the revised version of the principles report.

Session 2

Presentation and discussion of on-farm and community scale disposal basin processes

Session 3

Presentation and discussion on individual basin principles

Principle 4

It was pointed out that there is a need to recognise a net benefit, i.e. tradeoffs between basin siting and groundwater quality. However this was not acceptable to the Victorian EPA. The "beneficial use of groundwater" should be clearly stated as States define this differently.

Principle 5

This principle was somewhat controversial. A number of the participants felt that under government endorsed discharge strategies, saline water stored in disposal basins could be discharged to the surface drainage systems in a controlled manner (in accordance with Land and Water Management Plans). The question arose as to whether it would be more sensible to allow direct discharge from drains and pumps rather than dump much more saline basin water.

Principle 6

The issues of environmental, socioeconomic and aesthetic impacts should be proactive and part of an integrated plan. There was a comment to include the concept of decommissioning as a seventh principle.

Other principles (seen as overarching principles)

- Disposal basins have a role to play but must be contingent to other Land and Water Management Planning processes to create common ownership, accountability and responsibility obligations.
- Basins should be part of an integrated regional or catchment drainage or salinity management program (implied approval process).
- Community input is required in refining the guidelines.
- Responsibility for ownership and accountability and management should be clearly defined.
- Salt does not break down and remains in the environment - hence needs to be managed and accounted for to achieve sustainability.

In this session suggestions were made as to what guidelines (technical, economic and socio-political) are required to implement the principles:

- siting and design criteria (including leakage rates, site investigations, hydraulic design, life span requirements, take into account external flooding, timing for construction)
- basin management – including performance review
- cost sharing arrangements
- monitoring and a feedback loop
- hydrogeological and geotechnical standards
- community consultation on the establishment of basins
- contingency plans – including changes in ownership
- decommissioning processes
- jurisdictional approval processes or requirements – i.e. the decision processes
- aesthetic considerations – vegetation, slope, need for buffers
- link to a regional perspective
- water quality guidelines

Session 4

Discussion on future directions.

Appendix 2: Workshop Participants

Peter Alexander	Murray-Darling Basin Commission, Canberra
Matthew Bethune	Institute of Sustainable Irrigated Agriculture, Tatura
Peter Box	INTEGRA, Benalla
Evan Christen	CSIRO Land and Water, Griffith
Bryan Clark	MIA Council of Horticultural Associations, Griffith
Peter Dickinson	Goulburn-Murray Water, Tatura
Les Ellis	Murrumbidgee Irrigation, Griffith
Mike Erny	NSW Department of Land and Water Conservation, Dareton
Richard Evans	Sinclair Knight Merz, Melbourne
Lisa Filipin	Mallee Catchment Management Authority, Mildura
Drew Gailey	Shire of Campaspe, Echuca
Bruce Gardiner	NSW EPA, Albury
Peter Gillard	Department of Primary Industries and Energy, Canberra
Lamond Graham	Department of Natural Resources, Toowoomba
Ian Jolly	CSIRO Land and Water and CRC for Catchment Hydrology, Adelaide
Heinz Kleindienst	Sinclair Knight Merz, Tatura

Ary van der Lely	NSW Department of Land and Water Conservation, Leeton
Pardeep Mann	Dept. of Natural Resources and Environment, Melbourne
Jamie McCaffrey	EPA Victoria, Melbourne
Geoff McLeod	Murray Irrigation Limited, Deniliquin
Justin Nancarrow	Murray-Darling Basin Commission, Canberra
Carsten Nannestad	Murrumbidgee Catchment Management Committee, Wagga Wagga
Kumar Narayan	CSIRO Land and Water and CRC for Catchment Hydrology, Adelaide
Lance Netherway	MDBC Community Advisory Committee, Horsham
Bob Newman	Murray-Darling Basin Commission, Canberra
Russell Pell	Shepparton Irrigation Region Land and Water Salinity Management Plan Implementation Committee, Tatura
David Perry	CRC for Catchment Hydrology, Melbourne
Gavin Privett	Pyramid Salts, Kerang
Sandy Robinson	Murray-Darling Basin Commission, Canberra
Ken Sampson	Shepparton Irrigation Region Land and Water Management Plan Implementation Committee, Tatura
Gerrit Schrale	Dept. of Primary Industries and Resources, Adelaide
Pradeep Sharma	Murray-Darling Basin Commission, Canberra

Dominic Skehan	CSIRO Land & Water, Griffith
Bill Trehella	Goulburn-Murray Water, Tatura
Glen Walker	CSIRO Land and Water and CRC for Catchment Hydrology, Adelaide
Helen Watts	EPA South Australia, Adelaide
Richard Wells	Mallee Catchment Management Authority, Mildura
Robert Wildes	Institute of Sustainable Irrigated Agriculture, Tatura
Mike Williams	NSW Department of Land and Water Conservation, Sydney

Appendix 3: Workshop Presentations

This section contains the slides from the 4 presentations which were presented at the Workshop.

