Chap 1 The Second Generation Strategy

The objectives of the revised salinity management plan are:

- *deliver an integrated program to protect and enhance natural resources within the catchment*
- *develop a high level of community responsibility and accountability.*
- *control land degradation and protect important terrestrial and aquatic assets.*
- *maintain water quality for all beneficial uses, including agricultural, environmental, urban, industrial and recreational.*

The end of valley targets, as proposed by the MDBC and agreed to in principle by the State Government are only the start of the target setting process. Ultimately it will be the community that decides how much degradation they are prepared to accept and how much on-ground works they are willing to do. Any targets set at the catchment level will have to:

- *reflect community attitudes*
- *be technically feasible and economically efficient*
- *be equitable across different sectors of the community*

It is necessary to put the targets in a way that is more readily understood if the community is to participate in negotiating outcomes. To this end estimates are made of the area of land that needs to be treated in order to achieve the desired reduction in salt reaching the streams. These then become the targets for annual works programs as well as a measure of the overall area that needs to be treated.

On currently available information around 300,000 ha of land would need to be planted to high density trees (more than 500 stems to the hectare), or its equivalent, to meet the proposed end of valley targets. Both the Upper Goulburn Implementation Committee and the Mid Goulburn Broken Implementation Committee recognise that this is an unacceptable burden on the community and have instead opted for an overall target of 150,000 ha to be treated. A consequence of reducing the area to be treated is that the amount of salt entering the streams will be higher than is desired under the end of valley targets. The Goulburn Broken Catchment Management Authority will work with the Department of Natural Resources and Environment, the State and Federal Governments and the Murray Darling Basin Commission to identify how else the stream salt loads can be managed using salt interception works or other engineering options.

The areas to be targeted are firstly those sub catchments that contribute high salt loads into the Goulburn and Broken rivers. Within these sub catchments some areas contribute more salt than other or are more responsive to treatment. These areas have been identified using the groundwater flow systems within the sub catchments. The highest priority areas are those:

- *with high salt stores at risk of being mobilised*
- *with high groundwater salinities and zones of high recharge*
- *that are likely to respond to treatment options*
- *where the time it takes for the effect of treatments to be expressed are reasonable*

The actions taken to reduce dryland salinity and salt reaching the streams will depend on the suitability of different areas for those treatments. In the Goulburn and Broken plains, lucerne pasture in combination with high density trees offers some scope for slowing rising groundwaters. Over time more consideration will be given to living with salt options, as areas become salinised. In the higher rainfall areas high density trees will be promoted, particularly where there are likely to be commercial returns or where multiple benefits are most likely. Groundwater pumping is well suited to some areas of the catchment and will be used where it can be shown to provide a clear salinity benefit and where current or proposed land use is complemented by the availability of groundwater.

Objectives and Principles

The objectives of the original 1989 Goulburn Broken Dryland Salinity Management Plan were to:

- Reduce rainfall accessions to the groundwater system, by planting areas of high or moderate infiltration (recharge areas) with high water using trees, pastures and crops.

- Establish vegetation cover on denuded salt land, and to control erosion from these areas.

The Plan aims were to:

- Reduce long-term economic loss.
- Reduce the environmental and land degradation impacts of salinity.
- Reduce increasing salt loads to the Shepparton Irrigation Region and the Murray River.
- Reduce the social impact on landholders and regional communities.

Whilst these are still relevant today, the Plan needs to reflect the changed emphasis on community involvement and on the negotiation of trade-offs between interest groups that make up the catchment community. The Plan also needs to adapt to the increased emphasis on integrated catchment outcome and links between in-catchment activities and outcomes at the State and Murray Darling Basin scale.

The objectives of the GBDSMP in 2002 and beyond are to:

- deliver an integrated program to protect and enhance natural resources within the catchment, and to manage salt loads across the Basin.
- develop a high level of community responsibility and accountability for the setting and management of within valley and end of valley targets for salinity management.
- control land degradation and protect important terrestrial ecosystems, productive farmland, cultural heritage and built infrastructure. at community agreed levels.
- maintain water quality, within community agreed limits, in the Goulburn and Broken for all beneficial uses, including agricultural, environmental, urban, industrial and recreational.

Target Setting

Salinity management plans are simple in their basic concept. There are only two primary activities - managing saline discharge and salt loads, and living with the consequences of not doing the first one with 100% efficiency. The first activity has historically attracted community support through Government investment, and was the focus of the first 10 years of implementation of the GBDSMP. The community had refused to recognise the need to live with salt and was intent on implementing the Plan to control discharge through recharge management. The passing of time, and with it, improved knowledge, have made it clear that we cannot manage a reduction in salt loads with 100% efficiency, and so 'living with salt' is inevitable for large areas of the catchment. Targets therefore must be built by deciding how much salt can be prevented from reaching the land and streams, based on what level of degradation the community is prepared to accept and is willing to pay for.

