INTERIM

MANAGEMENT PLAN

6. BEST MANAGEMENT PRACTICES FOR FARM MANAGEMENT

6.1. *Introduction*

Part 2 of this report presents the Interim Management Plan for the Little River Catchment. It is "interim", because it is the first iteration of the plan developed to address the biophysical requirements of the area. The local community has agreed to these proposals as being feasible socially and technically, providing appropriate incentives and support mechanisms are provided. However, it has not yet been subjected to economic analysis, nor have the wider social implications or regional development aspects been investigated. These aspects will be undertaken in Stage 3 and the biophysical recommendations and priorities will be reviewed in light of these findings, prior to final recommendations for on ground works being presented in the Stage 3 report.

The Little River Landcare Group (LRLG) Steering Committee is very mindful that farmers know their own land better than anyone else and need to have flexibility in making their decisions. "Recipes" based on the "average" situation should be avoided. Instead, adaptive management, where farmers understand the environment they are working in, should be adopted ie. management options are continually reassessed and modified according to the impact current land use or land management is having on the environment, or as economic and social circumstances change.

By understanding basic principles, farmers can select the best options for their particular enterprise while, at the same time, meeting multiple objectives. For example: fallowing can be approached using a variety of techniques. Ideally, farmers should always opt for the least aggressive method that contributes to multiple management objectives. While minimal soil disturbance is generally preferable, there are conditions such as disease, too much stubble for emergence, or hard to kill weeds, where some cultivation or burning may be necessary.

With this in mind, the LRLG Steering Committee is NOT recommending a specific management practice as the only way to address a particular natural resource management issue. Instead they, along with the general community through public meetings, have agreed on a set of guiding principles that are essential to achieving long-term sustainability. Adoption of these principles should avoid further land degradation issues arising in the future. These guiding principles can be achieved with a range of land uses, farming systems, and Best Management Practices. These planning and management principles should be considered when making decisions on your farm and in your catchment.

6.2. *Guiding Principles*

The recommended Best Management Practices (BMPs) presented in this chapter and the Interim Land Uses presented in Chapter 7 are based on a set of "Guiding Principles". When adopted at both the farm and landscape level, these principles provide the foundation for successful integrated catchment management ie. production and conservation in harmony.

Over time, changing technology, new crops, pastures or farming systems might mean that the current BMPs may need to be revised. While practices may change, it is unlikely that these principles will vary significantly, because they represent a logical common sense approach to catchment management based on scientific investigations. If any of the BMPs presented in this Chapter, or information provided by agronomists or other advisers, conflict, they should be resolved by tailoring the practice to best achieve the principles. The recommendations in this report reflect the current knowledge and expert opinion about how to best implement the guiding principles in this catchment.

The principles are divided into planning principles and management principles, and are described below. Their relationship with each of the natural resource management issues prioritised in Chapter 3 is shown in Table 6.1.

6.2.1. Planning Principles

PRINCIPLES	***WHY?***
1. Solutions to land degradation need to be planned at landscape or catchment scale, but the decisions and actions to achieve these changes occur at property level and need to be tailored for different situations.	Some issues can only be addressed by regional solutions eg. salinity caused by regional ground water systems, or biodiversity conservation which requires connectivity and minimum areas of total available habitat. However, "on ground" change will only succeed if individuals understand the concepts and decide how to implement the recommendations on their property. Such changes also need to be within the framework of their own goals and family aspirations.
2. Decisions about natural resource management should optimise social and environmental outcomes, as well as economic benefits.	Sustainability includes social well being, economic viability and functioning ecosystems. While long term sustainability requires a balance of all, financial aspects currently seem to dictate many decisions at the expense of the sustainable use of our resources.
3. Adaptive management is essential if our resources are to be both conserved and used productively.	Monitoring should be in place to measure change and assess the appropriateness of management practices. Results should be evaluated and practices reviewed and adjusted to best meet catchment goals and objectives. This is necessary to avoid substantial, and potentially irreversible, impacts.

