Deep drainage is it for me? Workshop manual for participants

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DEEP DRAINAGE
- IS IT FOR ME?

WORKSHOP MANUAL FOR PARTICIPANTS

Deep Drainage – Is it for me?
Workshop Manual for Participants
ACKNOWLEDGMENTS

This workshop has been developed as part of the GRDC/NDSP-funded ‘A Million Hectares for the Future’ project, with support and input from key personnel from the Department of Agriculture, Western Australia (DAWA). Thankyou to the farmers who participated in the pilot workshops, providing valuable feedback on structure and content.

Developed and compiled by Richard O’Donnell
Department of Agriculture, Western Australia

June 2005

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Cover picture: Construction of leeved open drain with excavator, Eastern Wheatbelt of Western Australia

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These participant notes cover all of the topics discussed and overheads presented within the workshop, with space to add your own comments. Worksheets provide space for answering questions related to activities carried out.

These notes are a record of your discussions and any conclusions developed out of this workshop.
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<td>P3</td>
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Introduction

This workshop forms part of a series of workshops dealing with dryland salinity and options to manage it. All of the workshops have the common theme of identifying the risk at the catchment and farm level, assessing the potential consequences if the risk is not managed and determining the course of action to be taken. You will be able to determine the course of action based on your specific circumstances and goals. There is no one recipe that is suited to all situations.

This manual covers all of the topics discussed and slides presented throughout the day, with space to add your own comments. When completed, it should provide you with a documented record of the risks to your land, the likely impact of these risks and the planned activities to manage the risks.

Housekeeping

- Emergency exits, tea, coffee, toilets;
- Ground rules for discussion - It is important to make sure that all participants are encouraged to have their say and respect the rights of others and their opinions. This is also a good time to reinforce expectations of areas to be covered and those areas that won’t be covered;
- Mobile phones turned off.

Presentation 1 - Checklist 1 to 4

Slide 2

Aims of the workshop

By the end of this workshop, participants will have made an initial assessment of the suitability of Deep Drainage as a salinity management option for their farming business.

This will be achieved through:

- Using a case study site to work through the ‘Good Planning’ checklist for establishing Deep Drainage.
Aims of the workshop cont’d
• Understanding the terminology to describe water movement through soil
• Explore Deep Drainage options currently used in Western Australia and appreciating the benefits & limitations of these designs
• Learning where to access further information if you decide that Deep Drainage is a suitable salinity management option for your farm.

Workshop Overview
Purpose: To identify the suitability of the case study site for Deep Drainage
Areas covered:
The WHAT, WHY, HOW and WHO of the Planning Checklist,
Case study site details, and
Questions for the day.

The Good Planning Checklist
1. Why are you considering Deep Drainage?
2. What is your intended outcome?
3. How are you going to measure the success of the outcome?
4. Is surface water being controlled?
5. Obtain NOID package
6. What is the intended disposal point/site?
7. Trace proposed deep drain(s) onto farm map

The box in red is a possible service from DAWA that may be available in the next couple of years, subject to the training and development of Land & Water Development Officers (DAWA).

Good Planning Checklist cont’d
8. Site investigation (own)
9. Design considerations, including local government & neighbours
10. Costs
11. Submit NOID
12. No objection to construction given
13. Contractor organised and properly briefed, construction commences
14. Maintenance
Slide 7

**Case Study**

Farmers: Colin & Betty Wilkins
System: Mixed farming
- Cropping & livestock
Annual rainfall: 325mm
Growing period (May-Oct): ~225 mm
Soils: Mixture
Soil pH: 4.8-6.0

---

Slide 8

Note: There is a full page version of this slide on page 8.

---

Slide 9

**Questions to consider:**

- Is this site suited to Deep Drainage?
- What things need to be considered?
- How will I know if it has worked?
- Let’s start working through the ‘Good Planning Checklist’ for drainage!

---

Slide 10

**Deep Drainage - Is it for me?**

Describe your water drainage situation
Slide 11

**Good Planning Checklist**

1. **“Why are you considering Deep Drainage?”**

Slide 12

**Why are you considering Deep Drainage?**

- Beware of ‘Silver Bullets’
- Consider the RCA decision process
- Do you want to:
  - Recover,
  - Contain, or
  - Adapt
  the saline land?
- Are there alternatives or options that will compliment drainage?
  - Surface water management?
  - Perennials?
  - Salinity?
  - Do nothing?

Slide 13

**What is going down the drain?**

- Water
- Salt
- Low pH (highly acid) water
- Heavy metals – iron, cadmium etc
- Nutrients
- Or
- A combination of the above?

