Fact Sheet

15

Engineering – options for salinity management

Photo courtesy Kellie Fisher

‘However, engineering solutions will sometimes just shift the problem from one land manager to another.’

The Department of Water, Land and Biodiversity Conservation

SA Dryland Salinity Committee
A sub-committee of the Soil Conservation Council of SA

National Dryland Salinity Program

Government of South Australia

Engineering – options for salinity control

Fact Sheet 15

What is the problem?

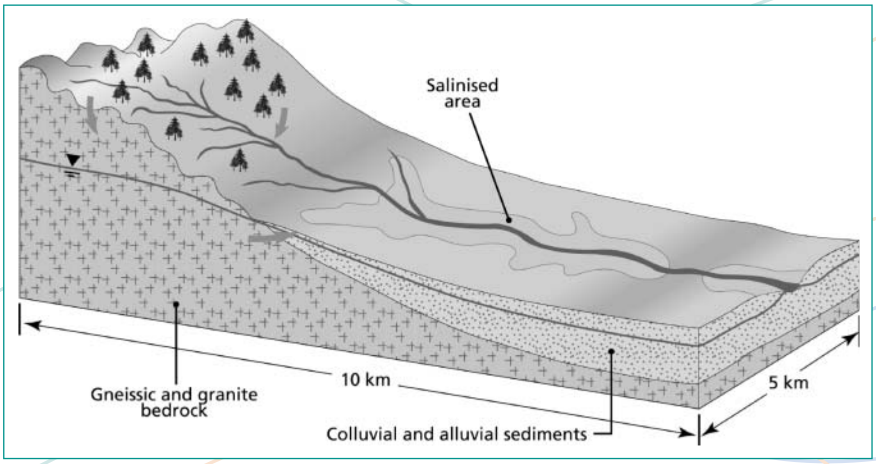
Dryland salinity in Australia is driven by increased recharge, resulting in increasing groundwater flows and salt mobilisation. Reducing the recharge might appear the obvious solution, but on its own it will not always be practicable or sufficient.

For one thing, we simply cannot sufficiently reduce recharge with current farming systems based on annual crops and pastures. For another, we do not have robust and profitable alternatives across different rainfall zones.

Large regional groundwater flow systems present a particular challenge: they call for areas of land-use change that might be unrealistically large, and even then there will be very long time lags between remedial actions and salinity outcomes.

Meanwhile, significant assets are threatened by salinity and need to be protected:

> water resources;
> urban infrastructure;
> important areas of biodiversity;
> agricultural land; and
> cultural heritage.



Typical model of a groundwater flow system

Can engineering help?

Fortunately there are engineering options that can sometimes help us manage these threats:

> groundwater pumping, deep drainage or sub-surface drainage for water table control; and
> surface drains or diversions to avoid ponding and waterlogging.

Because it generally deals with groundwater in a visible and tangible way, engineering is often seen as an inviting option. Indeed, there are many examples in South Australia where these engineering options have provided significant relief from salinity or protected valuable resources (see box). Used in conjunction with other management tools, engineering indeed has a role. However, there are rarely simple solutions to salinity and engineering, whilst it might buy us time, is certainly not the silver bullet.

Salt interception schemes have reduced saline seepage to the River Murray

South Australian examples – engineering works for salinity mitigation

> Salt interception schemes controlling salinity on the River Murray.
> Tile drains and groundwater pumping to control waterlogging and salinity in the irrigated areas of the Northern Adelaide plains.
> Drainage on River Murray floodplains to flush wetlands.
> Deep drains reducing flooding and controlling watertables in the Upper South East.
> Off-stream reservoirs (such as the Tod) reducing saline baseflows to water supplies.
> Shallow surface drains and clearing natural drainage lines to reduce ponding.

The risks

The engineering approach brings with it a number of risks:

Economic
Unless the groundwater flow system and other landscape properties are well understood and incorporated in the planning, the engineering approach might not deliver the hoped-for benefits. Even if the benefits are realised, engineering is generally expensive, with ongoing operating and maintenance costs that might be difficult to justify unless protecting high value assets.

Environmental
Because it often addresses the symptom rather than the fundamental cause of salinity, engineering might sometimes be embraced as an alternative to sustainable land management. It also often requires disposal of large volumes of saline water that might be quite hostile to the host environment. Drainage schemes might also fragment stands of native vegetation or disrupt the wetting and drying cycles of natural wetlands and floodplains.

Draining can also have serious negative impacts on the soil, depending on the salt composition and water regime. Soils that contain high amounts of black mushy sulfidic material are best left in a saline condition supporting wetland or salt tolerant plants.

Draining these soils can lead to extreme acidification (pH < 4), clogging and cementing of the soil and the movement of highly acidic and toxic leachate into the drain.