6.2.2. Management Principles

PRINCIPLES	***WHY?***
1. Use land according to its capability	Productivity will be optimised and the resource base sustained when land is used according to its capability **-** land degradation is invariably the result of land being used beyond its capability eg. dryland salinity is driven by the removal of perennial vegetation, when the land was suited to timber or perennial pastures.
2. Maintain at least 70% groundcover of desirable species	High levels (minimum 70% and preferably 90-100%) of ground cover reduce run off, improve infiltration, prevent erosion, and can increase soil organic matter. It also maximises the effectiveness of rainfall, assists soil microbial activity and nutrient cycling and reduces extremes of ground temperature and evaporation. Ground cover is determined by management, rather than by climatic conditions such as drought. Even in dry times, acceptable ground cover levels can be maintained by stock removal and leaving litter on the surface. While any ground cover reduces erosion and evaporation, desirable species have the added bonus of improving production and/or stock health.

PRINCIPLES	*WHY?*
3. Maintain nutrient balances	Nutrient imbalances contribute to soil and plant problems such as acidity, toxicity, low fertility and sodicity. A balanced soil on the other hand will optimise plant vigour and production and provide ground cover etc. Nutrient cycling by soil microbes within the soil is essential, although artificial nutrients may have to be used in some production systems.
4. Maximise infiltration	Maximising infiltration will reduce run-off and erosion and increase moisture for plant production. The soil is the most effective place to store moisture and should ultimately result in a sustainable water cycle that yields water throughout most of the year. However, there are immediate concerns about the lack of surface water available to be stored for stock and domestic purposes.
5. Maximise water use	Maximising water usage helps optimise plant growth and production. It also minimises deep drainage, which can lead to rising water tables. Water use is different to, but associated with, water use efficiency (WUE), which is a measure of the amount of production / mm rain. Plants with high WUE may not necessarily maximise water use. High water use requires "best practice agronomy" ie. adequate levels of soil fertility, good soil structure and growing plants with different rooting depths such as grasses or crops, herbs, shrubs, small trees and tall trees across the landscape.
6. Minimise deep drainage	Deep drainage through soils can potentially cause watertables to rise, waterlogging and dryland salinity. Deep drainage can remain near the surface as shallow unconfined watertables or can recharge deep aquifers. Recharge of deep aquifers also occurs through intake zones, such as gravel beds along rivers and streams or rock fractures. Given that the height of the sub-surface water has risen substantially in this catchment, minimising deep drainage is necessary to prevent rising watertables and, consequently, dryland salinity.
7. Maximise diversity of natural and agricultural systems	Biodiversity is the variation in both native and introduced living organisms. Maximising biodiversity enhances ecosystem functioning -soils, vegetation, fauna, aquatic, and improves agricultural production. eg. crop rotation and strip/alley farming reduces the potential for weeds, pests and diseases by reducing monoculture cropping eg. diverse pastures can better withstand climatic variability as different species are adapted to a range of conditions. Highly diverse pastures can support native animals and high levels of stock production. Diversity in soils is the invisible key to healthy soils and plants, as microbes increase the level of nutrient recycling. Microbes need moisture, good soil structure and plant litter or animal waste to recycle nutrients. Native vegetation in good condition usually has a high level of diversity, including understorey, to maintain ecosystem function and provide habitat
8. Prevent contamination of surface and ground water supplies	Clean, uncontaminated water is necessary for public health, to protect aquatic ecosystems, as well as for agricultural production, recreation and environmental purposes. Clean drinking water is required for high rates of animal growth and production. Contamination can occur when chemicals and other agricultural substances enter the water supply either through run-off and erosion, by leaching into the ground water or by direct contamination of ground water through bore heads eg. from chemical drums. The drainage of salts into the river or into ground water reserves can make supplies unsuitable for domestic or irrigation purposes. Increased nutrients from erosion, including streambank erosion and livestock wastes can cause algal blooms and poor quality water.
9. Sustainable extraction of water supplies	The health of the river system, and the agricultural enterprises it supports, depends on adequate water to maintain the aquatic ecosystem (including wetlands, streams and floodplains), and to provide for production, town water, industry, other stock and domestic uses, and fishing and recreation. Flow patterns should mimic natural flows, including highs and lows, and sometimes complete cessation of flow, as would have occurred during drought. A healthy river will prevent riparian degradation and meet long term social, economic and environmental needs of the community.