1

Managing Disposal Basins for Salt Storage Within Irrigation Areas

Kumar Narayan

Supported by SISE Program
(Project #7034)

Other Collaborators are
GMW, DLWC (NSW), ISIA (Vic.),
FUSA (SA) and MIA-CHA

CSIRO Land and Water

2

Project Personnel

Kumar Narayan - Project Leader (CSIRO Land & Water/ CRC for Catchment Hydrology)

CSIRO Land and Water (Griffith)
Evan Christen, Jai Singh, Quinlong Wu, Elaine Murray, Dominic Skehan

CSIRO Land and Water (Adelaide)
Fred Leaney, Keryn McEwan, Megan Easterbrook

CRC for Catchment Hydrology/CSIRO Land and Water
Ian Jolly, Lu Zhang, Peter Dyce

Flinders University of South Australia
Craig Simmons

Institute for Sustainable Agriculture
Matthew Bothune

3

Overall Project Objectives

Develop *siting, design and management guidelines* for on-farm and community salt disposal basins

Determine the *physical and economic factors* which influence salt disposal basin siting and design decisions, for the Riverine Plain

4

Workshop Objectives

- To ascertain from a wide range of stakeholders their views on the use of on-farm and community scale disposal basins in irrigation areas
- To discuss and obtain feedback on draft "principles" for siting, design and management of disposal basins
- To increase awareness of the project and its findings to a wide range of stakeholders, agencies and community groups

5

Workshop Program
(Facilitator: Peter Box)

9:00 - 9:10 am Introduction to workshop and MDRC perspectives (Sandy Robinson)

9:10 - 10:30 am Background presentation and discussion on the use of disposal basins in the Murray-Darling Basin (Kumar Narayan)

10:30 - 11:00 am Morning tea

11:00 - 12:30 pm Presentation and discussion of on-farm and community scale disposal basin processes (Evan Christen)

12:30 - 1:30 pm Lunch

1:30 - 3:00 pm Presentation and discussion of individual basin "principles" (Kumar Narayan and Evan Christen)

3:15 - 4:00 pm Discussion on future directions

1

The Use of On-farm and Community Scale Salt Disposal Basins in Irrigation Areas of the Murray-Darling Basin

Session 1: Background Presentation and Discussion on the Use of Disposal Basins in the Murray-Darling Basin

Supported by MDBIC SIAE Program Grant 17034

CSIRO Land and Water

2

Session Outline

- Importance of irrigation in the Murray-Darling Basin (MDB)
- Need for drainage to sustain productive irrigated agriculture
- Options for disposal of drainage water
- Brief history of the use of saline disposal basins in the MDB and the current status
- Future restrictions on salt exports
 - need for small scale constructed basins
 - need for technical policy framework for their use on the Riverine Plain

3

Importance of Irrigation

- Annual value of irrigated agriculture in Australia exceeds \$4.6 billion, with more than \$2.7 billion derived from export income (1992 prices)
- ~80% of all irrigated land (1.8 million ha) is located in the MDB
- ~90% of cereal, ~80% of pasture, ~65% of fruit and ~25% of vegetable production occurs in the MDB
- The majority of the MDB irrigation occurs in the region known as the Riverine Plain

4



5

Impact of Irrigation Development

- MDB historically contained vast amounts of salt in the soils and groundwater, and generally had deep water tables
- Irrigation and the associated distribution networks, and shallow-rooted crops has increased recharge and caused water tables to rise
- The stored salt has been mobilised and when the water table comes close to the surface:
 - soil salinisation and waterlogging occurs which damages agricultural production
 - increased hydraulic gradients cause enhanced movement of salt to drains, streams and rivers

6

Need for Drainage

- Productivity in irrigation areas with shallow groundwater is achieved by water table reduction and control measures such as:
 - deep open surface drains
 - sub-surface drains
 - groundwater pumping with bore (tubewells) and spearpoints
- This creates large volumes of saline drainage water which require disposal
 - OHD (1993) Pipeline to the Sea Report estimated that 335,000-806,000 ML/year of drainage required for the Riverine Plain

7

Disposal Options

- **River Disposal**
 - increases costs to downstream users
 - causes environmental problems
 - at capacity
 - salt export ('export the problem')
- **Pipeline to the Sea**
 - economically non-viable at this stage
 - impact on the marine environment unclear
 - salt export ('export the problem')
- **Land Disposal - Basins**
 - widely used already: >180 saline disposal basins presently in use
 - woodlots and serial biological conservation are just concentrations
 - still have to dispose of the final saline drainage

→ **for use access may be limited**

→ **unlikely to be implemented in the near future**

8

Basin Disposal

- Disposal basins are used to evaporate drainage water and store salt
- Natural features in the landscape such as lakes, discharge areas and topographic low points have typically been used for basin siting in the past
 - easiest option from an engineering viewpoint
 - often ignored are recreational, aesthetic and socio-economic impacts, leading to poor community perception
- Large disposal basins (typically >100 ha) have been used in the MDB for over 30 years
 - often accept drainage water from irrigation districts remote from their location (i.e. salt export from its source area)
 - refer to these as regional basins

9

Discussion Points

- Export of salt outside of irrigation areas will become much more limited in the near future
- Land disposal of drainage water into basins will continue to be an important option in the near future

10

Constructed Disposal Basins

- Introduced more recently as a result of:
 - constraints on salt export imposed by:
 - the MDB Salinity and Drainage Strategic Credits
 - changing views in environmental protection and resource agencies that effluent should be managed at the source
 - use of natural landscape features now being unacceptable because of environmental concerns
- Tend to be much smaller (typically <100 ha) and only receive drainage from adjacent areas
 - on-farm basins in the MIA: area < 15 ha in size
 - community basin of Goperg in SR is 38 ha; community basin at Wakool is 2,100 ha