Principles of target setting

The principles of setting targets are:

- targets must reflect and be responsive to community attitudes,
- they must be technically feasible and economically efficient, and
- they must be equitable across different sectors of the community.

Targets to reduce salt loads can be achieved through a combination of land use change and engineering approaches. For the catchment community, and the Implementation Committees in particular, the challenge is to identify that part of the target which can be achieved through land use change and, if there is a shortfall between what can be done and community expectations, to then investigate alternative options. Usually the alternative will be some form of salt interception works, either in or out of the catchment.

In order to assess the validity of a target, we need something more tangible than the required tonnes per year of salt load reduction. A more suitable measure is to estimate the area of land that needs to be treated to achieve the desired salt load level. Such a measure has the advantage of allowing decision makers to better envision what is being asked of them. This approach also links more easily to other natural resource programs, such as water quality management and native vegetation management. It is also the unit on which costs of program delivery are calculated.

The presentation of targets has to be done in such a way as to better facilitate community involvement in the target setting process. To this end, a number of options will be presented. It is envisaged that the process of setting targets will be an on-going process, as better information becomes available and as the community becomes more aware of the issues involved.

The size of the problem

The first step is to describe the size of the problem. The best available definition of the long-term dimensions of the salinity issue in the Goulburn-Broken Dryland comes from the Ultimate Salt Loads Study (SKM, 1999), which projects, within a 100 year timeframe, a salt load increase of 165,000 tonnes per year. A starting point for the establishment of targets to deal with this threat is provided by MDBC interim end-of-valley targets. An estimate of the area that needs to be treated, using high-density trees, to meet these interim targets is presented in Table 1.

Table 1 Estimate of saltload reduction required to meet EOV targets and area required to be treated for sub-regions of the Goulburn Broken

Sub region	**Area of catchment (ha)**	**% land uncleared**	**Saltload reduction required (tonne/yr)**	**Areas to be treated (ha)**	**% land treated to meet targets**
Goulburn Highland	838,800	50%	22,886	16,767	2%
South West Goulburn	297,500	20%	18,403	193,284	65%
Goulburn Plain	179,800	13%	3,799	35,409	20%
Broken Plain	303,600	8%	14,237	15,805	5%
Broken Highland	179,800	34%	8,522	49,029	27%
Total	**1,799,500**		**67,847**	**310,294**	

This shows that around 70,000 tonnes of salt has to be prevented from reaching the Goulburn River at Goulburn Weir and the Broken River at Casey's Weir each year. To do this will require treating the equivalent of 300,000 ha. The bulk of this would need to occur in the South West Goulburn area because:

a. it is an area with a predominance of high and moderate priority salinity areas, and

b. it is the area with the highest salt load generation rates (at 31tonne/km$^{2)}$, and so the area where the biggest gains can be made for the least cost, all other things being equal.

To achieve this salt load reduction would require a further 30% of land to be treated in the Broken Highlands, 20% in the Goulburn Plains, and a massive 65% in the South West Goulburn. It is possible to share the burden across different areas of the catchment more equitably, but such action would mean that more area in total would have to be treated, at a higher cost. The time required for the hydrological system to reach a new equilibrium would be greatly extended as a consequence. Clearly, there would be considerable resistance to this level of land use change from significant sectors of the community.

With the exception of the Plains country, most of the treatment options centre on revegetation, with perhaps some groundwater pumping in areas with suitable aquifer properties. To treat this much land would require an investment of around $240m to $270m in works alone. To this can be added an additional $120m in support and infrastructure costs and $200m in costs incurred by landholders in maintaining the sites where works are completed and opportunity costs. Such an investment could only be achieved if spread over a very long time, of the order of 50 years or more.

Options

The refinement of targets will be an on-going process that accommodates community aspirations and includes better information as it becomes available. That part of the EOV target that cannot reasonably be achieved through land use change, in a reasonable time period, will need to be managed by other means, probably salt interception works selsewhere in the Murray Darling Basin.

Table 2 shows the effect of reducing these catchment targets. Each time the targets are reduced, a shortfall is generated between the required salt load reduction (EOV) targets, and the salt load reduction achieved. It will be important to establish how any shortfalls in salt loads will be dealt with, whether it be within the catchment, within the State or somewhere within the Murray Darling Basin.