Table 6.1: How the Management Principles impact on Natural Resource Management Issues

Guiding Principles \ Physical Issues	Acidity	Erosion	Fertility Decline	Soil struc-ture decline	Pasture degrad-ation	Salinity	Urban salinity	Surface water quality	Surface water quantity	Riparian health	Fish popula-tions	G/water quality	G/water qantity	Native vegeta-tion decline	Weeds	Pest animals	Socio – economic impacts
Use land according to its capability	X	X	X	X	X	X	X	X		X				X	X		X
Maintain >70% groundcover		X	X	X	X	X	X	X		X				X	X		X
Maintain nutrient balances	X	X	X	X	X	X		X							X		X
Maximise infiltration	?	X		X	X	?		X / ?	?	?			X		X		X
Maximise water use	X	X			X	X	X		?				?		X		X
Minimise deep drainage	X					X	X						?	?			X
Maximise diversity of all systems			X	X	X	X		X		X	X			X	X	X	?
Prevent contamination of water supplies								X		X	X	X					X
Sustainable extraction of water supplies								X	X	X	X		X				?

X – Positive benefit ? -Possible negative impact

Best Management Practices

In the short term, it is unlikely there will be a major shift in landuse away from current agricultural industries, due to inadequate knowledge and skills, lack of investment and infrastructure, economic impediments and resistance to change. The recommendations in Chapter 7 for changes to landuse for each Land Management Unit (LMU) require an average increase of more than 12% in tree cover over the catchment in the next ten years, mostly at the expense of cropping. However, even where these changes are made in the near future, the impacts may not be felt for some time eg. tree planting will take many years to impact on groundwater flows.

So the key to reducing land degradation, in the short term, in much of the landscape, is to improve the way land is currently managed, by adopting Best Management Practice (BMP). Substantial impacts can be made in local situations eg. localised salinity outbreaks can often be managed by increasing perennial pastures and ground cover, through reducing annual cropping in the surrounding areas, along with some strategic tree planting. There are also other problems that need to be addressed, such as erosion and acidification, which do not necessarily require change to land use, but rather improvements in management practices.

This section outlines BMPs for on-farm management. Obviously, not every issue is found in all parts of the catchment. Similarly, all BMPs won't be relevant to every farm, and their application will vary according to personal goals and aspirations, current land use and management, natural resource management issues and socio-economic limitations. With this in mind, the following BMPs represent a suite of options to achieve the guiding principles, from which individual farmers can choose those that best suit their operations. The BMPs can be summarised into twenty management strategies (Table 6.2).

Table 6.2 Best Management Practices

Crop Management	**Grazing Management**
1. Match land use to land capability	5. Strategic grazing
2. Reduce fallow length / increase crop frequency	6. Perennial mixed pastures
3. Crop - pasture rotations	7. Native pastures
4. Conservation farming	
Vegetation Management	**Remedial Management**
8. High levels of diversity in all perennial systems	12. Ameliorants
9. Forestry (agro forestry and plantation)	13. Soil conservation earthworks
10. Strategic tree planting (for production and biodiversity)	14. Engineering solutions for salinity
11. Remnant vegetation conservation	15. Saltland agronomy
	16. Cooperative action to control pests and weeds
Aquatic Management	
17. Buffer areas between human activity and water sources	
18. Harvest / extract water at levels not more than long term sustainable levels	
19. In-stream management	
20. Urban waste and pollution	

The following table demonstrates how each Best Management Practice can simultaneously help meet a number of Guiding Management Principles - ie. it demonstrates the integrated nature of natural resource management, and the opportunity for multiple outcomes from changes in land management.