Slide 14

**Waterlogging**

Management of waterlogging, since it is a shallow and localised watertable, **can be achieved through effective surface water management structures.** Waterlogging is a consideration in designing deep drains but is not a reason for implementing deep drainage.
Slide 15

Rainfall & Salt importing

McFarlane and George 1992

Slide 16

Salinity

Production yield decline

Source: Saltland Pastures in Australia - A Practical Guide 2nd Ed

Slide 17

Salinity x Waterlogging

0% salinity
4% salinity
20% salinity

Source: Saltland Pastures in Australia - A Practical Guide 2nd Ed

The interaction of the two constraints to plant growth has a combined effect

Slide 18

pH Effects

- Acidic water pH < 5 has a detrimental effect on living organisms
- The cost of amelioration exceeds the value of the drained land is on-going
- Certain heavy metals become mobile at low pH conditions
  e.g. Iron, Cadmium, Copper, Zinc
  → toxic and loss of valuable nutrients
This graph shows percentage of acid bores found in different locations across Western Australia.

---

**Slide 20**

**Check back!**

- Why are you considering Deep Drainage?

  > “Site is going saline… Tried Surface Water Management, then tried – decided they weren’t doing enough.”

---

**Slide 21**

**Good Planning Checklist**

2. **“What is your intended outcome?”**

---

**Slide 22**

**Your Intended Outcome**

> “To keep cropping the entire paddock and to stop more soil erosion by surface water.”

What is your intended outcome?
- Protect vegetation?
- Lower watertable?
- Crop saline area?
- Stop further loss of land?
- Other?
Slide 23

**Good Planning Checklist**

3. “How are you going to measure the success of the outcome?”

---

Slide 24

**Measuring the Outcome**

How are you going to measure the success of the drainage works?
- Crop yield?
- Monitoring water table levels?
- Monitoring plant species?
- Value of property?
- Other?

“If I can crop right to the edge of the drain without too much yield penalty I’ll consider that to be successful deep drainage.”

What measurements would you see?

---

Slide 25

**Good Planning Checklist**

4. “Is Surface Water being controlled?”

---

Slide 26

**Surface Water Control**

- Surface Water Management (SWM) is the cheapest and most effective management option in controlling excessive water in the farming system before it becomes a groundwater issue.
- Understanding surface water hydrology is essential if a deep system is to work effectively.
- Costs of $100s/km versus $1000s/km for construction.
Slide 27
A W-drain is used to increase the volume of flow away from low-lying areas.

Slide 28

Slide 29

V-drain
Bread-based shallow channel (to increase flow volume)

Slide 30
Review
Checklist points 1-4:
1. Why are you considering Deep Drainage?
2. What is your intended outcome?
3. How are you going to measure the success of your outcome?
4. Is Surface Water being controlled?
1. Making application for the plan to happen

Purpose: To continue working through the ‘Good Planning’ checklist, specifically focussing on the Notice of Intent to Drain (NOID) requirements.

Presentation 2 - Checklist 5 to 7

Duration: **40 minutes** (S+55 to S+95)

---

Slide 2

**Good Planning Checklist**

5. Obtain a Notice of Intent to Drain or Pump Water (NOID) package

---

Slide 3

Obtain a Notice of Intent to Drain or Pump Water (NOID) package

Get a package from:
- Any district or regional Department of Agriculture office
- 08 9368 3282 (Commissioner of Soil and Land Conservation)
- Website: www.agric.wa.gov.au (search for “drain form”)

---

Slide 4

NOID Package

The NOID form is found within Farm Water #2 kit.

---

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Slide 8

6. “What is the intended disposal point/site?”

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Slide 9

What is the intended disposal point/site?

- On vs off-farm
  - Less investigation required for on-farm disposal
- Evaporation basin
  - Own use or communal use
- Neighbours
  - Users of the water and downstream landowners
  - You need to have written consent (Schedule 4)
- Other Public Authorities
  - The Commissioner of Soil and Land Conservation will seek advice from appropriate agencies such as CALM, Local govt, Dept of Environment and others

Slide 10

Evaporation basins

Source: DAWA

Slide 11

Good Planning Checklist

7. Trace proposed deep drain(s) onto farm map

Slide 12

Trace proposed deep drain(s) onto farm map

Factors to consider:

- Existing drainage lines (natural or constructed)
- Property infrastructure (roads, fences etc)
- Services (telephone, water, power)
- Intended disposal point/site
Slide 13

Remember the scale of plans!

Source: EWM Group, DAWA

Slide 14

Example...

Source: DAWA

Slide 15

Actual - Case Study

Slide 16

Review

Checklist points 5-7:
5. Obtain NOID package
6. What is the intended disposal point/site?
7. Trace proposed deep drain(s) onto farm map
2. Doing your own Site Investigation (understanding water movement in soils)

**Purpose:** To encourage land managers to conduct their own site investigations and to develop a better understanding of water movement through soils.

