9 The Action Plan

9.1 The Vision

Vision: *To manage salinity in the North East Region for the benefit of the environment, local communities and down stream users.*

The foundation of this plan is the 1997 NESS, the NESS review, the need to align with government objectives (RCS and state salinity framework), protect and enhance assets, and direction from the community and technical staff.

The vision was adapted by the current community reference group from the 1997 NESS vision '*to control salinity in the North East Region for the benefit of the environment, local communities and down stream users'*. At a meeting early in the development of the action plan the reference group recommended that the previous visions wording 'to control' was inappropriate that the 'to manage' was a more realistic approach. It strives to meet regional, state and nation objectives relevant to this catchment, supporting implementation of the North East RCS it also considers its vision of *'diverse, healthy landscapes; vibrant communities'.*

9.2 The Objectives

The objective/principles of this plan are to:

- Protect regional assets threatened by land and water salinity (through recharge management/ improved water use in the region).
- Manage regional assets affected by land and water salinity (through discharge management).
- Protect and manage assets for downstream users (through recharge and discharge management).
- Integrate with other natural resource management and primary production programs.
- Work towards regional, state and national targets for salinity management in this catchment.

9.3 The Outcomes

This plan seeks to project forward the original thinking in the NESS and incorporate all of the valuable community contributions to achieve better land management across the region. Currently the MERIF process for the RCS is reviewing the management action targets (MAT's) so the outcomes here may change with that process (Table 35). It is recognised that many of the current MAT's are in fact outputs.

9.4 The Targets

To achieve the objectives of this plan targets have been developed. It is also necessary to take into account targets that are outlined in other government policy, which this plan must comply with. The MDBC Basin Salinity Management Strategy outlines targets for salt loads in the North East, they are:

- Ovens River at Peechelba East – salinity to be maintained within 100% and salt loads within 101% of current levels.
- Kiewa River at Bandiana – salinity and salt load to be maintained within 100% of current levels.

The targets for inland waters imply that the salt loads in the Ovens and Kiewa Rivers must not increase from the 2001 levels identified in the MDBC Basin Salinity Management Strategy. The targets in Table 35 below have been developed based around the 1975-2000 climatic benchmark period set by the Murray Darling Basin Commission. Note that under current climatic conditions this will mean a significant reduction in areas affected by high watertables.

There are no specific targets set for the Riverine Plain Groundwater Flow System (GFS). This is a Regional Groundwater Flow System with slow response times in terms of the reaction between a treatment and a response.

The new Targets identified in this Plan are limited to Land, Inland Waters and Built Infrastructure Assets. During the development of the plan the initial process was to include developing targets for Biodiversity however after discussions with CMA staff it was agreed to limit this to existing targets. The Biodiversity targets are not being developed as part of this Action Plan, and will be considered separately as part of other regional programs.

Table 35 - Targets as identified in the RCS and identified for the implementation of this plan.

Asset	Existing Outcome Target (OT) in RCS	Existing RCS Resource Condition (RCS)	Proposed New Resource Condition in this Plan	Current Management Action Targets (MAT's) in RCS.	Proposed new Management Action Targets (MAT's) in this Plan.
Land	OT1: Well-planned future development of resilient agricultural production and product of other industries. OT1a: Maximise productivity from the regions high value agricultural land, whilst using water strategically and without loss of biodiversity.	RCT1.3: Target for land area threatened by shallow and rising saline water tables to be developed	Reduce the area of land affected by shallow (high) and rising saline water tables by maintaining the target set out in the MDBC Salinity Strategy using the 1975-2000 benchmark period. Develop revised regional RCT's for salinisation of inland waters and land in response to finalisation of approaches to End of Valley Targets across the Murray Darling Basin by 2010 (dependent on Government policy and timeframes). Develop catchment modelling and predictive tools across the region to better define relationships between climatic variability, land use change, water yield and salinisation processes, including 2C Salt and CAT by 2008.	MAT1.3.1 20% of regional landholders incorporate perennial pastures and trees into their farming system by 2009. MAT 1.3.2 Increase the area of perennial systems in high recharge areas on agricultural land to a minimum of 15% by 2009. MAT 1.3.3 Area of land threatened by rising watertables identified and mapped by June 2005. MAT 1.3.4 Model developed for estimating rates of rise in watertables by June 2005. MAT 1.3.5 Target for land area threatened by shallow and rising saline watertables developed by December 2005.	• Achieve revegetation and lucerne establishment of 483hectares/year (14,494hectares over 30years) within Salinity Priority Areas (SPA's) as listed in table 37 in this plan. • Ensure establishment of perennial vegetation cover (trees & shrubs/lucerne/perennial (includes native pastures) pasture and maintenance of over 75% of the area of the SPA's over 30years. • Adoption of "Best Management Practices" as defined in Ovens Basin and Upper North East Water Quality Strategies by 75% of landholders within the SPA's over 30years measured by periodic landholder surveys. • Target for the development of Whole Farm Plans (WFP): assist the development of WFP's to an accredited standard for 50% of properties within the SPA's over 30years.