Table 6.3 Interaction of Best Management Practices with the Guiding Principles

Guiding Principles / BMP	GROUP	1 Land Capability	2 Ground Cover	3 Nutrient Balance	4 Maximise Infiltration	5 Maximise Water use	6 Minimise Deep drainage	7 Maximise Diversity	8 Prevent Water contamination	9 Sustainable Extraction
1. Match landuse & capability	Cropping	⌘	⌘	⌘			⌘		⌘	+
2. Reduce fallow length			⌘			⌘	⌘			
3. Crop-pasture rotations		⌘	⌘	⌘	⌘	⌘	⌘	⌘		
4. Conservation farming			⌘		⌘	⌘				
5. Strategic grazing	Pasture		⌘	⌘	⌘	⌘	⌘	⌘		
6. Perennial mixed pastures			⌘	⌘	⌘	⌘	⌘	⌘		
7. Native pastures		⌘	⌘	⌘			+	⌘	+	
8. Diversity	Vegetation		⌘	⌘		⌘	⌘	⌘		
9. Forestry						⌘	⌘			
10. Strategic tree planting		⌘	+			⌘	⌘	⌘	+	
11. Vegetation conservation		⌘					⌘	⌘		
12. Ameliorants etc	Remedial		⌘	⌘	⌘	⌘	⌘			
13. Earthworks					+				+	
14. Engineering for salinity							+		⌘	
15. Salt land agronomy			⌘						⌘	
16. Cooperative pest control			⌘					⌘		
17. Buffer strips	Aquatic	⌘	⌘					⌘	⌘	
18. Water extraction								⌘		⌘
19. In-stream management								⌘		⌘
20. Urban pollution									⌘	

⌘ represents a positive impact + represents a partial benefit

CROP MANAGEMENT PRACTICES

6.3.1 Matching land use to land capability

Addresses Guiding Principles M1, M2, M3, M6, M8, (M9)

Using land beyond its capability is the key factor in land degradation. This occurs when land is used more intensively than it is suited for eg. too long in cropping, or a land use to which the area is not suited eg. timber removed and replaced by pastures or crops. The identification of land capability, and subsequent development of a property management plan in accordance with land capability, gives landholders the opportunity to match land use with land capability as the most important step in achieving long-term sustainability. The same principle can be applied to water use and capability.

6.3.2. Reduce fallow length / increase crop frequency

Addresses Guiding Principles M2, M5, M6

The current cropping system in the catchment is based on continuous winter crop, often cereals, with some farmers using canola as a break crop. If salinity is to be addressed, farming systems need to be established that will use all the available rainfall, in all but the wettest years. To do this, the following farming systems could be adopted -

a) intercropping / companion farming (crops sown into existing pastures), which means that plants are growing and using moisture throughout the year.

b) response / opportunity cropping (planting a crop once a "trigger level" of soil moisture has been reached). This option avoids a set fallow pattern and, hence, deep drainage when there is above average rainfall during the fallow. Response cropping is best combined with reduced tillage systems and may require specialised machinery.

c) delay the removal of lucerne prior to return to the crop phase until summer, to avoid deep drainage.

6.3.3. Crop - pasture rotation

Addresses Guiding Principles M1, M2, M3, M4, M5, M6, M7

Crop - pasture rotations provide many advantages for increased water use, nutrient cycling and improving soil health. This is sometimes referred to as phase cropping - using perennial pastures and/or lucerne to dry up subsoil moisture, then limiting the length of the crop phase to prevent deep drainage. Recommendations have been provided in Chapter 7 for each LMU regarding the maximum length the crop phase should be in order to prevent deep drainage. It is also important to manage the pasture phase to produce high growth rates, high water use and improved financial returns.

Improved crop agronomy, including crop rotations, will also improve plant growth and hence water use, water use efficiency and profits. Rotations during the crop phase, involving canola, legumes, cereals and maybe summer crops for response cropping should be considered. The use of pulses and legumes will help improve nitrogen levels. However, liming is necessary on most cropping soils in the district to avoid acidification.