Social
Salinity is inequitable in the burden it imposes on communities. Land managers who experience the symptoms are often not those whose practices led to the problem. Similarly, engineering solutions will sometimes just shift the problem from one land manager to another. In other cases, whilst the costs and benefits of an engineering solution might be shared among a community, these costs and benefits will not necessarily be shared equitably.

'Ten commandments'

Engineering works can contribute to salinity management and to the protection of natural resources and key assets. By adopting the following guiding principles, catchment planners and land managers can optimise the benefits and reduce the risks:

1. Engineering works must always be planned in the context of **integrated catchment management**, along with other land management changes and with due consideration to all social, economic and environmental impacts. *Engineering is but one tool, yet invariably has multiple impacts.*
2. The engineering works should proceed only if the benefits (**economic, environmental and social**) clearly exceed the dis-benefits. *Environmental and social benefits may be difficult to quantify but cannot be ignored.*
3. Appropriate **institutional arrangements** should be in place that allow adequate planning, long term accountability and maintenance, agreed cost-sharing and communication. *It takes only one landholder to stall a drainage program without adequate institutional arrangements.*
4. All stakeholders, including governments, should be clear on agreed cost-sharing arrangements, milestones and expected outcomes. A **communication strategy** must ensure they are also kept informed of progress and any variations in the program. *Landholders, their children and grandchildren will need to live with the result.*
5. The **groundwater flow system** and landscape attributes (the presence of sulfidic material in soils and sulfides in underlying rocks, the nature of the salts, the conductivity of the aquifer, the topography of the land, suitable outfalls, current and potential land uses) must be taken into account when planning engineering works and assessing potential benefits and risks. *It is too late after the event.*

Flow control gate installed to manage water movement along a drain

Alternative uses for saline land and water that are currently being explored:

> Salt harvesting
> Saltland agronomy
> Inland aquaculture
> Solar ponds for energy production
> Serial biological concentration.
> Desalination to provide potable water

Some of these are proving profitable, but with the exception of saltland agronomy, not on a scale or with a robustness to encourage widespread use.

A fauna crossing constructed to reduce the impact of a deep drain in a conservation park

6. **Export of water, salt and contaminants** should be minimised and then undertaken safely and responsibly. *Desalination, salt harvesting, aquaculture and solar ponds provide some opportunities for water re-use but generally these exports are a cost to the project.*

7. Engineering works should be sited, designed and managed according to **best practice** guidelines to minimise risk. *There is no shortage of sound information and new knowledge continues to emerge. Do not take short-cuts.*

8. Drainage design and management should allow for movement of animals, minimise damage to native vegetation and aquatic ecosystems, minimise weed transmission and allow appropriate flow regimes.

   Managing **environmental impacts** can be complicated by engineering constraints that limit the opportunities to provide water of suitable quantity and quality at appropriate times. *Design and manage drainage projects to maximise the positive and minimise the negative environmental impacts.*

9. Do not assume that engineering works will return salt affected land and the environment to its **original state**. *Drained soils may require treatment to restore agricultural production, protect water quality or manage erosion and may also require new agricultural production systems to suit the new landscape.*

10. **Legal responsibilities** should be acknowledged and satisfied before embarking on any engineering works.

Further information:

Contacts

Glenn Gale, Senior Project Officer, Salinity
Department of Water, Land and Biodiversity Conservation
GPO Box 2834
ADELAIDE SA 5001
Phone (08) 8303 9500
Email: gale.glenn @saugov.sa.gov.au
Web: www.dwlbc.sa.gov.au

Trevor Dooley
Rural Solutions SA
PO Box 245
NURIOOTPA, SA 5355
Phone: (08) 8568 6400
Email: dooley.trevor@saugov.sa.gov.au

Rod Dowie
Rural Solutions SA
PO Box 1783
PORT LINCOLN, SA 5606
Phone: (08) 8688 3400
Email: dowie.rod@saugov.sa.gov.au

Bruce Munday, SA Dryland Salinity Committee
Phone: (08) 8538 7075
Email: bruce@clearconnections.com.au

Dr Glen Walker, CSIRO Land & Water
Phone: (08) 8303 8400
Email: glen.walker@csiro.au

Dr Rob Fitzpatrick, CSIRO Land & Water
Phone: (08) 8303 8400
Email: rob.fitzpatrick@csiro.au

Land and Water Australia

A CD titled 'To Drain or not to Drain? Engineering options for salinity management: Proceedings of the SA Dryland Salinity Committee's Drainage Forum, April 2003' is available from:
http://www.lwa.gov.au/products.asp
(note product number EC030547)

National Dryland Salinity Program

An Internet-based interactive tool is now available from Australia's National Dryland Salinity Program (NDSP) to help land and water managers explore suitable engineering options in developing their salinity management plans.
Web: http://www.ndsp.gov.au/

Eyre Peninsula Natural Resources Management Group, Inc

The fact sheet 'Drainage of Saline Land on Eyre Peninsula – Information you need to know' is available from:
http://www.saltcontrolsa.com/factsheets.html