**Presentation 3 - Checklist 8**

**Duration:** 40 minutes (S+110 to S+150)

---

**Slide 2**

*Good Planning Checklist*

- Site Investigation (Own)

---

**Slide 3**

*Overview*

**Purpose:** To review principles of water movement in soils and to achieve use of common terminology.

**Areas covered:**
- Soil components
- Soil characteristics
- Layers
- Boundaries
- Barriers
- Hydrology terminology
- Rainfall vs Evaporation.

---

**Slide 4**

*Site Investigation*  
*Source: T. Mathwin, DAWA*
Doing It Yourself...

- Organise a backhoe to put in approximately 5 pits per km of drain to ~2.5–3 m depth
- Need to comply with WorkSafe requirements:
  - Soil horizons
  - Possible barriers
  - Which horizon the water flows from
  - Flow rate of water entering pit 1 hour and 24 hours after digging (exclude surface water)
  - EC and pH of the water

**WorkSafe WA Code of Practice:**
*Excavations* states that pits deeper than 1.5 m should be either shored up or have a sloped side to minimise the chance of side slump while someone is in the pit. Also preferable to have at least one end ramped for easy access and egress. If the pit is not going to be filled in straight away, a barrier of at least 900 mm height should be erected around the excavation. See Appendix 1 for further references.

### Slide 6

**Soil Components**

- Clay (≤0.002mm diameter)
- Silt (0.002 – 0.02mm)
- Sand (0.02 – 2mm)
- Gravel (>2mm diameter)

Source: Farm Monitoring Handbook

Clay content:
- Clay soils = >35% clay
- Loam soils = ~5-35% clay
- Sand soils = <5% clay

### Slide 7

**Soil Pit Examinations**

Series of pits dug around Woodanilling for site investigation. The soil characteristics are being determined by Paul Galloway (in pit) DAWA, 2002.

### Slide 8

**Soil Characteristics**

These charts are useful in relating soil type descriptions back to native vegetation and production systems. Obtain these from TopCrop – WA contact Carol Llewellyn, Department of Agriculture 08 9690 2126
What it means for Deep Drainage is that not one type of drain will work everywhere!

---

Barriers to water flow

- "cretes" (Sil-, Ferri-, Cal-)*
- Intrusions e.g. dykes
- Tight clay

*Some of the "cretes" can be quite transmissive if there are interconnecting cracks through the barriers.

---

Silcrete soils in the Kalannie/Goodlands area.

---
Slide 13

Water flow horizons

Surface flow systems
Subsurface systems
Groundwater systems

Subsurface systems

Groundwater systems

Slide 14

Seepage interceptor drain designed to intercept subsurface flows and channel them into a dam or creek.

Slide 15

Groundwater

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Slide 16

Evaporation usually exceeds rainfall.

Source: P. Raper, DAWA

Northam: 430 mm rainfall vs 1800 mm evaporation

Slide 17

Checklist for own site investigation:
(a) What are your main soils types that the drain will run through?
(b) Are there soil barriers to water movement?
(c) Which horizon(s) is the water coming from?
(d) What is the flow rate of the water into the backhoe pits?
(e) What is the EC and pH of the water?
3. **Design Considerations and Costs**

**Purpose:** To look at Deep Drainage options currently used in Western Australia and appreciate the benefits and limitations of these structures, especially design considerations and costs.

**Presentation 4 - Checklist 9 to 10**

Duration: **40 minutes** (S+165 to S+205)

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**Slide 2**

**Overview**

- **Purpose:** To examine basic design and cost considerations of deep drainage structures constructed in WA.
- **Areas covered:**
  - Design Considerations,
  - Types of drains, and
  - Costs involved

---

**Slide 3**

**Good Planning Checklist**

**Design Considerations and Types of Drainage structures**

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**Slide 4**

**Types of Drainage structures**

- Open relief
- Tile/Mole
- Levee
- Relief wells
- Groundwater pumping
Slide 5

Design Considerations

Note: There is a half page version of this slide on page 26

Slide 6

Open Deep Drain

Deep excavated channel
Design and Construction of open deep drains

- Constructed on a grade by an excavator, to collect surface and subsurface water from waterlogged or groundwater discharge areas. Spoil placed on one side or alternated on one side or the other.
- Reduces quantity of water stored in soils with high hydraulic conductivity. Drain can reduce watertable to level near bottom of drain and could draw down 100-200 m either side of the drain under ideal conditions. In soils with low hydraulic conductivity, drawdown may only be limited.
- Hydraulic gradient affects the quantity of groundwater released into the drain – areas with strong vertical gradient may not respond as well.
- Surface flows can enter the drain and can be removed from drainage site by same structure.
- Discharge into a safe disposal area is required so flow quantity and quality will not cause degradation.
- Drain dimensions are determined from the predicted erosive velocity of the structure and can be constructed on grades to 0.2%.
- Depth of drain can be up to 3 m with spoil placed on alternate sides.
- Depth of flow calculation critical as velocity of flow increases when flow depth increases.