6.3.4. Conservation farming

Addresses Guiding Principles M2, M4, M5

Conservation farming covers the following systems - reduced or zero tillage, direct drill, controlled traffic, contour farming and stubble retention. In all cases, it will improve ground cover and litter retention, which will improve infiltration and reduce erosion hazard. Stubble levels need to be around 2 t/ha to prevent erosion. So for canola or pulse crops, 3-4 t/ha of stubble are required at sowing time, if adequate levels are to still be present at harvest time. Reduced tillage will also reduce compaction, which improves root growth and, hence, water use and waterlogging. Reduced tillage systems generally require modified machinery, which may limit the capacity of some farmers to adopt this system.

Any system retaining large amounts of stubble will increase the need for nitrogen, particularly in the early years. Caution is needed to ensure there is no negative impacts on water quality or soil health from chemicals. Monitoring, including soil testing for residues, should be practiced to ensure no long term impacts occur ie. adaptive management.

GRAZING MANAGEMENT PRACTICES

6.3.5. Strategic grazing

Addresses Guiding Principles M2, M3, M4, M5, M6, M7

Strategic grazing covers high density stocking under rapid rotation (often referred to as Time Control Grazing), short duration grazing and rotational grazing. It does NOT include set stocking, which is the most common form of grazing management currently practiced. Strategic grazing requires an understanding of plant physiology, so managers can manipulate species composition to increase perennial species, diversity and provide for seed set of desirable species. It also requires the ability to assess ground cover, to ensure stock are removed well before ground cover and litter levels are reduced. The recommended outcome following grazing is 1/3 eaten, 1/3 trampled (to increase litter and ground cover) and 1/3 left standing. Grazing times can also be used to manipulate tree regrowth, as well as increasing perenniality and diversity. Retaining high levels of ground cover, including litter, is the key to improving soil health, nutrient cycling, increased infiltration and establishing a diverse pasture composition, which is able to withstand a wider climatic range.

Strategic grazing is most effective when paddock sizes are small and herd/mob numbers large. This may require additional fencing and watering points, and some adjustment to herd management, compared to the traditional approach of segregation of different classes of stock.

6.3.6. Perennial mixed pastures

Addresses Guiding Principles M2, M3, M4, M5, M6, M7

Currently, much of the land under pasture is degraded annual grasses and weeds, which are relatively ineffective in using water, preventing erosion, or protecting the soil from rain and wind erosion or compaction from stock. Perennial mixed pastures, with their deep roots and continual growth pattern throughout the year, have a far greater capacity to use rainfall and prevent deep drainage. They also provide better ground cover, increased litter onto the ground, improved organic matter and may result in improved financial returns. Perennial mixed grass pastures (ie. grasses and legumes, <30% in annual species component) also help reduce acidification in comparison to annual legumes or lucerne. Lucerne is an extremely effective plant in using moisture, but has poor ground cover and is highly acidifying. It is therefore recommended that it be grown in conjunction with other species, or if this is not possible, then the addition of lime is essential in most soils in this catchment.

Temperate perennial grasses are most suitable in the southern half of the catchment where it is cooler and wetter, while "C4" tropical species such as bambatsi panic will grow in the northern part of the catchment. These C4 species are large fast growing grasses, but less nutritious species than the temperate phalaris, cocksfoots and fescues etc. Annual grasses and legumes alone are not recommended as they allow long periods with no plant growth, increasing the risk of leaching, acidification and recharge.

6.3.7. Use native pastures

Addresses Guiding Principles M1, M2, M3, M7, (M6, M8)

Quite large tracts of native pastures remain in the catchment, particularly in the non arable areas. While these pastures are not as productive as improved species, and do not use as much water, they are better adapted to the areas of low fertility, nutrient imbalances and marginal rainfall. The use and reintroduction of native grasses is encouraged in the areas best suited to low input agriculture, where the costs of improved pasture are unlikely to be recouped. If properly managed under strategic grazing, they provide year round growth and ground cover and are far better users of moisture than degraded pastures full of annual weeds.

Native species also have the advantage of enhancing biodiversity, providing habitat for mammals and reptiles and conserving species. They are also the most suitable species for riparian buffers, where application of fertilisers is to be discouraged, and the decomposed litter from native species has little impact on the aquatic system, compared to improved species.