Table 2 Analysis of scenarios for recharge reduction and estimation of shortfall in meeting EOV targets

Option	1		2		3	
Sub region	25% reduction below target		50% reduction below target		75% reduction below target	
	Area treated (ha)	Saltload reduction achieved (t/yr)	Area treated (ha)	Saltload reduction achieved (t/yr)	Area treated (ha)	Saltload reduction achieved (t/yr)
Goulburn Highlands	12,575	4,218	8,384	2,812	4,192	1,406
South West Goulburn	130,756	44,978	87,272	30,038	43,788	15,098
Goulburn plains	27,256	2,998	19,103	2,101	10,950	1,205
Broken plain	12,310	862	8,815	617	5,321	372
Broken Highlands	36,799	4,048	24,569	2,703	12,339	1,357
Total	219,697	57,104	148,143	38,271	76,590	19,439
Shortfall in target load (t/yr)		**10,743**		**29,575**		**48,408**
Cost ($m)	**222.5**		**150.0**		**77.6**	
Annual targets 30 year timeframe	**7,323**		**4,938**		**2,553**	
Annual targets 50 year timeframe	**4,394**		**2,963**		**1,532**	
Annual targets 100 year timeframe	**2,197**		**1,482**		**766**	

Historically, the rates of implementation achieved by the GBDSMP have been around 75% less than that required to meet the interim EOV targets (equivalent to option 3). If this rate of implementation is sustained into the future, then there will be a need to deal with around 50,000 tonnes of salt each year through salt interception or other engineering options.

Preferred Option

The GBCMA has to strike a target for treatment works that reflects the target setting principles (see section Target Setting). The actual targets agreed to with different communities across the catchment will range between all three options. However, the catchment-wide outcome is still likely to be an area treated that is less than that required to meet the interim end-of-valley target solely from land use change.

It is recommended that the target levels for the catchment be set at 50% of the area required to meet the end-of-valley targets (ie. option 2). This is suitably challenging, requiring a prolonged investment and substantial land use change, whilst still accommodating different demands across the catchment. In effect, to achieve this over a 50 year time-frame requires the catchment community to increase the rate of revegetation with high-density trees achieved previously through the GBDSMP (an average of 200 ha per year) by some 15 times. Extensive establishment and management of perennial pastures, and widespread uptake of groundwater pumping options, will reduce the areas required for revegetation.

The implications of this target for each sub-catchment are presented in Appendix 4. Note that these are notional figures only. The target level in any one sub-catchment depends on all other sub-catchments achieving the required level of works.