Variables Leading to Risk of Degradation or Structure Failure

- Large catchment surface water run-off can cause erosion of drain batters and floor. Velocity increases as depth of flow increases. Large surface water flows entering drain can cause erosion of drain's batters.
- In soils with a high hydraulic conductivity, slumping of batters into drain can occur.
- In sodic soils and soils with low hydraulic conductivity, drawdown can be limited.
- If not designed adequately, saline discharge from drain can cause degradation of disposal site.
- Detailed survey of hydraulic properties and soil chemistry of the drainage site required.

Shallow channels
0.5 m deep, 3 m wide, 0.75:1 batter $1500/km
1.0 m deep, 3 m wide, 0.75:1 batter $3000/km
0.5 m deep, 5 m wide, 0.75:1 batter $2800/km
1.0 m deep, 5 m wide, 0.75:1 batter $4500/km

(Source: Farm Weekly Budget Guide 2004)
Design Considerations

- Equipment Widths
- Grade
- Soil Structure (Side Slope)
- Hydraulic Conductivity (Flow Rate)

Slide 7

Structural Integrity

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<th>Grades</th>
<th>Natural</th>
<th>Artificial</th>
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<tr>
<td>Notes</td>
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</tbody>
</table>

Recommended: <3% slope but >0%

Slide 8

Tile Drains

Subsurface drainage constructed to remove water from waterlogged soils or saturated soil layers.
Design and Construction of tile and mole drains

- Buried or created drainage in a herringbone pattern, used to reduce waterlogging and drain shallow groundwater tables.
- Excavators, backhoes, trench diggers or pipe layers used for placement of tile and slotted drainage into saturated layers.
- Tile drainage into excavated trenches can be bedded in an envelope of coarse sand prior to back-filling.
- Bulldozers and heavy tractors, pulling machines with torpedo-shaped cylinders through saturated clays, create mole drainage.
- Construction on a grade no more than 1%.
- Discharge into open drains or sumps and into evaporation basins.
- Drainage effect dependent on hydraulic conductivity of soil treated.
- Pastures and crops can be planted over the back-filled drainage.
- Trees can be planted clear of the site and clear of root interference with the drainage.

Variables Leading to Risk of Degradation or Structure Failure

- Poor understanding of the hydrology (including hydraulic conductivity) of the site to be drained. Detailed hydrological site survey is required to plan drainage.
- Fine particle block slots in piping.
- In iron-rich soils, precipitates block slots in piping.
- Tree roots can block or break piping.
- Mole drainage is effective for only a short period because of slumping.
- Planning for safe disposal for saline discharge required.
Slide 10

**Collector and Mole Drains**

Source: Bulletin 4610, DAWA

---

Slide 11

**Lateral influence on watertables**

Source: Bulletin 4617, DAWA

---

Slide 12

**Effective drawdown**

Effective drawdown is the minimum drawdown required for the watertable not to impact on crop growth. The effective zone where drawdown is greater than 0.75 m is shown below.

---

Slide 13

**Leveed Open Deep Drain**

Deep excavated and leveed channel constructed to remove subsurface water from land with low slopes.
Design and Construction of leveed open deep drains

- Constructed on a grade by an excavator, to collect subsurface water from waterlogged or groundwater discharge areas.
- Surface flows cannot enter the drain as spoil is placed to form levees on both sides of drain.
- Reduces quantity of water stored in soils with high hydraulic conductivity. Drain can reduce watertable to level near bottom under the most ideal conditions.
- Hydraulic gradient also affects the quantity of groundwater released into the drain – areas with strong vertical gradient may not respond as well.
- Pipes can be used to discharge small surface flows or ponded water into drain.
- Discharge into a safe disposal area is required so flow quantity and quality will not cause degradation.
- Drain dimensions are determined from the predicted erosive velocity of the structure and can be constructed on grades up to 0.2%.
- Depth of drain can be 3 m.
- Drains with small highly saline subsurface flow can be designed to discharge into an evaporation basin.

**Variables Leading to Risk of Degradation or Structure Failure**

- In soils with high hydraulic conductivity and low strength (e.g., sand), slumping of the batters into drain can occur. Spoil can also slump into drain.
- In sodic soils and soils with low hydraulic conductivity, drawdown can be limited.
- If not designed adequately, saline discharge from drain can cause degradation of disposal site.
- Large catchment surface flows can erode outside batters of spoil or may flood outside of spoil.
- Difficult to construct drains that discharge at ground level (due to depth).
- Detailed survey of hydraulic properties and soil chemistry of the drainage site required.