Asset	Existing Outcome Target (OT) in RCS	Existing RCS Resource Condition (RCS)	Proposed New Resource Condition in this Plan	Current Management Action Targets (MAT's) in RCS.	Proposed new Management Action Targets (MAT's) in this Plan.
Inland Water	OT3: Water salinity levels do not impact on key regional and downstream assets.	RCT3.1: Zero change in contribution to salinity at Morgan from the Ovens River as measured at Peechelba East by 2015. Based on 2000 conditions, utilising 1975-2000 climatic benchmark. RCT3.2: Zero change in contribution to salinity at Morgan from the Kiewa River as measured at Bandiana by 2015. Based on 2000 conditions, utilising 1975-2000 climatic benchmark.	Develop revised regional RCT's for salinisation of inland waters and land in response to finalisation of approaches to End of Valley Targets across the Murray Darling Basin by 2010 (dependent on Government policy and timeframes).	MAT3.1.1 Second Generation Salinity Management Plan Developed by June 2004. MAT3.1.2 Priority areas for salinity mitigation identified by June 2004. MAT3.1.3 Priority management actions for salinity mitigation identified by June 2004.	• Achieve an annual increase of 483ha of perennial vegetation within salinity priority areas as listed in table 37 in this plan. This is linked to the Land MAT and is not in addition to the above.
Built Infrastructure	OT13: Infrastructure that supports human scale, livable communities, making the region a place of choice to live.	RCT13.1: Reduce impact of high watertables and salinity on transport infrastructure by 20% of 2003 impacts by 2023 as measured by reduced expenditure on maintenance and reduced longevity of assets.	Provide Local Government areas across the region with a framework for identification and management of potential high watertables and salinity threat by 2010.	MAT13.1.1 Undertake baseline assessments to quantify length of road affected by watertable, costs to maintain roads and the longevity of transport assets by 2005. Review and revise resource condition target as appropriate.	Supply Local Government areas across the region with a framework for identification and management of potential high watertables and salinity threat by 2010 by developing maps of potential discharge and providing statements of planning implications.

Asset	Existing Outcome Target (OT) in RCS	Existing RCS Resource Condition (RCS)	Proposed New Resource Condition in this Plan	Current Management Action Targets (MAT's) in RCS.	Proposed new Management Action Targets (MAT's) in this Plan.
Biodiversity	OT7: Maintain the quality of all Ecological Vegetation Classes (EVCs).	RCT7.1: Improve the quality of priority EVC's (as determined by the North East Native Vegetation Strategy) by 10% of the 2005 levels measured by habitat hectares by 2023. RCT8.1- Achieve on-going "net-gain" for all EVCs ensuring a positive gain in extent, distribution and quality at anytime as measured against the previous year until at least 2023. RCT8.1a – Increase where possible the extent of native vegetation for endangered EVCs to 15%, and the extent of native vegetation for vulnerable EVC's to 30% relative to 1750 extent levels by 2023. RCT9.1- Maintain or improve the 2003 conservation status of 80% of threatened flora and 60% of threatened fauna species by 2023.	No RCT for biodiversity has been developed. This process will be undertaken using other Regional processes.	MAT7.1.3: Protect, enhance and restore 10,000ha of priority EVCs through management agreements, fencing, pest plant and animal management, and revegetation by 2009.	No direct MATs have been developed as part of this process.

9.5 Recommended Management Options to Achieve Targets

Within each salinity priority area, a number of GFS occur, for each of these a range of management options are recommended (Table 36). These options were developed over the life of the original NESS and the investigation taken by PIRVIC, SKM, and regional staff in the year 2000. Not all GFS and treatments have been included in this table due to their small size and contribution to salinity. Some options maybe relevant but require further investigation, for example surface drainage in the Greta and Riverine Plains could be considered as a suitable option but there has been no research undertaken to date. There is also the potential as in SW Victoria for the option of raised bed cropping. The potential impact of such options has not been adequately reviewed to date. Many of the following options are driven individual landholder programs of property development. The role of this Action Plan is to guide landholders to adopt land use options that do not impact on the assets of the region. Management options have not been developed to protect each asset, as reducing groundwater recharge for the benefit of the land assets or even the water asset can be achieved by the same actions. Also implementing management options, for example a perennial pasture may benefit more than one asset, through reducing groundwater in the paddock and surrounding paddocks and reduce saline water running into a waterway.

Table 36- Recommended management options for each salinity priority area and GFS.

Salinity Priority Area	Ground-water Flow System	Location in Land-scape	Perennial Pastures (including natives)	Improved water use in crop lands	Rotational cropping with perennial pastures	Inter-cropping perennial pastures	Improved water use in Horii-culture & viticulture	High density tree planting not targeted eg farm forestry	High density tree planting targeted at recharge	Trees and perennial pastures integrated	Protection and enhancement of native vegetation (including regeneration and native grasses)	Surface drainage /raised beds	Ground-water pumping	Salt tolerant plants
Indigo Valley, Wodonga – Baranduda CMU - Lower Kiewa, Mid Kiewa, Lower Ovens Area affected by salinity: 131Ha DTWT <3 = 1152Ha	L/GFS in Granitic Rocks	Break of Slope	★				★	★	★	★	★		★	★
	L/GFS in Fractured Rock	Mid to Upper Slope	★		★		★	★	★	★	★		★	★
	L&I/GFS in Upland Alluvium	Whole of Catchment	★		★		★	★	★	★	★		★	★
	R/GFS in Riverine Plain	Junction of Upper & Lower Terrace	★	★	★	★	★	★	★	★	★		★	★
Talgarno CMU - Lower Mitta Mitta Area affected by salinity: 7.1Ha DTWT <3 = 634Ha	L/GFS in Fractured Rock	Mid to Upper Slope	★		★		★	★	★	★	★		★	★
	L/GFS in Granitic Rocks	Break of Slope	★				★	★	★	★	★		★	★
Everton-Tarrawingee CMU - Lower Ovens,	L/GFS in Fractured Rock	Mid to Upper Slope	★		★		★	★	★	★	★		★	★