11

Existing Constructed Disposal Basins

Type and Location	Number	Basin Area (ha)	Drainage Salinity (EC) (MR 2002)	Drainage Volume (ML/year)	Comments
On-farm					
MIA	16	616.8	3,828-53,808	20,160	increasing to > 2 per year
Warrumbidgee	3	6.52	30,808-80,080	4.80	only one in area: 3000 planned
Community					
Wingah	1	38	18,080	808	operating successfully
Wakool	1	2,180	28,080	26,808	operating successfully

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On-farm Disposal Basins

- Sited on single farm and receives drainage from that farm only
- Farmer owned and managed - hence costs, benefits and any negative impacts are borne only by the farmer
- Less opportunity to use low-cost land
- Quality of management may be an issue
- Numerous sites to be monitored by regulating agencies and possibly be decommissioned

13

Community Disposal Basins

- Receives drainage from several farms in nearby area
 - water transport adds a cost
- Many possible choices of ownership (joint, independent, irrigation company, government)
- Better opportunity to use low-cost land
 - may be land equity and/or legal complications
 - complexities associated with changing land use and ownership
 - if is a long-term commitment
- Higher level of management necessary
- May become a community environmental asset
 - decommissioning may be difficult

Regional South Westing Basins

14

Where Are We Now?

- Expanded use of regional basins is extremely unlikely
 - constructed On-Farm and Community Basins are a possible alternative
- For on-farm and community basins, there is presently no technical and policy framework for siting, design, management and decommissioning
 - need for an agreed set of Principles and associated Guidelines for their responsible use
- This workshop will only be concerned with constructed on-farm and community disposal basins
 - will concentrate on developing a set of sound Principles

Regional South Westing Basins

15

Discussion Points

- Use of large scale regional disposal basins will be less prevalent in the future
- Small scale constructed disposal basins will increase in use in the future

Regional South Westing Basins

1

The Use of On-farm and Community Scale Salt Disposal Basins in Irrigation Areas of the Murray-Darling Basin

Session 2: Presentation and Discussion on Disposal Basin Processes

CSIRO Land and Water

2

Session Outline

- What is a saline disposal basin and what is its purpose?
- Processes within a basin
 - evaporation
 - Leakage
 - basin capacity
- Drainage/disposal basin system
- What defines an effective saline disposal basin?

3

What is a Saline Disposal Basin and What is its Purpose?

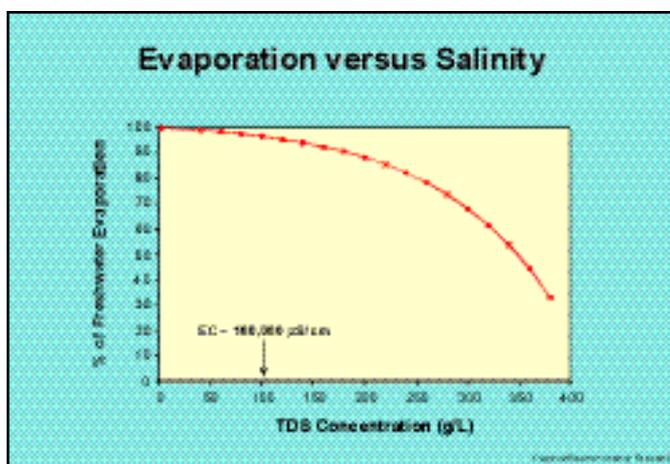
- Evaporate drainage water
 - only for short-term storage of water
- Store salt in a defined location

4

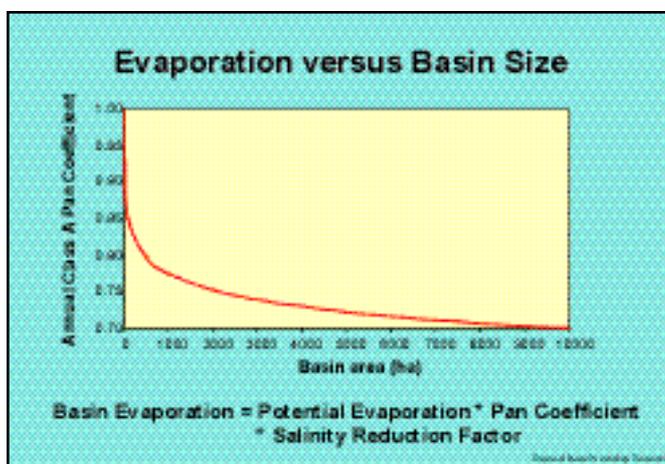
What Affects Evaporation?

- Salinity of the ponded water
 - as salinity increases, evaporation decreases
 - due to a higher proportion of the water being bound in hydrated form to the solutes
- Basin size ("oasis effect")
 - as basin size increases, evaporation decreases
 - due to lesser ability to remove humidity above the basin
 - wind turbulence is affected by basin orientation and design
- Water temperature
 - as water temperature increases, evaporation increases
 - affected by depth and colour
- Climate
 - spatial variations in net evaporation over the Riverine Plain