Leveed deep drains
1.8 m deep with 0.5:1 batter $4000/km
2.2 m deep with 0.5:1 batter $4600/km
2.5 m deep with 0.5:1 batter $5000/km
3.0 m deep with 0.5:1 batter $7000/km

(Source: Farm Weekly Budget Guide 2004)
Slide 14

**Structural Integrity**

Soil Stability – this will determine the maximum side slope ratios of the structure to minimise soil erosion

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Side Slope Limit for Deep Drains</th>
<th>Maximum Side Slope Limit</th>
<th>Minimum Side Slope Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>0.5</td>
<td>0.25</td>
<td>0.5</td>
</tr>
<tr>
<td>Clay</td>
<td>0.3</td>
<td>0.1</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Note: The method of computation of slopes is given in Table 3.

Source: Bulletin 4617, DAWA

Slide 15

**Soil Stability**

Batter erosion and sedimentation in an open leaved drain less than 2 years old

Slide 16

**Equipment widths**

Consideration should be given to the distance between open drains, including spoil banks, and machinery widths – both current and future.

Source: Bulletin 4607, DAWA

Slide 17

**Relief wells**

A relief well is a 'free flowing' groundwater bore driven by artesian pressure.

Source: R. George (DAWA)
Relief wells

This ‘confined’ artesian pressure at depth is maintained through rainfall infiltrating and recharging watertables at a higher elevation in the catchment that in turn feed recharge of the deeper aquifer.

Relief wells are one means of reducing the impact of salinisation and waterlogging around specific groundwater seepage areas and as a method of developing localised on-farm water supplies.

Relief wells are used to increase groundwater discharge at a given site. By increasing discharge it may be possible to increase hydraulic head or upward flow and thereby decrease the area affected by groundwater seeps. The average quality of deep groundwater in areas of undulating terrain and moderate rainfall (greater than 550 mm) is often less than 2000 mS/m.

Placement

Relief wells are most effective when placed on localised hillside seeps. If the topographic gradient is greater than 1.5%, the use of groundwater siphoning may be used as an alternative. There is no assured means of locating an area that will contain artesian pressure that will enable relief wells to be used.

In most areas where artesian pressure can be found, a suitable aquifer (sand or bedrock fractures) can be expected 10 to 25 m below ground level. In south Western Australia, experience suggests that a typical relief well will yield between 4,000 and 15,000 litres of groundwater per day. Maximum rates of over 1 litre per second can be achieved. This supply rate is expected to remain relatively constant through out the year. However in dry years the rate of water supply from a relief well can fall by 10 to 20%. Other causes of reduced artesian yield include aquifer pumping, screen clogging, bore collapse and revegetation within the catchment.

Watertables near the relief well remains at or near ground level. In contrast, siphons can be used to create a maximum drawdown of about 8 m.

Design

To test for artesian conditions, a test well or piezometer (about 40 mm in diameter) is drilled on-site. In most cases the drilling of a shallow 6 m tracer will prove if artesian conditions are present. However, on sites with deeper sediments, bores deeper than 10-15 m may be required.

A relief well is designed to provide a preferred pathway for water to exit the ground. The recommended dimensions for an efficient relief well include the drilling of a 100 mm (4 inch) bore hole (diameter) with a 50 mm (2 inch) inside diameter PVC casing. An average drilling depth in the dissected landscapes of the South West is expected to be about 25 m.
Construction

Prior to construction, a Notice of Intent (NOI) should be lodged with the Soil Conservation Commissioner 90 days before drilling commences. Construction of a relief well requires the drilling of a groundwater production bore into an aquifer that contains artesian pressure. For a relief well to produce 'the best possible flow rate':

- drilling needs to occur directly on the site that contains artesian pressure; and
- drilling must penetrate a permeable aquifer (sand or bedrock fractures) at depth (usually 15–30m).

Special care is required to prevent leakage and in some areas, licensed drillers are required.

In areas of low artesian pressure (less than 1 m), a length of perforated casing is inserted to a depth that covers the thickness of the aquifer, once the hole has been bored. A pack of permeable gravel is then inserted around the perforated casing to allow the maximum possible volume of groundwater to enter the bore casing. A plug (usually containing cement and bentonite) must be packed above the gravel to prevent groundwater from rising up the outside of the casing. To prevent leakage, this may need to extend to the soil surface.

In areas of high artesian pressures (greater than 3 m), a large diameter casing (125 mm or greater) needs to be cemented into a large bore (200 mm diameter or greater), in a position above the zone of pressure and left to set. Drilling can then proceed inside the casing and the well capped if required.

Maintenance

No maintenance is required other than ensuring no material is allowed to into the well casing and that the screen and bore remain functional.