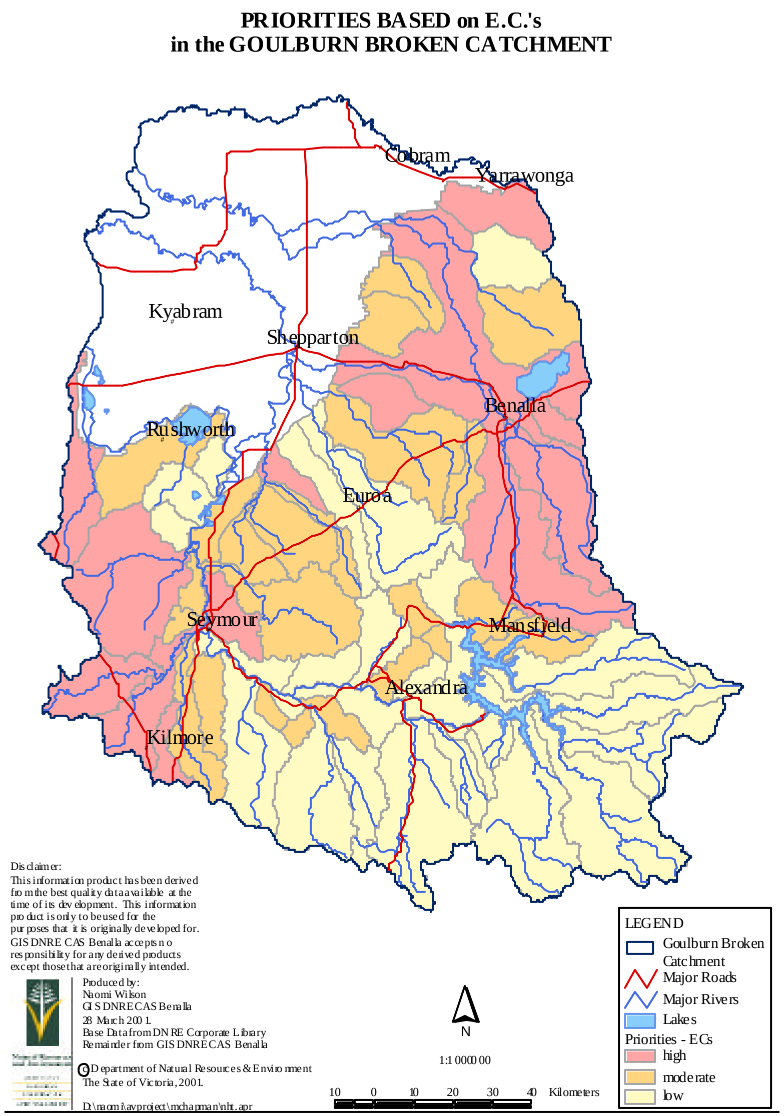
Priorities

A priority setting framework

In 1999, two studies were produced that categorised each sub-catchment in the Goulburn Broken Dryland according to the severity of salinity problems, the risk of future saline discharge, and the adequacy of current monitoring (Cheng, 1999; SKM, 1999).

The outcome was a ranking of the salinity risk for each sub-catchment on a three-point scale (high, moderate, low), which was then used to indicate where implementation programs should be targeted. The analysis was subsequently modified to define the priorities according to whether the dominant issue was stream salt load or stream salinity (Cheng, unpub). The outcomes are presented in Figure 1.

As noted earlier in Chapter 2, whilst stream salinity is an issue for the catchment community, it is salt loads that dominate the inter-governmental agreement and justifies the participation of the MDBC and investment through the National Action Plan for Salinity and Water Quality. For these reasons, it is recommended that the sub-catchment priorities based on salt loads be used to establish priorities for the GBDSMP.



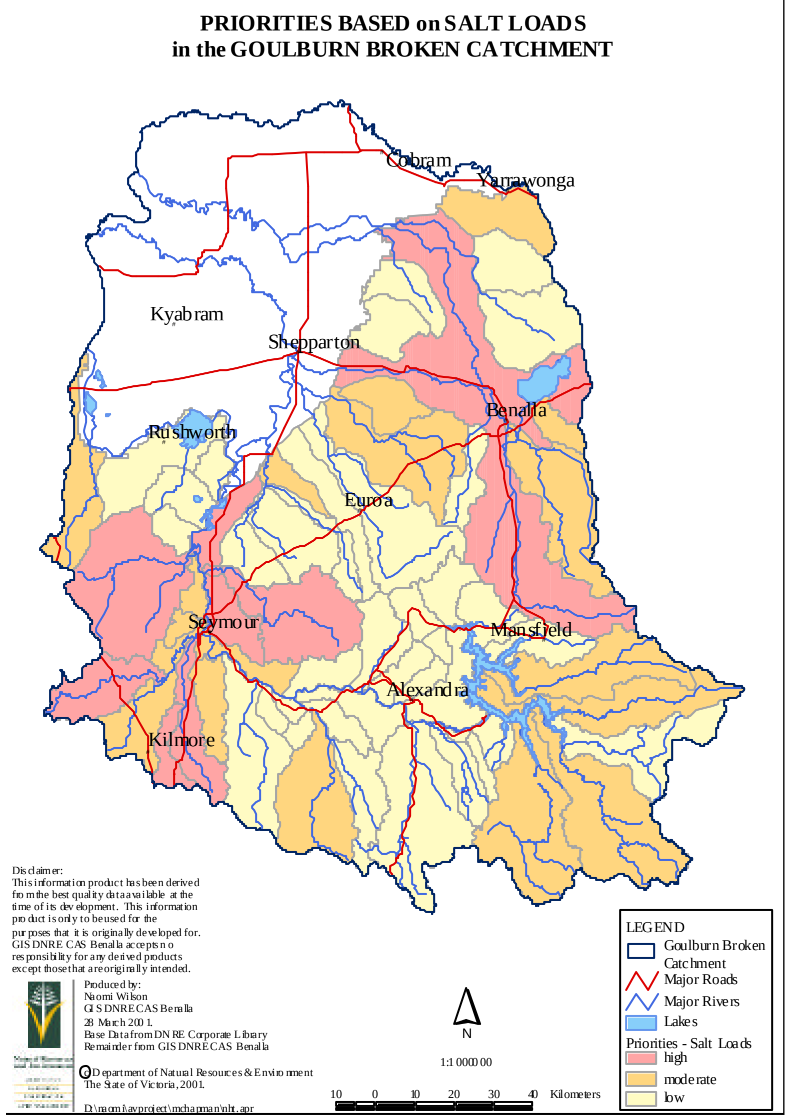


Figure 1 Sub-catchment priorities for the Goulburn Broken catchment based on stream salinity and salt loads

Groundwater Flow Systems and Sub-catchment Priorities

The sub-catchment priorities are a first step in the targeting of works. To ensure works are effective and efficient, more information is required on which parts of the sub-catchments are likely to best respond to the different control options, and in what timeframe. Thirteen groundwater flow systems have been identified in the Goulburn Broken. They are shown in Figure 2.