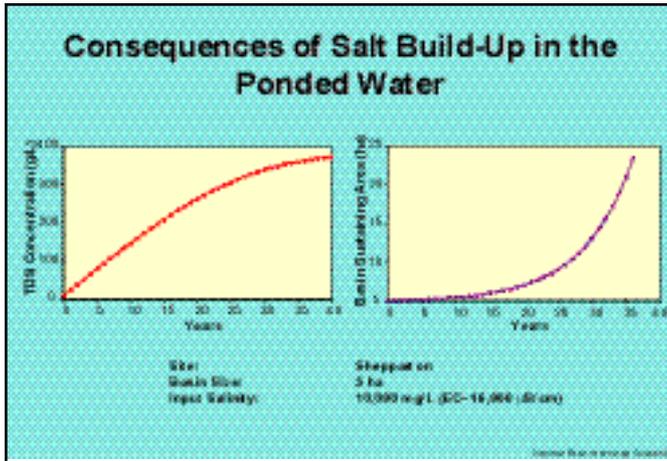
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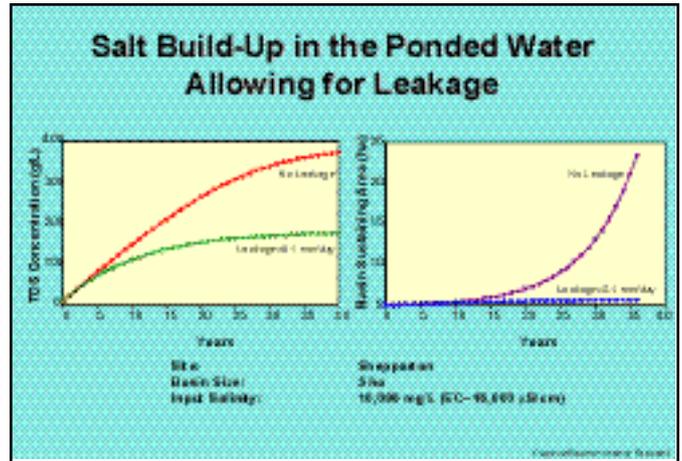
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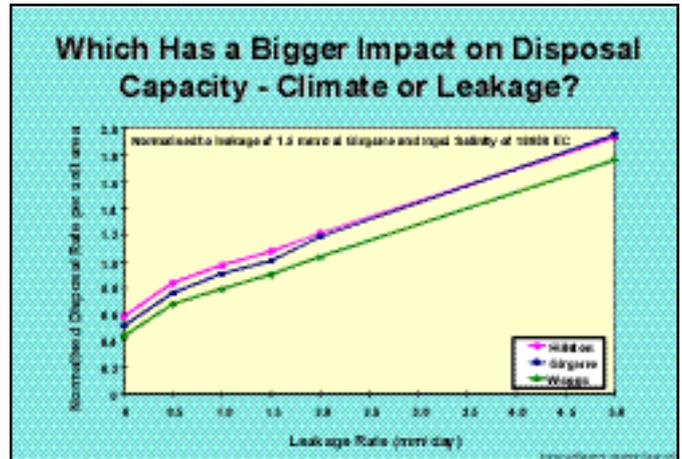


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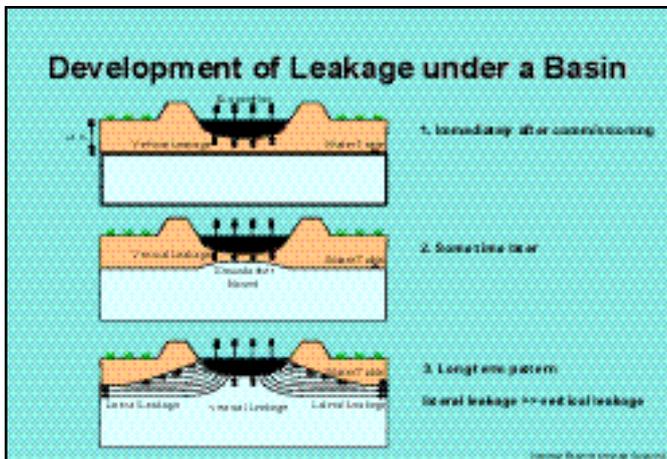
Variation in Nett Evaporation Over the Riverine Plain

Location	Mean Annual (PE - P) (mm)
Hillston	1370
Griffith	1160
Hay	1275
Swan Hill	1220
Deniliquin	1130
Shepparton	960

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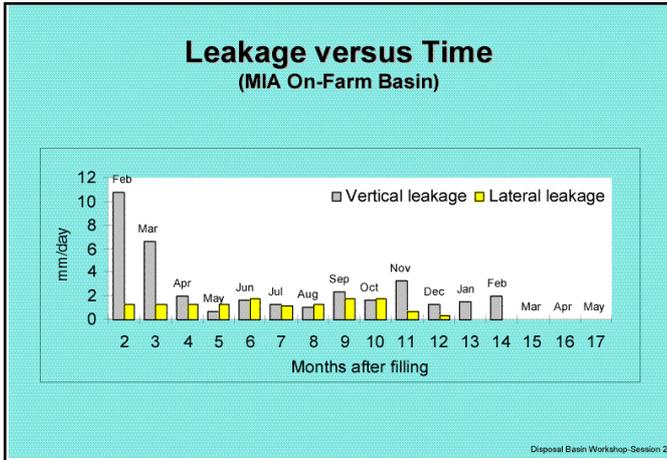
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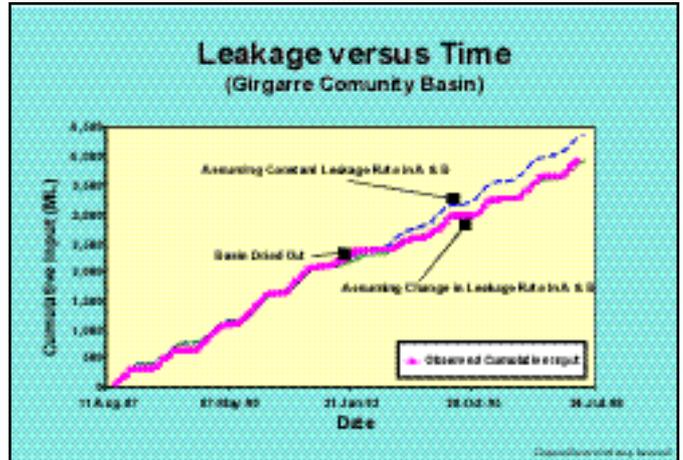
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- ### Factors Affecting Leakage Rate
- Soil type (more clayey the soil lower the leakage)
 - Salinity of ponded water (changes soil sodicity dispersion)
 - Head difference between basin water level and watertable
 - Bio-clogging (algal mats etc.) & salt precipitation on basin floor
 - Compaction or artificial lining of the basin floor
 - Wetting and drying of the basin
 - Basin size (perimeter to area ratio)