Cost

A typical relief well with a drilling diameter of 100 mm, installed using 50 mm diameter casing, to a depth of 25 m is estimated to cost $1000. High pressure wells may cost twice this amount, but are not common in WA wheatbelt.

Impacts and Risks

Disposal of groundwater extracted by relief wells or siphons, requires appropriate design and management. Inappropriate disposal may lead to degradation of productive land and freshwater creek-lines. A disposal licence may be required from the Water and Rivers Commission (DEP).

Relief wells can only function in areas of artesian pressure and does to appear economic to use relief wells alone to recover primary saline land but is likely to have the best impact in areas affected by secondary or low level salinity. Relief wells should be used in conjunction with other water management options to enhance their effectiveness.

Groundwater Pumping

Source: R.O’Donnell, DAWA

- Constructed to **lower groundwater tables** and remove seepage at depths too great to be intercepted by constructed drainage.

---

**Design and Construction**

- Groundwater pumping for salinity control is used to dispose of saline subsurface water from profiles affecting the landscape surface.
- Effectiveness of the pumping depends on hydraulic conductivity of water-bearing part of soil profile and leakage rate of overlying layers.
- Containment of highly saline water in an evaporation basin or pond, either constructed of natural (salt lake), may be a preferable option to running it down the drainage line to the detriment of other landowners.
- To be effective, requires an unconfined aquifer.

**Variables Leading to Risk of Degradation or Structure Failure**

- Favourable hydrogeological characteristics of aquifers are not always likely to be found in required locations. Discharge of often highly saline water can degrade disposal site.
- Differing bedrock profiles, origins and weathering processes cause irregularities in transmissivity, hydraulic conductivity and storage coefficients of aquifers.
- Salinity of discharge is often as high as seawater.
- If pumping from a confined or semi-confined aquifer there may be little or no drawdown of the watertable for several years.

---

**Review**

- Name 4 considerations for drainage design.
- Give the pros & cons of 2 drainage types.

**Case Study:**

- Given the site location, what factors have to be considered in drainage design?
**Good Planning Checklist**

10. **Costs**

- Site investigation
- Contractor rates
- Maintenance
- Land area out of production

**Site Investigation Costs**

- **Who can do it?**
  - Yourself
  - Community Landcare Technician
  - Civil engineer

- **How much?**
  - Your time & equipment
  - Hourly rate (sub $100/hr)
  - $2000+ per day

Rule of Thumb: Site investigation should be 10% of total cost

**Contractor Rates**

- $3500/km
- $3500/km

Deep Drainage – Is it for me?
Workshop Manual for Participants
Slide 24

Scale of Design

Source: EWM Group, DAWA

Slide 25

Cost of Maintenance

Drain clean out ~$1500 /km every 5 years

Source: T. Mathwin, DAWA

Slide 26

Other farm management costs & considerations

• Fencing
• Weed & pest control
• Running costs
• Soil amendments (eg. Gypsum)
• Time & labour
• Disposal site

Slide 27

20-year cumulative position of current and future farm

100% salinity control scenarios

Deep Drainage – Is it for me?
Workshop Manual for Participants
A two-stage transition was also investigated with the aim of spreading the cost of construction over a longer period i.e. drains were constructed in two equal stages, the first in 2004 and the second in 2009.

**Note:** This slide will be *Slide 27 in the Participants Notes*

---

**Immediate or 2-stage transition?**

- Cumulative position of both transition strategies is similar after 2009
- However, delaying half the drain construction until 2009 minimises the farm deficit in the first 5 years of the transition
- 15-16 years before cumulative position of the 80 m spacing drainage scenarios overtakes that of the current farm

---

**Review**

Checklist points 9-10:

9. Design Considerations and Types of Drainage structures
10. Costs
   - Use your own site investigation knowledge
   - Calculate your real costs
   - Appreciate the time frames of breaking even that are involved

Case study:
- Estimate the cost of the proposed Deep Drainage works on the site

---

Please take the following:

- Participants notes with pens
- Hat/suncream/water
- Jumper/raincoat
4. **Field Trip to Case Study site**

Duration: **90 minutes** (S+220 to S+310)

1. Why did you consider Deep Drainage?
   - History of site
     - ___________________________________________________________________
     - ___________________________________________________________________
     - ___________________________________________________________________

   - Yields
     - ___________________________________________________________________
     - ___________________________________________________________________

   - Paddock trafficability
     - ___________________________________________________________________

   - Other observations
     - ___________________________________________________________________
     - ___________________________________________________________________
     - ___________________________________________________________________

2. What is your intended outcome?
   - Reason for establishing drainage system
     - ___________________________________________________________________
     - ___________________________________________________________________
     - ___________________________________________________________________

3. How are you going to measure the success of the outcome?
   - ___________________________________________________________________
   - ___________________________________________________________________
   - ___________________________________________________________________