Map 1 Groundwater flow systems in the Goulburn Broken CMA Region

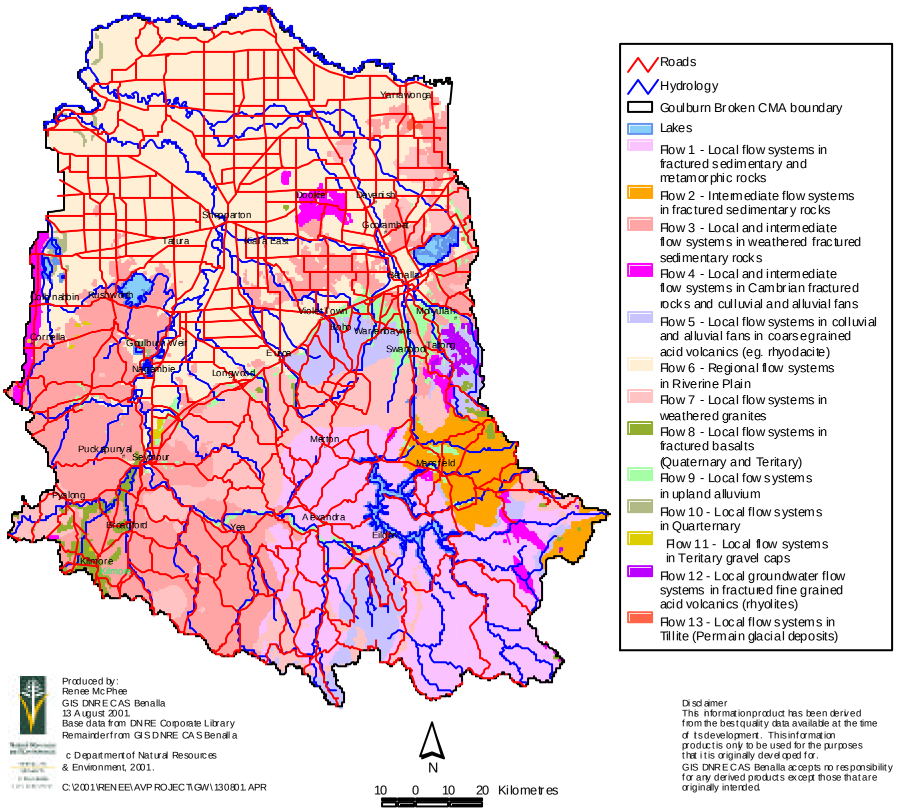


Figure 2 Groundwater flow systems for Goulburn Broken catchment

The key features of each of these groundwater flow systems is described in the appendix. This information, combined with the priority sub-catchments, allows us to target high priority areas with specific salinity control options. The highest priority areas are those:

- with high salt stores at risk of being mobilised,
- with high groundwater salinities and zones of high recharge,
- that are likely to respond to treatment options,
- where salinity occurrence and salt accession process (baseflow or washoff) allow effective treatment, and
- where the equilibrium response time (the time over which the system is likely to respond to treatment) is reasonable.

Information on the groundwater flow systems within each high and moderate priority sub-catchment is presented in Table 3. The table includes information on the percentage of the total sub catchment area occupied by each groundwater flow system, the areas best targeted for salinity control works, and the recommended salinity management options.

Table 3 High and moderate priority sub catchments in the Goulburn Broken catchment, zones to be targeted and the priority actions for each