Mid Ovens Area affected by salinity: 66.9Ha DTWT <3 = 585Ha	L/GFS in Granitic Rocks	Mid to Upper Slope	★				★	★	★	★	★		★	★
	R/GFS Riverine Plain	Junction of Upper & Lower Terrace	★	★	★	★	★	★	★	★	★		★	★
	L/GFS in Glacial Sediments	Mid to Upper Slope	★		★		★	★	★	★	★			★
Greta CMU - Mid King Area affected by salinity: 76.9Ha DTWT <3 = 3992Ha	L/GFS in Fractured Rock	Mid to Upper Slope	★		★		★	★	★	★	★		★	★
	L/GFS in Fractured Basalt	Upper Slopes	★				★	★	★	★	★			★
	L?GFS in Glacial Sediments	Mid to Upper Slope	★		★		★	★	★	★	★			★
	L&I/ GFS in Upland Alluvium	Whole of Catchment	★		★		★	★	★	★	★		★	★
	R/GFS in Riverine Plain	Junction of Upper & Lower Terrace	★	★	★	★	★	★	★	★	★		★	★
Carboor - Bobinawarrah CMU - Mid King Area affected by salinity: 77.9Ha DTWT <3 = 838Ha	L/GFS in Fractured Rocks	Mid to Upper Slops	★		★		★	★	★	★	★		★	★
	L&I/GFS in Upland Alluvium	Whole of catchment	★		★		★	★	★	★	★		★	★
	R/GFS in Riverine Plain	Junction of Upper & Lower Terrace	★	★	★	★	★	★	★	★	★		★	★
Whorouly CMU - Mid King, Mid Ovens Area affected by salinity: 0Ha DTWT <3 = 580Ha	L/GFS in Fractured Rocks	Mid to Upper Slope	★		★		★	★	★	★	★		★	★
	L&I/GFS in Upland Alluvium	Whole of Catchment	★		★		★	★	★	★	★		★	★
Chiltern CMU - Lower Ovens,	L/GFS in Fractured Rocks	Mid to Upper Slope	★		★		★	★	★	★	★		★	★

Lower Kiewa, Mid Kiewa Area affected by salinity: 2.7Ha DTWT <3 = 3719Ha	L/GFS in Granitic Rocks	Break of Slope	★				★	★	★	★	★		★	★
	L&I/GFS in Upland Alluvium	Whole of catchment	★		★		★	★	★	★	★		★	★
	R/GFS in Riverine Plain	Junction of Upper & Lower Terrace	★	★	★	★	★	★	★	★	★		★	★
Rutherglen CMU - Lower Kiewa, Lower Ovens Area affected by salinity: 17.7Ha DTWT <3 = 2046Ha	L/GFS in Fractured Rocks	Mid to Upper Slope	★		★		★	★	★	★	★		★	★
	L/GFS in Deeply Weathered Fractured Rock	Whole of Catchment Hill Top	★	★	★	★	★	★	★	★	★	★	★	★
	R/GFS in Riverine Plains	Junction of Upper & Lower Terrace	★	★	★	★	★	★	★	★	★		★	★
Springhurst CMU - Lower Ovens Area affected by salinity: 53.1Ha DTWT <3 = 1003Ha	L/GFS in Glacial Sediments	Mid to Upper Slope	★		★		★	★	★	★	★			★
	L/GFS in Granitic Rocks	Mid to Upper Slope	★				★	★	★	★	★		★	★
	L&I/GFS in Upland Alluvium	Whole of Catchment	★		★		★	★	★	★	★		★	★
	L/GFS in Fractured Rocks	Mid to Upper Slope	★		★		★	★	★	★	★		★	★
	R/GFS in Riverine Plain	Junction of Upper & Lower Terrace	★	★	★	★	★	★	★	★	★		★	★
Murmungee CMU - Mid Ovens Area affected by salinity: 25.5Ha DTWT <3 = 381Ha	L/GFS in Granitic Rocks	Mid to Upper slope	★				★	★	★	★	★		★	★
	L/GFS in Fractured Rocks	Mid to Upper Slope	★		★		★	★	★	★	★		★	★

Riverine Plain CMU -Lower Kiewa, Lower Ovens, Mid king, Mid Ovens Area affected by salinity: 658Ha DTWT <3 = 4918Ha	R/GFS in Riverine Plain	Junction of Upper & Lower Terrace	★	★	★	★	★	★	★	★	★		★	★

The areas shaded indicate suitable management options. CMU = Catchment Management Unit, DTWT = Depth to Water Table, L/GFS = Local Groundwater Flow System, L&I/GFS = Local & Intermediate Groundwater Flow System, R/GFS = Regional Groundwater Flow System.

9.6 Implementation Targets for increased perenniality.

To achieve a reduction in the groundwater table and saline discharge area and to ultimately protect assets, targets for increased perennial vegetation have been developed (Table 37 & 38). These targets are based on current estimates of what is required in each GFS. It is recognised throughout South Eastern Australia that to achieve any change in the equilibrium between land use, groundwater discharge, and general climatic conditions, there needs to be a shift towards a more perennial land use system. Current dependence on annual based systems in cleared agriculture land will not achieve this equilibrium.

This section of the plan has adopted a 5-10% to perennial systems to achieve this target. The assumption made here is taken from other regions across south eastern Australia that an adoption of a 5-10% will create sufficient change to reduce recharge. To be effective these activities need to be undertaken in nominated higher recharge areas based on the GFS. These targets represent increased perennial vegetation across the priority areas and GFS required to achieve the recommendations in the plan (MAT's).

