SALINITY

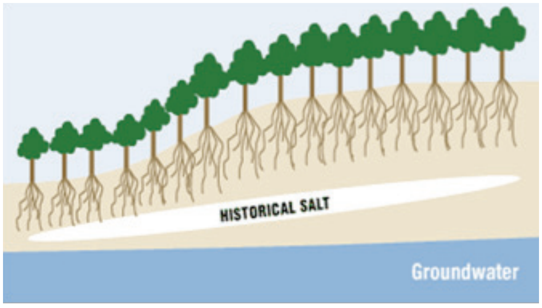
KEY TERMS

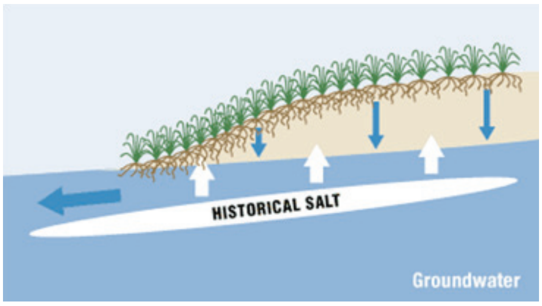
Dryland Salinity: Changes in land use increase recharge to groundwater. The volume of groundwater in storage increases, bringing the watertable into the root zone of plants. If the water is salty, the roots ability to take up water decreases, causing the plants health to be affected.

Dryland salinity is a process of environmental degradation that results from broad-scale changes in land use. In many parts of Australia, the replacement of native forests and woodlands with shallow rooted annual crops and grassland changed the amount of water entering the soil. The increased soil moisture in turn increased the rate of recharge. As more water reached the groundwater the level of groundwater started to rise.

The groundwater often naturally contains salts at concentrations that make it hard for the plants' to take up water through their roots. The efficient water use capacity of many of Australia's native plants often concentrates the natural salts that come in with the rain, as the plants use the water leaving the salt behind. This concentrates the salt in a zone beneath the root zone. As the watertable rises, the stored salt is mobilised, increasing the saltiness of the groundwater. As the vegetation struggles to take up water, it loses health and ultimately is replaced by species that have adapted to cope with higher salinities.

FIGURE 8.1 BASIC SALINITY PROCESS ARISING FROM THE REPLACEMENT OF DEEP ROOTED VEGETATION WITH SHALLOW ROOTED VEGETATION, INCREASING RECHARGE.





Signs of salinity include the ground becoming waterlogged or damp, areas of bare soil,the dieback of vegetation in low-lying areas, deterioration of road and infrastructure and rising groundwater levels in bores.

Where does the salt come from?

Much of the salt in groundwater comes from rainwater. Rain water contains very low concentrations of salt. However, soil and plant processes store or use the water, concentrating the small concentrations of salt. A study in Western Australia of the rainfall chemistry at 65 locations, showed that the concentration of salt in rainwater ranged between less than 1mg/L to nearly 50 mg/L (Table 8.1).

TABLE 8.1 RAINFALL CONCENTRATIONS AND RESULTING SALT LOAD PER HECTARE OF LAND.

	Sea Salt kg/Ha	Rainfall mm/yr	Rainfall salt concentration (mg/L)
Maximum	362.2	1554.0	48.9
Minimum	2.7	34.0	0.7
Mean	83.8	535.2	15.3
Median	41.1	498.0	10.7

(SOURCE: MODIFIED FROM HINGSTON F.J AND GAILITIS V, 1976: THE GEOGRAPHIC VARIATION OF SALT PRECIPITED OVER WESTERN AUSTRALIA. AUST. JOUR. OF SOIL RES., V14).

The highest concentrations of salt occur near the coast, and decrease inland. The near coast salt content is a combination of both salts dissolved in the rainwater and very fine particles of windblown salt. The particles of salt fall to the ground with the first rainfall over land. As the clouds move inland, only salts dissolved in the rainwater itself remain.