VEGETATION MANAGEMENT

6.3.8. High levels of diversity in all perennial systems

Addresses Guiding Principles M2, M3, M5, M6, M7

Agricultural systems generally have very low levels of diversity, particularly cropping and improved pasture enterprises. Even the remaining stands of timber are generally very low in diversity, as most of the understorey has been removed by grazing or clearing, leaving only the dominant tree species.

Increased diversity in soils, flora, and fauna enriches and improves ecosystem functioning. This in turn helps maintain the processes that provide for a healthy landscape. High levels of diversity in plants ie. herbs and grasses, shrubs, small and tall trees, provides a wide range of rooting depths, which can better utilise soil moisture before it drains into the surface water table or ground water system. Diversity also improves habitat value, helps plant communities withstand climatic variability and, in agricultural systems, provides resistance to pests and diseases.

6.3.9. Forestry (agroforestry and plantation)

Addresses Guiding Principles M5, M6

The removal of trees and perennial grasses from the landscape has resulted in rising ground water and dryland salinity. While native species provide a wider range of benefits, agroforestry and plantation forestry offer faster growing species. This may provide some impact on the current rising water tables, as well as an economic return for the timber and some potential returns through carbon credits and /or proposed salinity credits. Economic and environmental efficiencies can be gained by planting in larger blocks. The location and design of plantings will depend on suitable sites, the reason for the planting and the potential for cooperation between landholders. The selection of species should be carefully considered. The widespread use of pines may exacerbate the acidification problem in the catchment and create an in-stream acidity problem.

6.3.10. Strategic tree planting (for production and biodiversity)

Addresses Guiding Principles M1, M5, M6, M7, (M2, M8)

Strategic tree planting provides an opportunity to achieve a range of natural resource management objectives. Many more trees are required in the landscape to restore landscape and water cycle function, reduce recharge and dryland salinity, provide shade, shelter and wind protection, enhance biodiversity through improved connectivity, increase diversity and reduce edge effects around remnants. Careful selection of the location for these plantings can achieve a number of the following objectives simultaneously; recharge control, wildlife corridors, restoration of riparian zones, provide bush tucker or timber, or agricultural production through alley farming with perennial pastures or crops.

Wherever possible, native species, grown from local seed, should be used and the planting design be wide enough to provide biodiversity values, reduce pests and edge effects, and address the relevant land degradation issue such a recharge control or erosion.

6.3.11. Remnant vegetation conservation

Addresses Guiding Principles M1, M6, M7

It is less labour intensive and costly to retain and enhance existing vegetation than to revegetate. As well, the greatest biodiversity benefits come from enhancing or conserving existing remnants, rather than trying to recreate the ecosystem.

Due to the extremely low level of tree cover in the catchment, there should be no further clearing. Every possible action should be taken to protect the remaining riparian vegetation from salinisation, including planting the toe of the slope with fast growing trees to reduce the saline discharge in the valley floor.

Fencing is needed to control stock and provide opportunities for regeneration, and some select areas should be protected for conservation purposes (see targets in Chapter 7). Enhancement of remnants may be necessary, including re-establishing understorey, linking remnants with corridors of native vegetation to improve habitat values and planting buffers around remnants to reduce edge effects and impacts from agriculture, such as weed invasion, chemical drift or spread of fertiliser. Active management of remnants is also required, including weed and pest control, especially rabbits, goats, pigs, and foxes. In some situations, the use of management tools, such as fire or scarifying to stimulate regeneration and seeding, may be warranted.

REMEDIAL MANAGEMENT

While remedial actions do not represent Best Management Practice, they are necessary strategies to restore catchment health, due to the extent of degradation already present.

6.3.12. Apply ameliorants

Addresses Guiding Principles M2, M3, M4, M5, M6

Regular soil testing should take place to monitor the status of the soil chemistry, and fertilisers or ameliorants applied appropriately where soil chemistry is out of balance, taking care that they do not wash into drainage systems.