4. Is surface water being controlled?
   - ___________________________________________________________________
   - ___________________________________________________________________

5. What NOID process did you use?
   - ___________________________________________________________________
6. Where is the disposal point/site?
_________________________________________________________________
_________________________________________________________________

7. What site features did you have to consider? (Site Investigation)
Roads/ powerlines/ SWM/ other features
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

What are the main soil types of the site?
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

Are there any barriers to water movement through the soil profile? ____________
Where?
_________________________________________________________________
_________________________________________________________________

8. How did you determine the drainage structure and design?
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

9. How much did it cost you?
_________________________________________________________________
_________________________________________________________________

10. How long it take for approval? ____________________

11. What was your experience from working with the contractor?
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

12. Are you going to maintain the structures?
_________________________________________________________________
5. The final Checklist parts

**Purpose:** To present to participants the final parts of the ‘Good Planning’ checklist and where to access further information and service providers if they decide that Deep Drainage is a suitable salinity management option for their farming business.

**Presentation 5 - Checklist 11 to 14**

Duration: **25 minutes** (S+310 to S+335)

**Slide 2**

*Good Planning Checklist*

11. **Submit NOID**

**Slide 3**

*NOID submitted*

Providing that....
No objections are raised to the proposed works during local consultation
then,
Proposed works, site and disposal point will be investigated by a representative of the Commissioner of Soil and Land Conservation

**Slide 4**

*Good Planning Checklist*

12. **No objection to construction given**
A 'No Objection' reply means that the Commissioner of Soil and Land Conservation is satisfied that there will be no land degradation issues as a result of the proposed drainage works.

However,

This is not the same as an 'OK' that the structure will work effectively.

---

Contractor briefed and construction commences

Prior to employing, ask the contractor:

"What qualifications and formal recognition of skills do you have?"

---

Contractor briefed & construction commences
Slide 9

**Good Planning Checklist**

14. **Maintenance**

---

Slide 10

**Maintenance**

---

Slide 11

---

Slide 12

**Contacts & Further Information**

- Department of Agriculture
  - Technical expertise
  - Commissioner of Soil and Land Conservation
    www.agric.wa.gov.au
- Department of Environment
  www.environment.wa.gov.au
- Department of Conservation and Land Management
  www.calm.wa.gov.au
- Department of Local Government and Regional Development
  www.dlgdrd.wa.gov.au
- Community Landcare Technicians
Slide 13

Contacts & Further Information

- Australian Association of Agricultural Consultants (WA)
  www.assocw.com.au
- Environmental Consultants Association (WA)
  www.ecc.org.au
- Catchment Councils
  Avon Region www.avonicm.org.au
  South West Region www.swcatchmentscouncil.com
  Northern Agricultural Region www.calci.org
  South Coast Region www.script.asn.au

Slide 14

The Good Planning Checklist

1. Why are you considering deep drainage?
2. What is your intended outcome?
3. How are you going to measure the success of the outcome?
4. Is surface water being controlled?
5. Obtain NOID package
6. What is the intended disposal point/site?
7. Trace proposed deep drain(s) onto farm map

Note: There is a half page version of this slide on the back page of your Workshop manual as a quick reference guide.

Slide 15

Good Planning Checklist cont’d

8. Site investigation (own)
9. Design considerations, including Local Government & Neighbours
10. Costs
11. Submit NOID
12. No objection to construction given
13. Contractor organised and properly briefed, construction commences
14. Maintenance

Note: There is a half page version of this slide on the back page of your Workshop manual as a quick reference guide.

Slide 16

Thank you...

To:

- The presenters
- The specialists
- The participants
- The caterers
- The organisers
**Please fill in the evaluation sheet in the back of your Participants Notes and hand it to the presenter(s)**
Appendix 1. Contact Details

Members of the following organisations have a range of skills relating to farm and environmental management. The list may be a useful source of information for people wanting to further investigate water management options for farms. This list is not exhaustive and in no way reflects any preference of the complier or the Department of Agriculture Western Australia. They are recorded in good faith as potential sources of information. It is up to the user of this information to seek out the relevant credentials of individuals.