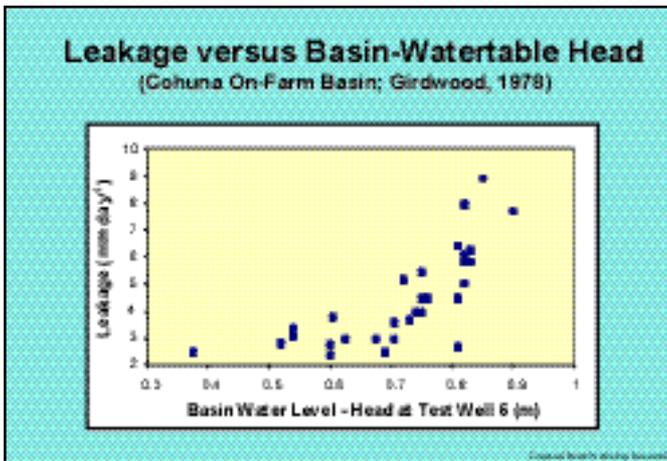
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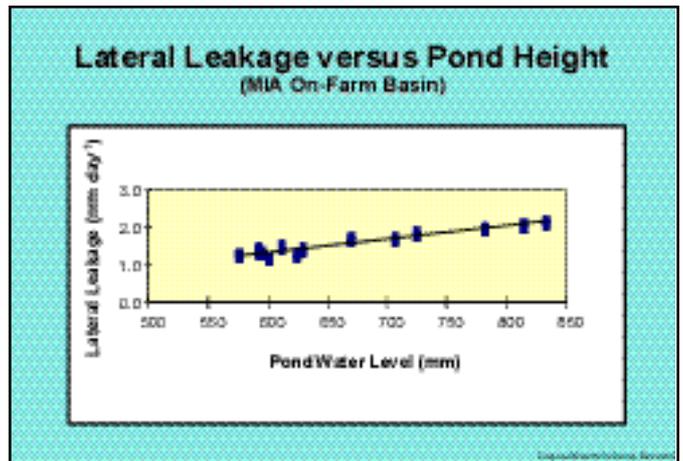
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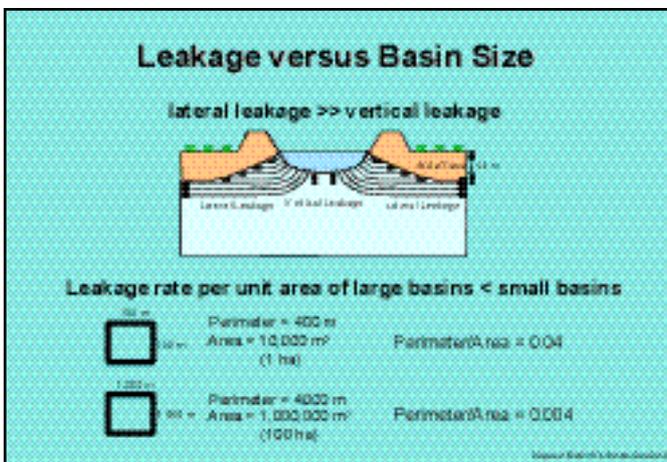
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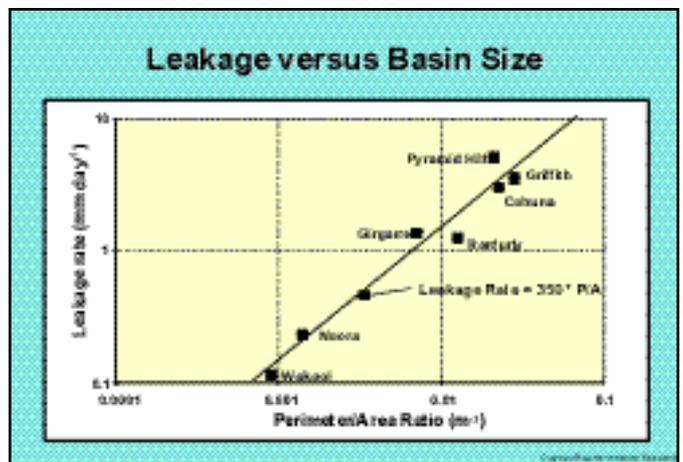
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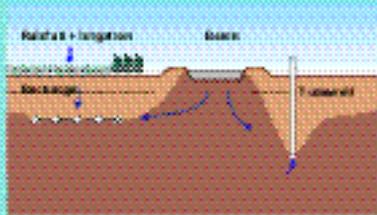
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Summary So Far

- Basins are for the evaporation of water and storage of salt
- Basins ~~can~~ should will leak
 - can minimise the leakage rate
 - probably cannot stop leakage completely over long periods of time
- Leakage, even at very low rates, increases disposal capacity
 - allows more of ordarkle salt disposal
- Larger basins generally have lower leakage per unit area
- Potential for detrimental off-site effects caused by leakage