Most of the soils in the Little River catchment are subject to increasing acidification and fertility decline. Liming is not accepted by many farmers in this district as standard agricultural practice. However, acidification, including Aluminium and Manganese toxicity, is a driving factor in rising ground water, due to poor plant growth and reduced water use. This issue must be addressed if dryland salinity is to be minimised. There are currently few available options to address existing acidification other than by the addition of lime or lime fortified bio-solids.

The cropping areas are subject to declining fertility. The use of a lucerne rotation reduces the dependence on nitrogen, but increases the need for lime. There are no natural options available to replenish phosphates.

In areas where the soils are sodic, the use of gypsum may improve soil structure and reduce run-off and erosion.

6.3.13. Soil conservation earthworks

Addresses Guiding Principles (M4, M8)

Erosion remains the greatest cause of lost production in this and most other catchments. While conservation farming should be practiced at all times, some landscapes also require earthworks to prevent or repair erosion. These include preventative works such as contour banks to reduce slope length and rates of run-off, contour ripping in scalded or compacted sites, or gully control structures and gully restoration works, which may also require fencing and revegetation. Earthworks may be required to divert water away from sensitive sites such as saline discharges or scalded patches.

Care is needed to ensure that earthworks do not divert flows away from natural drainage patterns or increase flooding risks. This is particularly important when irrigation infrastructure is constructed on floodplains.

6.3.14. Engineering solutions for salinity

Addresses Guiding Principles M8, (M6)

Engineering solutions are the last option for salinity control, and should only be considered when vegetative means are not capable of addressing the problem, and safe areas for the disposal of saline water are available.

Investigation of engineering solutions is currently being undertaken for the Little River catchment but, in general terms, the best approach to controlling dryland salinity in the Little River catchment is using vegetative methods to minimise deep drainage, and have each farmer undertake Best Management Practice on their own farm.

a) Pumping
Groundwater pumping requires detailed knowledge of how the Groundwater Flow System functions in the proposed area. Many of the subsoils affected by rising water tables in the Little River catchment are high in clay, and it is very difficult to extract water by pumping from clay soils. Areas that are water logged, but not saline, are not common, limiting the

opportunity to pump and utilise the water. Around Cumnock, where the water table is fresh, it may be possible to pump from depth but there is limited land in the vicinity suitable to irrigate.

If the ground water system is both fresh, and pressurising the unconsolidated surface water table, fresh water could be pumped from depth into the river system. The reduction in pressure will draw the salt water down deeper into the profile below the root zone, allowing flushing with fresh rainwater over time. This can be achieved using low volume airlift pumps for extraction. However, the aquifers are very variable and each situation / location would have to be assessed individually.

b) Drainage
Tile Drainage / Mole Drainage/ Spear Point Drainage would only be economically feasible in this district if the works provided significant off-site benefits. They may also have a role in areas of high economic value, such as threatened dwellings or infrastructure.

c) Use of Saline Water
There may be some commercial opportunities for the use of saline resources eg. aquaculture using salt-water fish. Dams need to be at least 1.2m deep, 1500 cu. metres and have an electrical conductivity exceeding > 5dS all the time. However, farmers need to be conscious of seepage from dams ie. it is important to consider the location of dams in the landscape and relative to local geological features. Biological concentration of salt water and the growth of halophytes could also be investigated.

6.3.15. Saltland agronomy

Addresses Guiding Principles M2, M8

Saltland agronomy eg. saltbush, puccinellia or tall wheat grass, are vegetative options of last resort after land has become too saline for traditional agricultural plants. Affected areas should be fenced out, the salt tolerant species allowed to establish and then used for light strategic grazing. Only some parts of the catchment are suited to saltbush, due to difficulties in establishing this species on acid soils.

6.3.16. Cooperative action to control pests and certain weeds

Addresses Guiding Principles M2, M7

Native animals tend to be a problem in the western side of the catchment near the National Park and other timbered areas. There is inadequate habitat for these animals once they move out of these areas, so control programs will only temporarily reduce numbers. Any such programs will only achieve some success if cooperative action occurs between all affected landholders.