Sub-catchment	GFS	Targeting area	Recommended salinity management options
South West Goulburn			
High priority			
Dry Ck	3(80%), 8(10%), 1(10%), 9(>1%)	Discharge sites and high watertable are widespread at the lower slopes and valley floor. Hill slopes have been extensively cleared. High recharge may occur along gentle cleared slopes (GFS 3).	High-density trees targeted at recharge area (e.g. gentle slopes of weathered sedimentary hills) would be the most effective. Perennial pasture along would not be effective to control recharge due to high rainfall, but incorporation with low-density trees would be more effective. Opportunities for groundwater pumping may be limited due to high salinity of groundwater and low yield in the fractured rock aquifer. Establishing salt tolerant grasses and saltbush at discharge area would increase productivity and reduce salt wash-off.
Hughes Ck	7(78%), 3(15%), 9(4%), 6(2%), 1(1%)	Discharge sites and high watertables mainly occur on the valley floor and along drainage lines at the upper Hughes Ck (GFS 3). Salinity risk is believed to be relatively low.	High-density trees targeted at recharge area (e.g. gentle slopes of weathered sedimentary hills) would be the most effective. Perennial pasture along would not be effective to control recharge due to high rainfall, but incorporation with low-density trees would be more effective. Opportunities for groundwater pumping may be limited due to high salinity of groundwater and low yield in the fractured rock aquifer. Establishing salt tolerant grasses and saltbush at discharge area would increase productivity and reduce salt wash-off.
Kurkurac Ck	3(44%), 9(25%), 1(24%), 8(7%)	Discharge sites and high watertables mainly occur on the valley floor and along drainage lines in the sedimentary country (GFS 3). It is believed that high recharge occurs on along gentle cleared slope of sedimentary hills.	High density trees targeted at recharge area (e.g. gentle slopes of weathered sedimentary hills) and along drainage lines would be the most effective. Perennial pasture along would not be effective to control recharge due to high rainfall, but incorporation with low-density trees would be more effective. Opportunities for groundwater pumping may be limited due to high salinity of groundwater and low yield in the fractured rock aquifer. Establishing salt tolerant grasses and saltbush at discharge area would increase productivity and reduce salt wash-off.
Majors Ck	3(52%), 1(31%), 9(14%), 6(3%)	Discharge sites and high watertable are widespread at the lower slopes and valley floor, particularly in the southern part of the sub-catchment where hill slopes have been extensively cleared. High recharge may occur along gentle cleared slopes (GFS 3).	High density trees targeted at recharge area (e.g. gentle slopes of weathered sedimentary hills) and along drainage lines would be the most effective. Perennial pasture along may be effective to control recharge due to high rainfall, but incorporation with low-density trees would be more effective. Opportunities for groundwater pumping may be limited due to high salinity of groundwater and low yield in the fractured rock aquifer. Establishing salt tolerant grasses and saltbush at discharge area would increase productivity and reduce salt wash-off.

Mollisons Ck	7(67%), 3(19%), 1(7%), 9(4%), 8(3%)	Discharge sites and high watertables mainly occur on the valley floor and along drainage lines in the sedimentary country (GFS 3). Small patches of discharge and high watertables also occur at valley floor in the granites country. It is believed that high recharge occurs on along gentle cleared slope of weathered sedimentary rocks and granites.	High density trees targeted at recharge area (e.g. gentle slopes of weathered sedimentary hills) and along drainage lines would be the most effective. Perennial pasture along may be effective to control recharge due to high rainfall, but incorporation with low-density trees would be more effective. Opportunities for groundwater pumping may be limited in the sedimentary country due to high salinity of groundwater, but granites country may provide some opportunities. Establishing salt tolerant grasses and saltbush at discharge area would increase productivity and reduce salt wash-off.
Sunday Ck	3(72%), 1(12%), 7(10%), 8(6%)	Discharge sites and high watertable are widespread at the lower slopes and valley floor. Hill slopes have been extensively cleared. High recharge may occur along gentle cleared slopes (GFS 3).	High-density trees targeted at recharge area (e.g. gentle slopes of weathered sedimentary hills) would be the most effective. Perennial pasture along would not be effective to control recharge due to high rainfall, but incorporation with low-density trees would be more effective. Opportunities for groundwater pumping may be limited due to high salinity of groundwater and low yield in the fractured rock aquifer. Establishing salt tolerant grasses and saltbush at discharge area would increase productivity and reduce salt wash-off.
Whiteheads Ck	3(52%), 9(18%), 6(12%), 1(9%), 7(4%), 11(4%)	Discharge sites and high watertable are widespread at the lower slopes and valley floor. High recharge may occur along gentle cleared slopes (GFS 3).	High-density trees targeted at recharge area (e.g. gentle slopes of weathered sedimentary hills) would be effective. Tree belts along the streams would form a effective buffer to reduce groundwater/surface water interaction (may reduce baseflow into the surface water system. Perennial pasture incorporated with low-density trees would be also effective. Opportunities for groundwater pumping may be limited due to high salinity of groundwater and low yield in the fractured rock aquifer. Establishing salt tolerant grasses and saltbush at discharge areas would increase productivity and reduce salt wash-off.
Moderate priority			
Dabyminga Ck	3(64%), 7(25%), 1(9%), 9(2%)	Discharge sites and high watertable occur at the lower slopes and valley floor. High recharge may occur along gentle cleared slopes (GFS 3). Forest is well retained at the upper part landscape.	High-density trees targeted at recharge area (e.g. gentle slopes of weathered sedimentary hills) would be the most effective. Perennial pasture along would not be effective to control recharge due to high rainfall, but incorporation with low-density trees would be more effective. Opportunities for groundwater pumping may be limited due to high salinity of groundwater and low yield in the fractured rock aquifer. Establishing salt tolerant grasses and saltbush at discharge area would increase productivity and reduce salt wash-off.
Sheepwash Ck	3(43%), 6(26%), 1(23%), 9(7%), 8(1%)	No discharge is reported. High watertables may occur in places. Stream/groundwater interaction may be active.	Tree belts along Goulburn River would form a effective buffer to reduce groundwater/surface water interaction (may reduce baseflow into the surface water system.