Perennial vegetation can be defined as new plantings, regeneration of natural areas, enhancement of native grasses (particularly hill country), and establishment of perennial pastures. The targets are in addition to remnant vegetation that exists within the catchment (Table 39). A target has not been developed for the regional GFS in Riverine Plains as it is uncertain of the long term benefit of additional perennials in the regional system.

The 12 salinity priority areas that have been identified are fundamental to the implementation of this plan with those areas being where the assets are known to be at the most risk. These priority areas are favoured for implementation as they have the greatest potential to influence future salinity management.

Table 37 – Thirty year targets for increased perennial vegetation to protect assets within the region

Priority Area	LGFS Fractured Rock (ha)	LGFS Granitic Rock (ha)	LGFS Deeply weathered fractured rock (ha)	LGFS Glacial Sediment (ha)	L&IGFS Upland alluvium (ha)	LGFS Basalt (ha)	RGFS in Riverine Plains (ha)	TOTAL
Re-vegetation target (Percent)	10	10	5	10	5	5		
CARBOOR BOBINAWARRAH	1348.2	0.00	0.0	0.0	74.0	0.0		1422.2
CHILTERN	723.1	1910.23	1.6	2.6	214.5	0.0		2852.03
EVERTON TARRAWINGEE	495.9	698.78	0.0	2.9	55.2	0.0		1252.78
GRETA	776.9	14.39	0.0	89.9	177.9	22.2		1081.29
INDIGO VALLEY	983.3	409.92	0.0	0.0	102.3	0.0		1495.52
MURMUNGEE	464.5	8.40	0.0	0.0	0.4	0.0		473.3
RIVERINE PLAIN	313.7	94.91	21.8	10.2	9.4	0.0		450.01
RUTHERGLEN	1017.6	0.00	90.2	0.0	6.3	0.0		1114.1
SPRINGHURST	112.9	1088.74	0.0	76.7	22.1	0.0		1300.44
TALGARNO-WISES CREEK	139.4	982.81	0.0	0.0	47.8	0.0		1170.01
WHOROULY	1224.0	0.00	0.0	0.0	59.5	0.0		1283.5
WODONGA – BARANDUDA	146.5	441.83	0.0	0.0	10.4	0.0		598.73
TOTAL	7746	5650.01	113.6	182.3	779.8	22.2		14493.91
Annual perennial vegetation targets across	258.2	188.33	3.79	6.08	25.99	0.74		483.13

all salinity priority areas								
Annual targets for grass perennial pastures (including natives and Lucerne).	129	95	2	3	13	1		243
Annual targets for trees/shrub planting and natural regeneration.	129	95	2	3	13	1		243

The above table indicates that no targets have been set for the Riverine Plains at this stage. The Riverine Plains are a priority for research rather than for activities.

The target for grass perennial pastures (including natives and lucerne) has been set at 50% of the total annual increase in perennial vegetation. This is because it is more realistic that landholder will adopt perennial grass pastures, as pastures are currently the regions dominate agricultural land use and it is unlikely that such targets would be achieved using revegetation based options alone. A qualitative analysis of salinity priority has also been undertaken to look at aspects such as the effectiveness of the options and community responsiveness (Table 40).

Deep rooted perennial grass pasture may be supported as an incentive for re-vegetation where annual rainfall is greater than 600mm. This would occur, in the first instance, on a trial basis. The option is not to be included in the economic analysis.

Table 38 - Thirty year targets for perennial pasture establishment

Annual perennial pasture target	50 percent of priority areas where annual rainfall is less than 600mm & lands is not under trees or saltland pastures (largely west of the Hume Highway). Note: Lucerne in Riverine Plains approved on a case by case basis within 500 metres of the upper/lower terrace interface.
Saltland pastures target	50 percent of saline lands managed according to its capabilities. It is recognised that many of the discharge sites are close to inland water assets it is not expected that the use of salt tolerant species would be encouraged in these areas. However there will be some opportunities to stabilise class 2 and 3 salt lands where there is no risk to other assets. It is acknowledged that many of the discharge areas are in fact also recharge zones at different times of the year. Therefore the treatment of these areas will be considered as part of the 30-year perennial vegetation targets.

Table 39 – Area of each salinity priority area remaining under tree cover (does not include isolated paddock trees).

Priority Area	Total_Area (ha)	Remaining Tree Cover (ha)	Percentage (%) tree cover
CARBOOR BOBINAWARRAH	15705	4988	2.1
CHILTERN	36052	14125	5.9

EVERTON TARRAWINGEE	17000	2649	1.1
GRETA	18994	1268	0.5
INDIGO VALLEY	19237	3732	1.6
MURMUNGEE	11934	2979	1.2
RIVERINE PLAIN	58060	11909	5.0
RUTHERGLEN	14588	1611	0.7
SPRINGHURST	14517	2702	1.1
TALGARNO-WISES CREEK	12892	3404	1.4
WHOROULY	14108	4366	1.8
WODONGA - BARANDUDA	6134	1468	0.6
Total	**239220**	**55200**	**23.1**

Table 40 - Results of a qualitative analysis of salinity priority areas with the Reference Group. H=High, M=Medium, L=Low.