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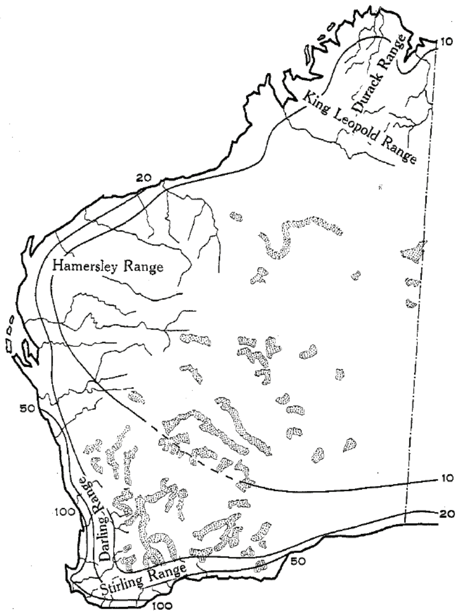
FIGURE 8.2 CONCENTRATIONS OF CHLORIDE ION ONLY IN RAINFALL, SHOWING THE HIGHEST CONCENTRATIONS NEAR THE COAST, DECLINING AS RAINFALL MOVES INLAND.



(SOURCE: MODIFIED FROM HINGSTON F.J AND GAILITIS V, 1976: THE GEOGRAPHIC VARIATION OF SALT PRECIPITED OVER WESTERN AUSTRALIA. AUST. JOUR. OF SOIL RES., V14).

Salts can also be derived from the weathering of rock materials. The weathering process can result in the dissolution of rock material into the groundwater.

Over thousands and in many cases millions of years, the processes of evaporation or transpiration of rainfall and the dissolution of rock material concentrates the salt into the groundwater beneath the ground.

The risk of salinity depends on the depth of the watertable. Salts can remain in the ground and cause little disruption to surface agriculture. Where the watertable comes within several metres of the surface (generally considered to be 2m, although this varies with soil type), groundwater can then be evaporated directly from the watertable. This further concentrates the salt from the groundwater in the shallow soil profile. In the worst cases, salt plains or salt pans formed.

Ensuring that salts stay locked beneath the ground is the goal of scientists who work on salinity management. Revegetation with native species and conservation of existing native vegetation is often the best option. The Men of Trees organisation have planted 5 million trees since1979. Landcare groups all over Australia have helped thpousands of volunteers to conduct planting days to keep the salt underground and away from surface plant species. Other useful initiatives include:

- Improving farming systems - plan crops and crop management around the local groundwater situation.
- Encouraging the production of salt tolerant species e.g. Oil Mallee
- Harvesting salt for human consumption e.g. Murray Salts
- Engineering solutions - Creating drainage systems or pumping systems to move salt water out of landscape
- Commercial tree plantations
- Integrated Catchment Management. (ICM) – to manage recharge across entire catchments

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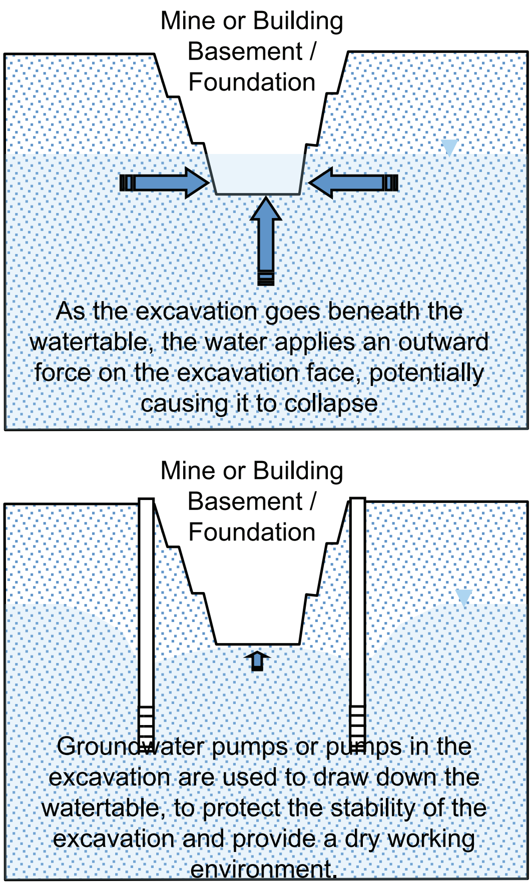
GROUNDWATER IMPACTS ON INFRASTRUCTURE AND MINES