Stony Ck	3(44%), 1(38%), 9(12%), 8(5%), 6(1%)	Small discharge sites are reported. High watertables may occur in places. Stream/groundwater interaction may be active.	Tree belts along the streams would form a effective buffer to reduce groundwater/surface water interaction (may reduce baseflow into the surface water system.
Trawool	7(36%), 3(35%), 9(20%), 1(9%)	Small discharge sites are reported. High watertables may occur in places. Stream/groundwater interaction may be active.	Tree belts along the streams would form a effective buffer to reduce groundwater/surface water interaction (may reduce baseflow into the surface water system.
Upper Goulburn			
High priority None			
Moderate priority			
Big R	1(88%), 5(8%), 9(2%), 10(2%)	Low salinity risk -no discharge site reported, well-retained forested and low stream salinity	Low significance for reduction of salinity risk
Delatite Ck	2(43%), 1(32%), 7(16%), 9(5%), 5(3%), 4(>1%)	Salinity risk is low in general. Maybe some potential risk in the lower part of the sub-catchment due to extensively cleared land	Tree belts along stream may act as buffers and reduce salinity input into the stream, but low significance for reduction of salinity risk is expected due to high rainfall.
Yea R	3(52%), 1(33%), 9(9%), 7(4%)	Salinity risk is low in general. High watertables may occur at the lower part of the sub-catchment. Salt export is relatively high.	Tree belts along Goulburn River. Retention and re-introduction of native vegetation are also recommended.
West Goulburn			
High priority None			
Moderate priority			
Cornella Ck	4(30%), 3(26%), 1(18%), 6(17%), 9(7%)	Widespread high watertable along foothills, high recharge on hill slopes of Cambrian fractured rocks and colluvial and alluvial fans. However, off-catchment impact may be insignificant due to low stream flow.	High-density trees, particularly moderate water-use species such as sugar gum, would be suitable in most high recharge areas. Well-managed perennial pasture would be suitable at mid and lower slopes. There are some opportunities for groundwater pumping fresh groundwater from fractured rock aquifers to irrigate horticulture or farm forestry. Saline agronomy would be suitable at lower slope where watertable is high.

Goulburn Plains			
High Priority			
Lower Goulburn	6(93%), 3(5%), 1(2%)	The area with high watertable is not significant, but along Goulburn River and probably contribute significant salt load to the river	Tree belts along Goulburn River and Goulburn Weir would form an effective buffer to reduce groundwater/surface water interaction.
Moderate priority			
Honeysuckle Ck Plain	6(68%), 9(16%), 3(15%), 1(1%)	High watertables occur at the BOS and lower of the sedimentary rises, and the area near irrigation area and drainage lines	Alley faming with perennial pasture at the lower slope. Low density tree planting along slopes of sedimentary rises.
Honeysuckle Ck Upland	5(81%), 9(15%). 1(3%), 3(1%)	High watertables are widespread at the BOS, lower slope, valley floor and along drainage lines. High recharge probably occurs along gentle colluvial slopes (GFS 5)	High-density plantings along colluvial slopes may be the most suitable options, particularly Break of Slope plantations. Salt tolerant vegetation is also warranted at the lower and valley floor where watertable is high and saline. There may be some opportunities for groundwater pumping in the colluvium. Perennial pasture is generally unsuitable due to relatively high rainfall and acid soil.
Sheep Pen Ck Plain	6(98%), 3(2%)	Shallow watertables are widespread and saline across the sub-catchment. Discharge occurs along drainage lines and the plain/upland interface.	Wider adoption of salinity management protases is necessary due to influence of regional groundwater system. Widespread establishment of relatively salt tolerant perennial pasture (e.g. lucerne) is warranted. Improved management of traditional crops and pastures would reduce deep drainage, particular in low and moderate recharge area. The majority of the catchment area is not suitable for tree plantations due to shallow and saline watertables. There may be some opportunities along the plain/upland interface for moderate water-use tree species (e.g. red ironbark). The use of engineering options may be limited due to saline groundwater and problem of its disposal. Some opportunities for establishment of salt tolerant grasses in the areas with high watertables.
Sheep Pen Ck Upland	3(64%), 6(20%), 1(16%)	Shallow watertables are widespread at the lower slope, BOS and valley floor. Watertables are generally deep and rising steadily below hills. Groundwater is generally saline, but fresh shallow groundwater occurs in places. It is believed that high recharge occurs along fault zones where weathered sedimentary rocks are highly fractured.	High-density trees along the fault zones may be effective to control recharge. There may be some opportunities for farm forestry (e.g. alley farm) on the gentle slopes. Some opportunities for pumping fresh groundwater from plaeochannels. Some opportunities for establishment of salt tolerant grasses at the lower slope and BOS.