Assessment criteria	Carboor/ Bobinawarrah	Chiltern	Everton/ Tarrawingee	Greta	Indigo	Murmungee	Riverine Plain	Rutherglen	Springhurst/Byawatha	Talgarno/ Wises Creek	Whorouly	Wodonga/ Baranduda
Responsive Community	M	M	H	H	H	H	L	H	H	M-H	M	L-M
Responsive GFS	L-M	M	M	M	H/M	L-M	L	L	M-H	M	L-M	M
Clear confidence, opportunities, apparent strategic action	M	M	H	M	H/M	M	M	H	M-H	M-H	M	?
Cross Program Benefits	H	H	H	H	H/H	H	M	H	H	H	H	M
Define Problem	H	H	H	H	H/L-M	H	H	H	H	M	L-M	M (h)???
Ability to monitor change, benchmarking	M	M	M-H	L	M-H	M	L-M	M-H	M-H	M	M	L
Asset Threat												
Individual	H	H	H	H	M-H	M	H	H	M-H	M	?	H
Community	M	M	M	M	M-H	L-M	L	M	M	L-M	?	M
Off-site	M	M	M	M	M-H	M	L	M	M?H	L	?	?
Basin Wide	L	L	L	L	L	L	L	L	L	L	L	?

9.7 Implementation Strategy

The following implementation strategies have been developed to achieve the targets and objectives of this plan. The implementation of this plan is based on a number of key concepts (eg, assets, GFS, priority areas etc), some of these have been discussed in previous chapters, and others will be expanded on in this chapter. The implementation of this plan will occur through a targeted approach, using priority areas or sub catchments, integrated programs, current best knowledge and activities which are accepted by the community (Table 41).

The implementation takes into account the need for programs that deliver:

- On-ground works
- Extension and community engagement, and whole farm planning
- Monitoring
- Research
- Evaluation

Table 41 – Implementation of the plan included a range of methods of delivering management options.

Management options	On-ground works (incentives)	Extension on site	Community engagement	Whole Farm Planning	Monitoring	Research	Targeted Approach
Perennial Pastures	★	★	★	★			★
Improved water use in crop lands		★	★				
Rotational cropping with perennial pastures		★	★				
Intercropping perennial pastures		★	★				
Improved water use in horticulture & viticulture		★	★				
High density tree planting not targeted (eg farm forestry)	★	★	★	★			★
High density tree planting targeted at recharge	★	★	★	★			★
Trees and perennial pastures integrated	★	★	★	★			★
Protection and enhancement of native vegetation including Land class fencing	★	★	★	★			★
Surface drainage/raised beds						★	
Groundwater pumping						★	
Salt tolerant plants	★	★	★	★			★
Multiple outcomes Targeted areas	★	★	★	★			★

During the early stages of the development of this plan the Community Reference Group reviewed the potential of how an implementation program could be achieved across different priority areas. The following table is one view of the challenges of the implementation Strategy.

9.7.1 On-ground Works

The on-ground works undertaken to implement this plan will occur within salinity priority areas. The types of on-ground works that are recommended for salinity management within the region are based on:

- Current best knowledge: A range of documents were reviewed in the development of this plan to identify management options that are considered suitable for the region as well as effective. A number of these were research reports written specifically on the North East, while others were state or national documents.

- Groundwater Flow Systems: The type of management option and where it is used in the landscape is based on how effective it would be in reducing recharge within specific GFS.
- Adoption by the community: A number of management options have been used in the region successfully during the implementation of the previous NESS, these were also given consideration.
- Cost Benefit Analysis: Was undertaken to look at the cost benefit of some commonly used management options.

The dominant on-ground works to be promoted in the region includes those that involve tree establishment, remnant protection, and perennial pasture establishment (Lucerne). These options have incentives associated with them.

9.7.2 Extension and Community Engagement

A strong feature of the NESS was raising community awareness of salinity in the region. This was important, as salinity had not been widely recognised as occurring in the region. A number of tools that will continue to be used to assist in the implementation of this plan include:

- North East Salinity Strategy Implementation Newsletter (NESSI).
- Brochures.
- Field days and community talks.
- Media articles.
- North East salinity web-page.
- Community participation in stream and groundwater monitoring.
- Working with schools and other tertiary institutions

9.7.3 Whole Farm Planning

Whole farm planning has been used for many years in the region as a tool to assist land managers. It allows landholders to identify the assets on their property and plan works to be undertaken. The implementation of this plan will be assisted by the use of whole farm planning. Landholders will be alerted to the threats to assets in the region and how they can be involved in managing them at a property scale for the benefit of the region.

The region recently adopted a modern version of farm planning call My Farm Our Landscape (MYFOL). This version is based around the computer program ArcView and can be delivered to a landholder on their property. Whole farm planning will also be organised in the traditional group presentation approach, however using an accredited course. Whole farm planning allows landholders to be exposed to the concept of multiple outcomes which is explored in section 8.7.6

9.7.4 Monitoring

Groundwater monitoring started in the Springhurst area during 1981and later at Everton Upper. During the late 1980"s and early 1990's the network expanded and now includes 330 bores that are monitored monthly for depth to watertable (Figure 18). The network covers a range of landscape situations, with the majority less than 30metres in depth. The monitoring network is critical to the region's ability to measure change in hydrogeological condition. They are also fundamental to our ability to account changes in resource condition targets and modelling proposals.

The region also has 4 continuous stream monitoring stations and 59 stream sites monitored for salinity levels monthly (Figure 26).

9.7.5 Research Needs

There are significant gaps in knowledge within the region (Table 42). This is especially the case in areas outside of current salinity priority areas, for example limited knowledge is known of salinity in the Upper Murray/Omeo areas of region. One of the recommendations of the NESS review was to develop a research and investigation plan for the region.
The following table is not an exhaustive list of all the NE needs however does give the lead into a process for considering the immediate opportunities.

Table 42 - Research and investigation priorities in the North East in order of priority.