This is a similar situation for weeds, particularly in riparian areas, where dispersal downstream by water means collaborative action is required by all landholders along the river system if weeds are to be brought under control.

AQUATIC MANAGEMENT

6.3.17. Buffer areas between human activity and water sources

Addresses Guiding Principles M1, M2, M7, M8

Riparian zones, wetlands and floodplain sinks act as buffers, which filter chemicals, nutrients, sediment and animal waste, as well as urban pollution, before run-off enters the riverine system. These areas are vital in helping to maintain water quality and should be managed separately from the surrounding landscape, in such a way as to enhance their role as a buffer zone, as well as a unique area of land.

Managing the pollutant risk from livestock grazing along creeks and rivers requires specific strategies, including fencing to ensure adequate control of grazing pressure and establishing alternative watering points and shade away from streams. Cropping is not an appropriate activity in riparian zones and wetlands.

Groundwater sources are also liable to contamination. Direct pollution from chemical drums around bore heads can occur when mixing agricultural sprays, as can leaching of nitrates and heavy metals from intensive livestock industries and bio-solid application. However, the most likely risk of contamination of ground water aquifers in the Little River area is through salinisation, as salts are mobilised and leached down into the deeper aquifers.

6.3.18. Harvest / extract water at levels not more than long term sustainable levels

Addresses Guiding Principles M7, M9

Although over-allocation is not a major issue in the Little River catchment at this time, consideration should always be given to the amount of water allocated or harvested for extraction from both surface and ground water systems. Extraction includes stock and domestic use, including farm dams, as well as irrigation licenses. Sustainable extraction should ensure a healthy river, including concepts of adequate water for aquatic life, stable bank and bed regimes, as well as the opportunity for wealth creation. In ground water systems, it includes maintaining both the yield and quality of the water. There may be some opportunities in limited areas to increase ground water extraction to reduce upward pressure on surface water tables.

6.3.19. In-stream management

Addresses Guiding Principles M7, M9

In-stream management is an issue largely unconsidered by most landholders, as it is not seen as affecting their livelihood. However, the state of the river, including extent and placement of large woody debris, stability of the steam bank, extent of aquatic vegetation, and presence of non-native fish such as carp and mosquito fish, all impact on the health of the aquatic ecosystem and, therefore, the health of the river.

Landholders, in conjunction with the wider community and agencies, should take direct action to improve the condition of the in-stream environment, including revegetation of banks, removal of invasive weeds and willows, and enhancing habitat for native fish particularly through woody debris and aquatic vegetation, so they can compete with carp.

6.3.20. Reduce urban pollution

Addresses Guiding Principles M8

Urban pollution includes rubbish, oil, garden refuse and escaped plants, detergents, pet waste and sewerage. These pollutants can enter the river or ground water system through runoff, leaching below rubbish tips, or releases from Sewerage Treatment Plants (STPs). STPs are scheduled to replace septic systems in Cumnock and Yeoval in the near future, which will reduce the risks of ground water contamination.

The urban population, as much as rural landholders, also has a responsibility for maintaining a healthy environment and clean water. Increased levels of awareness and changes in practices, such as reduced water use in homes and gardens, detergent selection, and a willingness to get involved in maintaining the environment, are all required if access to clean water for drinking, recreation and production is to be maintained.

Attachment 6.1 provides detailed management practices, which can be adopted to address specific land degradation issues, and highlights the LMUs the options are most applicable to. It also provides some explanation as to how each option can help and whether there are barriers or impediments to adoption. These are presented in four sections:

1. Soil Health
   - Acidity
   - Erosion
   - Soil fertility and soil structure decline
   - Sodicity
   - Sustainable farming systems

2. Ground Water
   - Dryland salinity
   - Groundwater quality

3. Perennial Vegetation
   - Pasture management
   - Weed control
   - Remnant vegetation
   - Revegetation
   - Habitat enhancement
   - Pest management

4. Surface Water
   - Water quality
   - Riparian zone
   - In-stream management