Groundwater as a hazard to mining and other infrastructure.

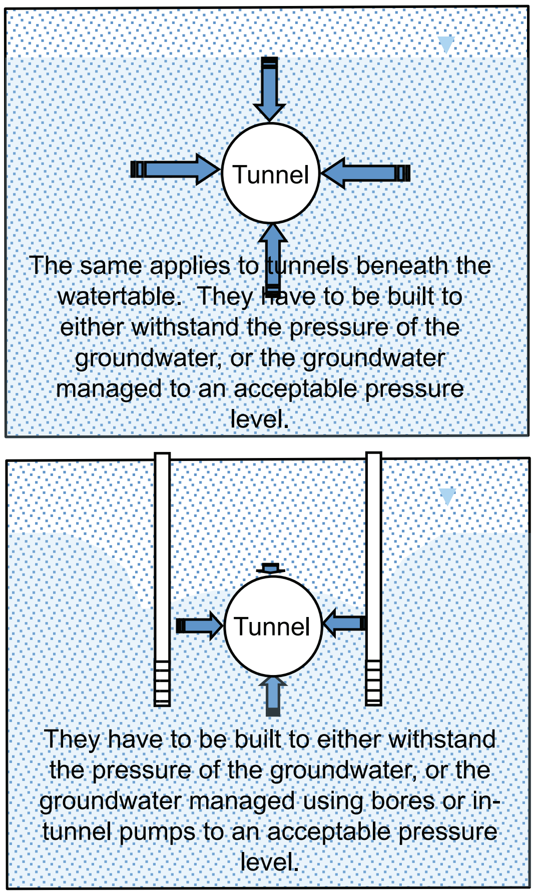
When excavations are made deep enough into the ground, they will encounter groundwater. The groundwater often has to be managed to provide stability to the excavation, and provide a safe operating environment. For large open pit excavations, whether it be for a building foundation and car park, or a quarry or mine, bores may be required as part of the construction to "dewater" the ground before it is excavated. The watertable has to be continually managed throughout the life of the excavation. Depending on the rate of inflow to the excavation, this may be maintained by bores or in-pit pumping systems. It is not uncommon for major buildings with deep basements to have continuous pumping systems built into their basements, continually managing the level of groundwater.

FIGURE 8.3 GROUNDWATER MANAGEMENT FOR EXCAVATIONS



In dewatering excavations, the key element is to managed the pressure the groundwater applies to the excavation walls through managing the groundwater level or pressure in the aquifer. This is most commonly achieved by extraction, using bores or in-pit pumps. The aim is to design a system of bores or pumps where the drawdown cones intersect to give the desired reduction in pressure on the excavation or tunnel.

FIGURE 8.4 PRESSURE MANAGEMENT PRINCIPLES FOR TUNNELS.



In addition to causing instability, the groundwater itself may react with any infrastructure placed beneath the watertable. An example is highly saline groundwater corroding metals such as cables or corroding concrete building foundations. In these cases, the materials have to either be designed to resist the corrosion, or the groundwater managed to prevent contact.

Where watertables are close to the surface, they can also impact surface infrastructure such as roads. Salts in the groundwater can be drawn up into the surface soils or roads and drains, affecting materials such as bitumen, concrete or brickwork.

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