Knowledge Gap	Groundwater Flow System	R&D Requirement	Potential Partners	Comments
Knowledge of the extent of regional stream salt loads and salinity with and without intervention	All GFS	Stream flow and groundwater analyses in association with numerical hydrological simulation modelling	(1) CRC for Plant Based Management of Salinity (2) DPI PIRVIC - Rutherglen and Bendigo (3) Other technical consultants (4) MDBC 2CSalt program	Currently being advanced but requires further research.
Sub-catchment understanding of the effectiveness of recommended salinity management measures	Local GFS in Granitic Rocks Local GFS in Fractured Rocks	Numerical modelling of landscape-groundwater interactions and salinity manifestation	(1) CRC for Plant Based Management of Salinity (2) DPI PIRVIC - Rutherglen and Bendigo (3) Other technical consultants	Sub-catchment application of CAT or similar distributed groundwater models
Understanding of the capacity to comply with end of valley targets specified under the MDBC BSMS Strategy	All GFS	Application of the 2C Salt models developed above to End of Valley Target issues within the NE region	(1)DSE /DPI (2)Murray-Darling Basin Commission	Overall requirement by DSE for all northern catchments
Understanding of the water balance processes driving groundwater pressures in the lower Ovens Catchment	Regional GFS in Riverine Plains	Study of recharge processes influencing regional groundwater pressures in the Riverine Plains	(1) North Central and Goulburn CMAs (2) DPI PIRVIC Salinity Group - Bendigo (3) Other technical consultants (4) CSIRO – Land and Water	Need for a multi-regional project that incorporates post 1996 drought data
Understanding of the effectiveness of break of slope	Local GFS in Granitic Rock	Applied research aimed at measuring the performance of BOS plantations	(1) DPI PIRVIC Salinity Group - Bendigo (2) Other technical consultants	Applied research that aims to establish plantation-

plantings				groundwater interactions
The influence of native grass management on groundwater elevation	Local and Intermediate GFS Fractured Rock	Establish the water balance of well managed perennial native grass stands on groundwater recharge	(1) CRC for Plant Based Management of Dryland Salinity (2) Other technical consultants (3) DPI PIRVIC	General requirement across all northern catchments in Vic
Factual based evidence and knowledge of salinity risk	All GFS	Assessment of salinity hazard and risk from historical groundwater records both in terms of land use and climate change.	(1) DPI PIRVIC - Rutherglen and Bendigo (2) Other technical consultants (3) Tertiary Institutions	Compare with MDBC Groundwater Status Report
Knowledge of non-invasive salt tolerant pastures tolerant of low to moderate soil salinity and waterlogging	Most GFS in higher rainfall areas	National R&D requirement for higher rainfall salt prone areas	(1) CRC for Plant Based Management of Salinity (2) DPI PIRVIC (3) Land, Water and Wool program	Widespread requirement throughout Eastern Australia
Requirement for an Evaluation Framework	All GFS	Establish a performance and baseline reporting system for groundwater bores and stream-flow stations	(1) PIRVIC - Rutherglen and Bendigo (2) Other technical consultants	Compare with Wimmera region GFS based groundwater classification and reporting system.
Lack of sufficient definition in Groundwater Flow Systems Framework	All GFS	Either an embellishment of the current 1:250,000 scale maps or production of a 1:100,000 sheet	(1) DPI PIRVIC - Rutherglen and Bendigo (2) Other technical consultants	Currently being undertaken as part of the above project
Surface water management	All GFS	Refer to RCS	(1) DSE (2) MDBC (3) Goulburn-Murray Water	Revisit North East Regional Rural Drainage Strategy
Opportunities to harvest low salinity groundwater for innovative commercial purposes	Local GFS in Granitic Rock & Fractured Rocks	Low volume groundwater pumping in support of innovative commercial enterprises	(1) Other technical consultants (2) Goulburn-Murray Water (3) CRC for Plant Based Management of Dryland Salinity	Compare with saline aquaculture enterprises
Salinity risk in areas outside salinity priority areas	All GFS	Determine the salinity risk and groundwater processes outside	(1) DPI (2) DSE (3) Other technical consultants	

		salinity priority areas.		
Management options that require further investigation	All GFS	Management options for salt affected areas and engineering.	(1) DPI (2) DSE (3) Other technical consultants	

9.7.6 Targeted and Integrated Approach

The dispersed nature of previous approaches to land management programs makes it difficult to assess the merits of "are we making a difference" to achieving the objectives of the Regional Catchment Strategy and programs such as this. There has been a progression to this targeted approach to "on-ground" implementation for some time now. This has the risk of alienating some parts of the community by only working in selected areas but it does provide real benefits for program delivery and for investors.

An implementation strategy that the community has expressed interest in using in this plan is a targeted and integrated approach to activities. In recent years this approach has been used in implementing salinity management in the region, it has been well received in the community and has had a high participation rate.

The targeted approach has involved focusing planning and works in one salinity priority area over a number of years (usually three years) before moving on to another priority areas. This approach has provided landholders with additional coordination and assistance, such as organising ripping of tree lines, ordering and purchasing of trees. The first year is generally a planning year, with two implementation years following. This varies from the traditional approach where landholders from any priority area contact staff for a financial assistance and undertake the entire project by themselves. The targeted approach will continue to be used in the implementation of this plan, as will the traditional approach to allow all interested landholders to participate in salinity management. The continued interest in whole farm planning has allowed DPI to develop a coordinated approach using a system called MYFOL (My Farm Our Landscape), originally developed for the Goulburn Broken catchment. This approach using a laptop computer while sitting around the kitchen table is more friendly and acceptable to many landholders.