**Department of Agriculture**
*(Commissioner of Soil and Land Conservation)*
3 Baron-Hay Court
South Perth WA 6151
Tel: 08 9368 3282
Fax: 08 9368 3684
Website: [www.agric.wa.gov.au/](http://www.agric.wa.gov.au/) (search for "drain form" include the double quotes)

**Regional & District Offices (Agricultural regions)**

<table>
<thead>
<tr>
<th>Region</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albany</td>
<td>08 9892 8444</td>
</tr>
<tr>
<td>Bunbury</td>
<td>08 9780 6100</td>
</tr>
<tr>
<td>Esperance</td>
<td>08 9083 1111</td>
</tr>
<tr>
<td>Geraldton</td>
<td>08 9956 8555</td>
</tr>
<tr>
<td>Jerramungup</td>
<td>08 9835 1177</td>
</tr>
<tr>
<td>Katanning</td>
<td>08 9821 3333</td>
</tr>
<tr>
<td>Lake Grace</td>
<td>08 9865 1205</td>
</tr>
<tr>
<td>Merredin</td>
<td>08 9081 3111</td>
</tr>
<tr>
<td>Moora</td>
<td>08 9651 1302</td>
</tr>
<tr>
<td>Narrogin</td>
<td>08 9881 0222</td>
</tr>
<tr>
<td>Northam</td>
<td>08 9690 2000</td>
</tr>
<tr>
<td>Three Springs</td>
<td>08 9954 1004</td>
</tr>
<tr>
<td>Waroona</td>
<td>08 9733 7777</td>
</tr>
</tbody>
</table>

**Department of Environment**

**Head Office**
Hyatt Centre
3 Plain Street
East Perth WA 6004
(PO Box 6740 Hay Street East, East Perth, WA 6892)
Tel: 08 9278 0300
Fax: 08 9278 0587
Email: salinity@environment.wa.gov.au
Environmental Consultants Association (WA)

This is a professional body representing commercial environmental consultants throughout Western Australia. The ECA publishes a Register of Members and their services each year. It is distributed free of charge. Included is a list of members, summary tables of services provided by companies and detailed entries for members (excerpt from www.eca.org.au)
PO Box 971
West Perth WA 6872
Email: admin@eca.org.au
Website: www.eca.org.au

Conservation Earthworks training in Western Australia

National units of competency exist for the conservation earthworks industry and are detailed as part of the Conservation and Land Management Training Package (RTD 02). For information on the availability of these training opportunities contact:

Challenger TAFE Course Info Centre
For information on all courses at all locations
41 South Terrace,
Fremantle WA 6160
Tel: 08 9239 8189
Fax: 08 9239 8070
Country Toll Free: 1800 001 001
Email: info@challengertafe.wa.edu.au
Website: www.challengertafe.wa.edu.au/ (search for ‘conservation & land management training package’)

Avon Catchment Council (ACC)
Lot 12, York Rd
(PO Box 311)
Northam WA 6401
Tel: 08 9690 2250
Fax: 08 9690 2255
Website: www.avonicm.org.au

South West Catchment Council (SWCC)
PO Box 5066
Bunbury Delivery Centre WA 6231
Tel: 08 9780 6193
Fax: 08 9780 6198
Email: swcc@agric.wa.gov.au
Website: www.swcatchmentscouncil.com
Community Landcare Technicians

There is no current list of Community Landcare Technicians (CLTs) as the CLT Association is no longer active. However, some individual CLTs are still practising in many areas. This list provided was current in 2000. Although some individuals are still operating, some of the names and telephone numbers provided may not be relevant at present.

Central Wheatbelt

CORRIGIN
Richard Guiness 9065 7045

Southern

JERRAMUNGUP
Trevor Davey 9835 1103
Steve Tindale 9835 1069
Dave Campbell 9386 6057

Metropolitan Area

PERTH
Monica Durcan 9291 8289

Yellow Pages® listings under ‘Hydrologists’
Appendix 2. References


Bennett, D., Speed, R., Taylor, P. and Goodreid, A. (Unpublished) Excavation and hydrologic investigation of silcrete hardpan in the northeastern wheatbelt of WA to determine its hydrological role and implications for the oil mallee industry. Department of Agriculture, Western Australia.


Hunt, N. and Gilkes, R. (1992) Farm Monitoring Handbook. The University of Western Australia, Nedlands, Western Australia.


Sandison, A., Kirk, G. and Cannington, B. (2002) Report defining the existing farming systems in the less than 325mm rainfall areas in the northern wheatbelt zone of the northern agricultural region. Planfarm Pty Ltd. Geraldton, Western Australia.


TopCrop Western Australia. Contact Carol Llewellyn, DAWA, Northam 08 9690 2126.


The Good Planning Checklist for Deep Drainage

The Good Planning Checklist

1. Why are you considering Deep Drainage?
2. What is your intended outcome?
3. How are you going to measure the success of the outcome?
4. Is surface water being controlled?
5. Obtain NOID package
6. What is the intended disposal point/site?
7. Trace proposed deep drain(s) onto farm map

Pre-NOI visit by Dept of Ag soil conservation specialist

Good Planning Checklist cont’d

8. Site investigation (own)
9. Design considerations, including local government & neighbours
10. Costs
11. Submit NOID
12. No objection to construction given
13. Contractor organised and properly briefed, construction commences
14. Maintenance