20

Drainage/Disposal Basin System



- Drainage systems lower the water table
 - reducing waterlogging and soil salinisation
- Salt in the drainage water is concentrated in the basin and over time may leak out
- Just redistributing diffusely stored salt to a point location

21

Fate of the Salt in a Leaking Basin

- Generally moves immediately below the basin
 - regional hydraulic gradient's and conductivities are generally low in the Riverina Plain
- Localised lateral leakage immediately adjacent to the basin
- If the basin is located within the drainage system then salt can be continually recycled
 - system still has a finite life due to the salt imported in irrigation water - but it will be an extremely long time

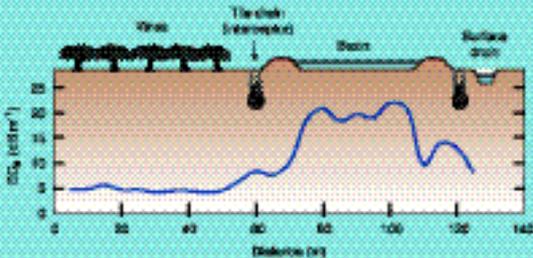
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Localised Lateral Leakage

- Water table mounds often develop under basins, possibly resulting in waterlogging and/or salinisation of immediately adjacent land
 - affect usually only local (10's - 100's m)
- Can be controlled successfully by interception works such as:
 - deep open drains
 - tile drains
 - tubewells
- Tubewell drainage systems may, in some instances, enhance movement of leakage water
 - due to the large hydraulic gradient's produced by pumping

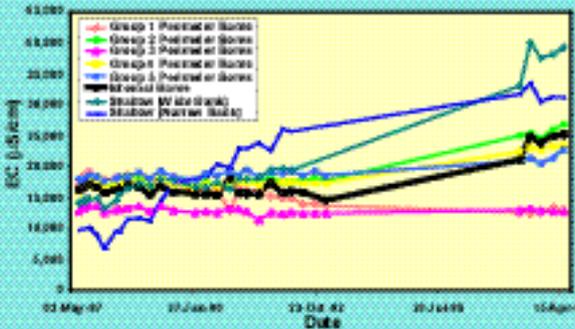
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Soil Salinity Around MIA Tile-Drained On-Farm Basin

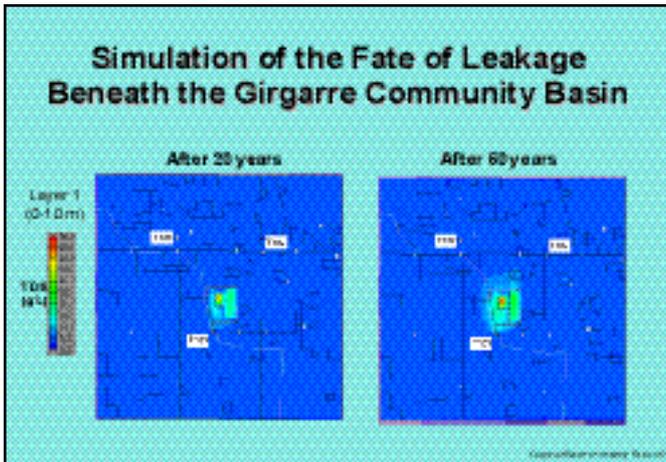


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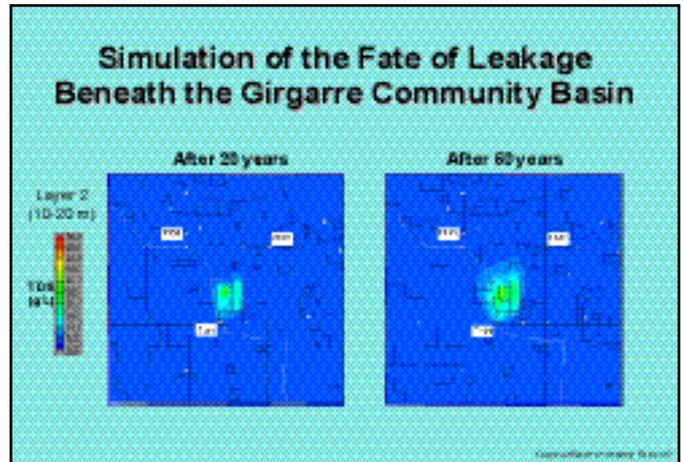
Effect of Leakage on Groundwater Beneath the Girgarre Community Basin



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27

Leakage Summary

- Key to success is to maintain control of the salt and to recycle it to the basin
- Best way to do this is to have the basin located within the boundaries of the drainage system
 - and in multi-cell basins, put terminal cell (highest salinity) in the middle

28

Potentially Toxic Pollutants

- Basins will evapoconcentrate whatever chemicals are in the drainage water
 - nutrients
 - pesticides/herbicides
 - heavy metals
 - trace elements (eg. selenium in Californian basins - unlikely given the alkaloid geology of the Fiverine Plain)
- Risks can be reduced by excluding surface water drainage from basins
- Comprehensive screening program of drainage water required before pumping to a basin
 - pesticides have been detected under irrigation areas of the Fiverine Plain

29

What Defines an Effective Saline Disposal Basin?