Broken Highland			
High Priority			
Broken R upland	2(31%), 7(31%), 9(24%), 5(6%), 1(5%), 3(1%), 4(1%)	High watertables are widespread at the BOS, lower slope, valley floor and areas along the river. High recharge probably occurs along gentle colluvial slopes (GFS3 and GFS 5)	High-density plantings along colluvial slopes may be the most suitable options, particularly Break of Slope plantations. Tree belts along the creek would form an effective buffer to reduce groundwater/stream interaction. Salt tolerant vegetation is also warranted at the lower and valley floor where watertable is high and saline. There may be some opportunities for groundwater pumping in the colluvium and fractured rocks. Perennial pasture is generally unsuitable due to relatively high rainfall and acid soil.
Moderate priority			
Four and Sevens Ck	1(37%), 9(32%), 3(13%), 6(12%), 7(6%)	High watertables are widespread at the lower slope and valley floor, but the total area is insignificant. High recharge probably occurs along gentle slopes of weathered sedimentary rocks (GFS3)	High-density plantings along slopes (GFS3) may be the most suitable options, particularly Break of Slope plantations. Retain native vegetation in ridge and upper slope areas. Salt tolerant vegetation is also warranted at the lower and valley floor where watertable is high and saline. There may be some groundwater pumping opportunities in the fractured rocks. Perennial pasture is generally unsuitable due to relatively high rainfall.
Holland Ck	9(33%), 5(29%), 12(10%), 2(8%), 1(6%), 4(4%), 6(4%), 3(2%), 7(2%),8(2%)	High watertables are widespread at the BOS, lower slope, valley floor and areas along the creek. High recharge probably occurs along gentle colluvial slopes (GFS3 and GFS5)	High-density plantings along colluvial slopes may be the most suitable options, particularly Break of Slope plantations. Tree belts along the creek would form an effective buffer to reduce groundwater/stream interrelation. Retain native vegetation in ridge and upper slope areas. Salt tolerant vegetation is also warranted at the lower and valley floor where watertable is high and saline. There may be some opportunities for groundwater pumping in the colluvium. Perennial pasture is generally unsuitable due to relatively high rainfall and acid soil.
Broken Plain			
High Priority			
Lower Broken R (Kialla East-Pine Lodge South)	6 (97%), 3 (3%), 1(1%)	Entire catchment area due to widespread shallow watertable, high groundwater salinity and active groundwater/stream interaction. Recharge occurs across majority of the sub-catchment.	Wider adoption of salinity management practices is necessary due to influence of regional groundwater system. Widespread establishment of relatively salt tolerant perennial pasture (e.g. lucerne) is warranted. Improved management of traditional crops and pastures would reduce deep drainage, particular in low and moderate recharge area. The majority of the catchment area is not suitable for tree plantations due to shallow watertables and high groundwater salinity. Some of sandy rises and area along Broken River and near irrigation area may offer some opportunities for moderate water-use tree species (e.g. red ironbark). The use of engineering options may be limited due to high groundwater salinity and problem of its disposal. Some opportunities for establishment of salt tolerant grasses at discharge area.

Moderate priority			
Congupna Ck Upland	4 (73%), 6(14%), 3(7%), 1(6%)	Widespread high watertable along foothills, high recharge on hill slopes of Cambrian fractured rocks and colluvial and alluvial fans	High-density trees, particularly moderate water-use species such as sugar gum, would be suitable in most high recharge areas. Well-managed perennial pasture would be suitable at mid and lower slopes. There are some opportunities for groundwater pumping fresh groundwater from fractured rock aquifers to irrigate horticulture or farm forestry. Saline agronomy may be the most suitable at lower slope where watertable is high.
Muckatah Ck	6(78%), 3(20%, 1(1%), 13(1%)	Widespread high watertable in the northern part of the sub-catchment. High watertables also occur at lower slope of sedimentary rises (GFS3) in the southern part of the sub-catchment	High-density trees along the irrigation boundary (as interception and recharge control) and hill slopes of sedimentary rises (as recharge control only). Widespread establishment of perennial pasture is warranted across the catchment area. Limited opportunities for groundwater pumping or drainage