Also used in conjunction with the targeted approach is the integration of other natural resource management programs. Rather than the salinity program delivering a package of works, education and research independently other staff and programs are also brought into the target area. This approach can achieve multiple benefits for the environment as well as for the landholder. This approach may include developing a whole farm plan, undertaking pest control, revegetating waterways, protecting remnant vegetation or even managing native grasses. Where this approach has been used landholders have been able to achieve 10 years of works in just 2 or 3 years.

9.7.7 Multiple Outcomes Case Study

The "Heartlands" program is an example of an integrated natural resource program that has been undertaken in North East Victoria. The Heartlands initiative aimed to improve land use in the Murray-Darling Basin thereby preserving land and water resources and sustaining commodity production. The Heartlands initiative aimed to develop strategies for targeting land use change and supporting on-ground implementation in focus catchments in southern NSW and Northern Victoria. The program aimed to harness the combined knowledge of researchers, Natural Research Management agencies, and farmers.

Some of the key messages from Heartlands can be summarised as follows (Cresswell & Earl 2005):

- The integration of Heartlands research with on-ground works programs

- Discovering the values, attitudes, aspirations and concerns of local communities
- Effective local implementation staff
- Technical support for catchment coordinators
- Participatory research approach
- A diverse but complementary set of approaches
- Use of a variety of community engagement tools
- Efforts to promote landuse change

Four different catchments were selected to be involved in the program, two in Victoria and two in New South Wales. The target catchment for North East Victoria was the Ovens Valley, although more specifically the Byawatha Hills district. In the Spring of 2002 and 2003 approximately 23 landholders participated in the tree planting component of the project planting more than 157ha of trees. Although the project activities were much broader than this and included:

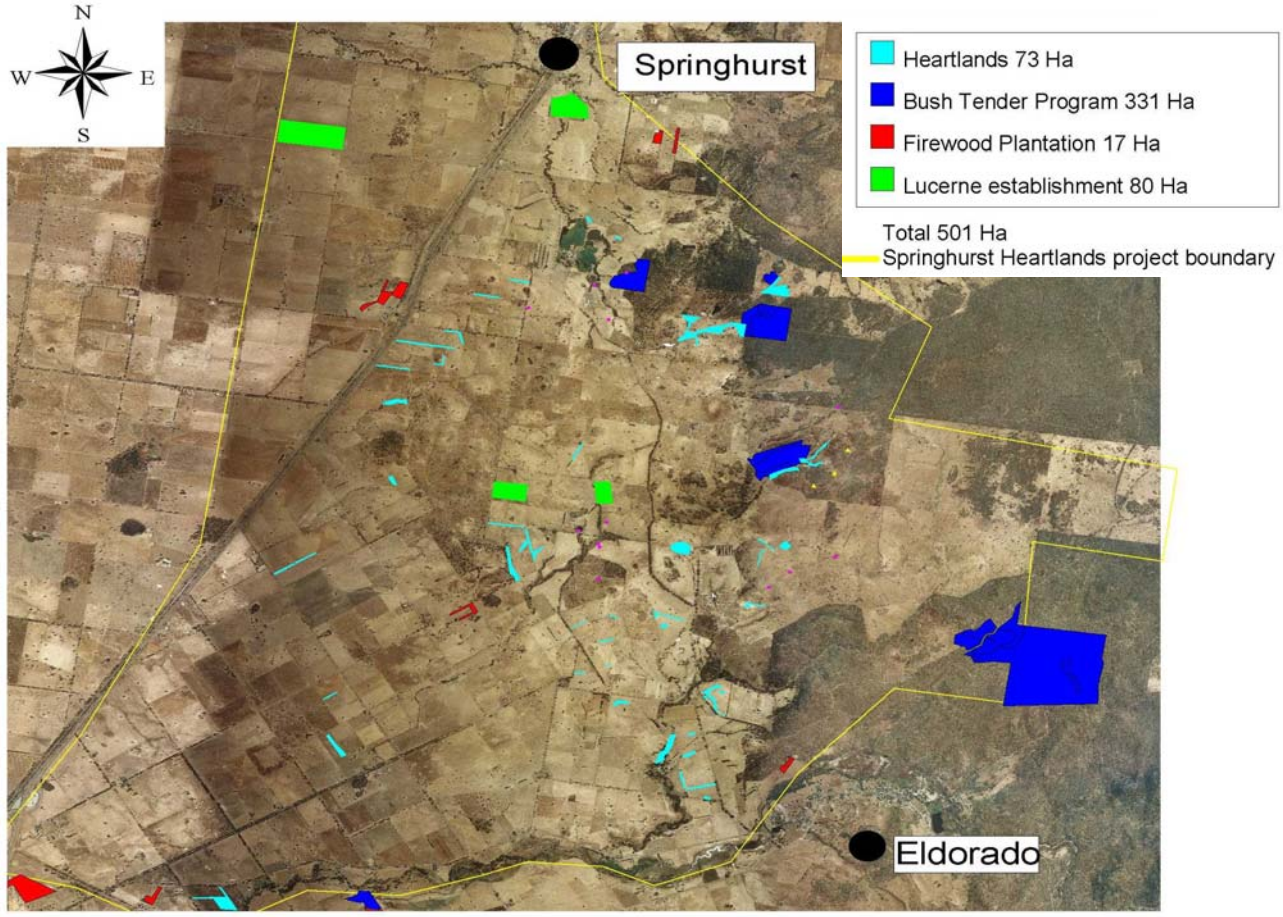
- Local area and Whole Farm planning
- Land class fencing
- Protection of remnant vegetation
- Agroforesty trials
- Concentrated rabbit campaign
- Perennial pasture establishment
- Landholder attitudes survey
- Tree decline survey
- History of clearing in the Springhurst Catchment
- Bird surveys
- Invertebrate surveys
- Native grass research
- Rotation grazing trial