Water Disposal

Disposal capacity is maintained by controlled leakage

Salt Storage

Leakage is contained within the drainage/disposal basin system

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Discussion Points

- To maintain disposal capacity the salinity of the ponded water must be controlled, so that evaporation remains high.
- This is best done by allowing controlled leakage of water (and hence salt) into the soil and groundwater below the basin
- This saline leakage should and can be contained within the drainage/disposal basin system

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The Use of On-farm and Community Scale Salt Disposal Basins in Irrigation Areas of the Murray-Darling Basin

Session 3: Presentation and Discussion on Principles for Responsible Basin Use

Supported by MDBC S&E Program Grant 170M

CSIRO Land and Water

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Session Outline

- Background for developing a set of Principles
- What is a Principle and how does it differ from a Guideline?
- Overall objectives of the Principles
- Presentation and discussion of each of the 6 Principles

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Background

- No existing comprehensive Principles or Guidelines
- Some legislation - not specific to saline disposal basins
- Minimal local guidelines (e.g. DLWC M&A on-farm basins for new horticulture)
 - specific to local area
- Need a generic framework for the effective and environmentally responsible use of small scale saline disposal basins

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What is a Principle and How Does it Differ From a Guideline?

PRINCIPLE: "an important general truth or law"
(Chambers Dictionary) "a sense of what is right in conduct"

- a general over-arching philosophy

GUIDELINE: "leads or directs action"
(Chambers Dictionary)

- much more detailed
- enables implementation of Principles
- there may be several sets of different (regional) Guidelines that satisfy the set of Principles

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Overall Objectives of Saline Disposal Basin Principles

To:

- Define the type of water appropriate for basin disposal
- Define where salt can be stored
- Contain salt within the area where it was extracted
- Prevent pollution of useable groundwater resources
- Prevent pollution of surface water resources
- Minimise other environmental and community impacts

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Assumptions

- No net salt export from the area in which the groundwater is extracted
- Best management engineering practices will be employed for siting and design
- Principles should be considered within the framework of existing State and Federal legislation and Local Government regulations, where appropriate
- In instances where Principles contradict each other these minimising adverse environmental effects will apply

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Principle 1

Intention: *to minimise the volume of disposal, thereby minimising the basin size and cost, and to ensure the best use of water as a resource*

Definition: Evaporation basins are only for the disposal of saline water from sub-surface drainage systems, after all potential productive uses have occurred or the water is shown to be technically or economically unsuitable for use

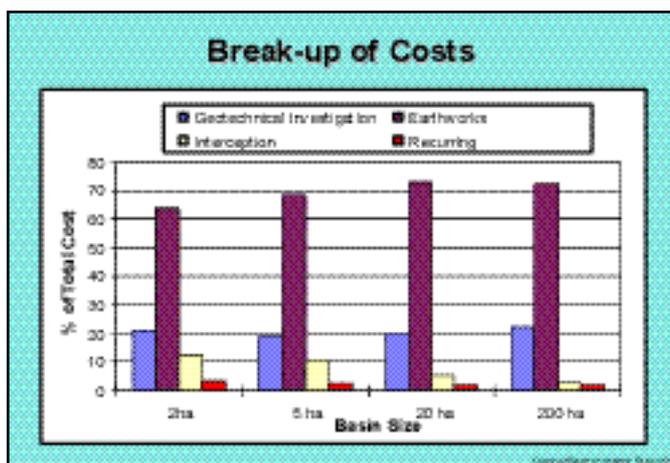
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Principle 1

Justification:

- basins are expensive to construct, remove land from production, and generally don't generate revenue
 - ∴ need to minimise size
- need to maximise benefits from irrigation water (i.e. promote re-use)
 - ∴ minimise water volume
- volume & design not suitable for run-off storage and water can be re-used
 - ∴ minimise water volume

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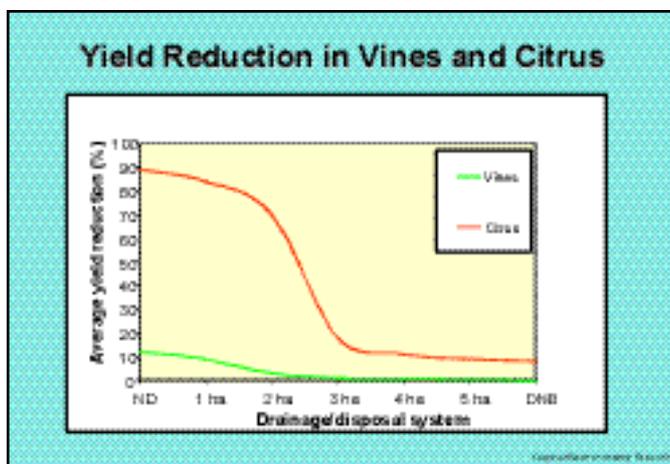


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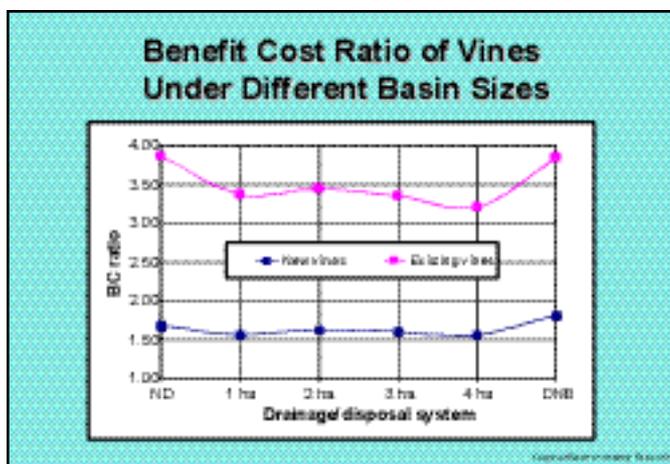
Best and worst case scenarios for evaporation basin siting and construction

Cost Item	Scenario	2 ha	5 ha	20 ha	200 ha
Geotechnical costs	Best	low	low	low	medium
	Worst	extensive	extensive	extensive	extensive
Basin shape	Best	square	square	square	square
	Worst	irregular	irregular	irregular	irregular
Size of cell (ha)	Best	2	5	10	20
	Worst	1	2	5	5
Compaction	Best	no	no	no	no
	Worst	yes	yes	yes	yes
Seepage control	Best	ppp	ppp	ppp	ppp
	Worst	open	open	open	ppp
No. Pumps	Lowest	10.2	6.1	4.1	4.3
	Highest	11	6.7	4.6	4.7
Cost per ha (\$/ha)	Lowest	13.3	7.4	6.0	6.0
	Highest	16.2	13.3	9.7	10
Worst	Most likely	22.7	14.0	11.2	11.7
	Highest	24.8	16.0	12.7	13.3

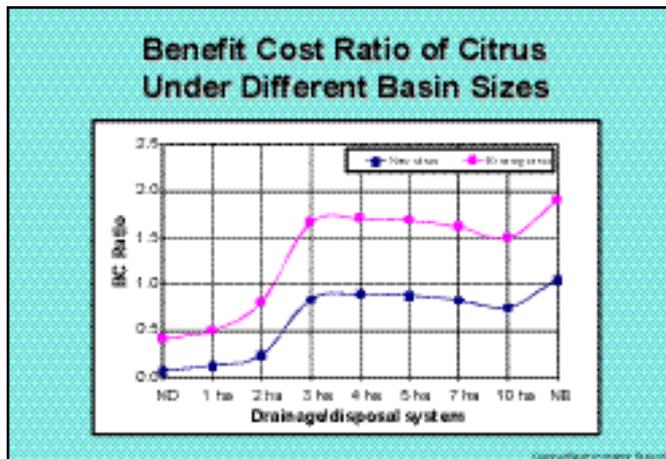
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Conclusions

- Basin costs - highly variable, scope for minimisation
- Drainage using disposal basins is attractive in vines, but not attractive in new citrus
- Annual variation in Net Cash Flow is important

Future Work

- Subsurface drainage attractiveness in pasture
- On-farm and community basin comparison

Issues

- Yield losses are only due to waterlogging, not considering long term salinity effects
- Economic analysis of disposal basins compared to other options

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Principle 2

Intention: *to maximise and maintain disposal capacity; recognition of leakage as an unavoidable reality*

Definition: Salts remaining in a basin due to evaporation should be stored not only in the ponded water but also in the soil and aquifer system below the basin

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Principle 2

Justification:

- controlled leakage limits increases in ponded water salinity
 - ∴ maintain a high evaporation rate
- high evaporation rate maximises disposal capacity
 - ∴ minimise basin size
- storage in the basin alone will require removal and export of salt
- can be environmentally acceptable (see Principles 3 and 4)

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Principle 3

Intention: *to ensure that salt is not exported to adjoining land outside the drainage area benefiting from the drainage water disposal*

Definition: Salt stored below the basin should remain in the area of influence of the drainage system, or within a specific salt containment area around a basin located outside the limits of a drainage system

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Principle 3

Justification:

- prevents salt export which can degrade land and water in adjacent areas
- ownership and responsibility for the salt remains with the beneficiary of the drainage
- basin is preferably located within the drainage system, otherwise a stringent salt containment system is required
- decommissioning plan needs to ensure the salt is contained/managed

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Principle 4

Intention: *prevent pollution of usable groundwater resources*

Definition: Leakage from a basin should not pollute groundwater with existing or potential beneficial use

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Principle 4

Justification:

- good quality groundwater is a valuable resource
- may sometimes contradict Principle 2
- ∴ need to decide which is of greater importance

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Principle 5

Intention: *prevent pollution of surface waters*

Definition: Water stored in disposal basins should not be released to surface drainage systems

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Principle 5

Justification:

- should not pollute surface waters and ecosystems, even at high flows
- ∴ do not export the problem to downstream users
- basins are for the evaporation of water, not storage
- sends an inappropriate signal to basin users that good irrigation and drainage management is not required
- in extreme flood events this may not be possible, and surface waters may also enter the basin

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Principle 6

Intention: *to ensure that detrimental side effects of basin use are minimised*

Definition: Basins should be sited, designed and managed to minimise environmental, socioeconomic and aesthetic impacts

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Principle 6

Justification:

- need to address other issues such as:
 - local salinisation around the basin
 - exposure and erosion of soil and redistribution of salt dust
 - bird, insect and odour problems
 - visual impact - improving aesthetics
 - siting away from sensitive land uses (residential and business areas, community facilities etc.)
 - siting away from surface water features, flood-prone areas
 - on farm or community basin?
- basins can be a community and ecological resource
- management and decommissioning plans required which identify off-site risks

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Future Directions

- Development of technical guidelines associated with the disposal basin "principles"
 - tools and other relevant information for siting, design, management and decommissioning
 - development of an overall framework for the use of small-scale disposal basins in the Resource Plan
- Communication strategy needs to be developed by the MDSC
 - formal policy on drainage disposal and management/policy framework to be discussed with the stakeholders