The many organisations involved also illustrate the integrated approach in providing extension and research on the current best practices, which included:

- CSIRO
- Murray Darling Basin Commission
- North East Catchment Management Authority
- Department of Natural Resources and Environment (now DPI and DSE)
- Rural City of Wangaratta
- Greening Australia
- Meat and Livestock Australia – Sustainable Grazing Systems
- Springhurst Byawatha Landcare Group
- Charles Sturt University
- Latrobe University

The program saw a greater amount (eg. 10 years works achieved in 2 years) of on-ground works achieved with a diversity of benefits, rather than a single focus (Figure 38). Works were located in targeted areas of the landscape to have a great or multi benefit. The program also tried a different approach to providing incentives to landholders. The program supported landholders with labour and materials to undertake works, as well as incorporating this in a whole farm plan. There are new and emerging extension tools available to staff such as the Land Water Wool suite of products for advisors which could be adapted into this program.

Figure 38 – Map of revegetation works undertaken during the Heartlands program.



9.7.8 Multiple Outcomes in the implementation of this plan

This section illustrates the relationship between other major threats to assets and salinity in the region (Figure 39). That is other threats can contribute to salinity in the region just as salinity can contribute to them. Also the management of salinity can be affected by other threats, while managing salinity can contribute to the management of other threats. Throughout this plan salinity and its management is not considered as a single issue, it has also been highlighted by landholders in the NESSI Review that salinity should not be focused on as a single issue. The implementation of this plan using an approach that has multiple outcomes is an important feature. Only those other threats which have a clear relationship with salinity are explored here for multiple outcomes (Table 43, 44, 45, 46, 47, 48and 49) – all threats for the NE as listed in the RCS are in section 5.3.

Figure 39 – Diagram of the relationship between salinity and other threats to assets.

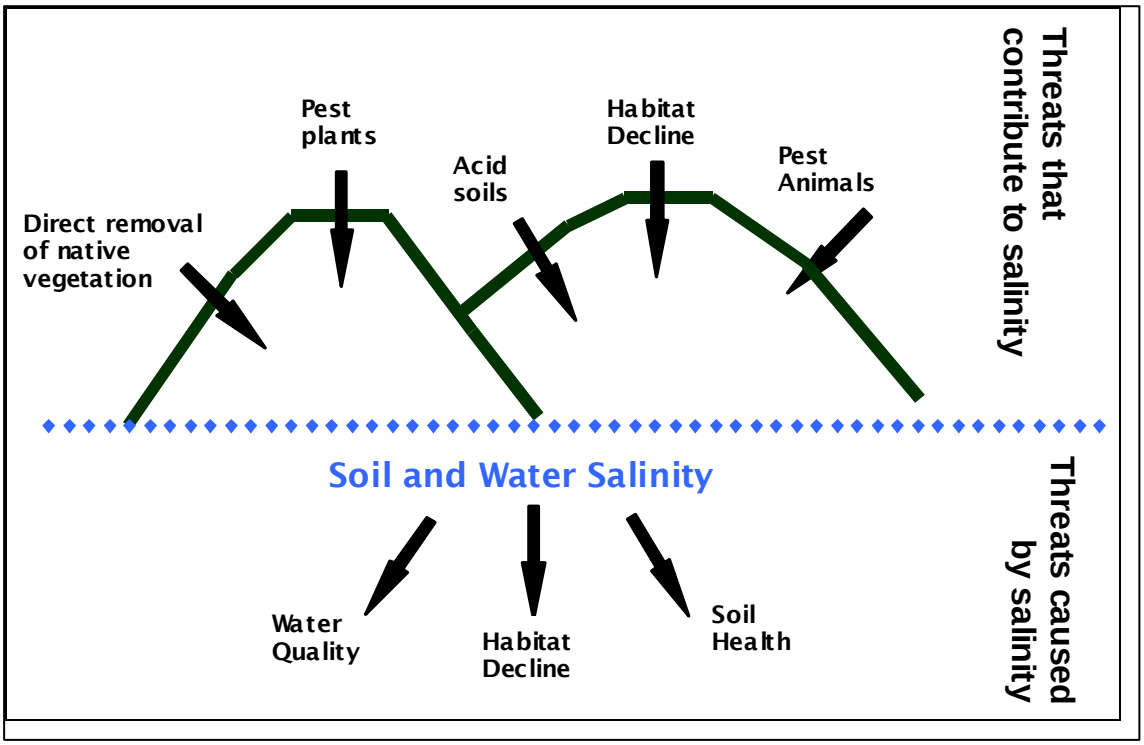


Table 43 – Relationship of salinity to pest plant management in the North East.

Pest Plants	
Description of the Threat	Weeds lead to (a) soil conservation issues, (b) losses in agriculture production, (c) contamination of wool and seed products etc.
Contribution to recharge	Weeds are predominantly annual species that are not as effective at using water. They may contribute to rising watertables. Weed species are found on saline discharge sites.
Impact on Salinity Management Activities	• Requirement to control weeds on sites where trees and pastures are being established. • Potential for plants used in salinity management to become weeds. • Weeds that develop within tree belts can provide a harbour for pest animals
Policy associated with the management of this threat. (State wide)	Victorian Pest Management, A Framework for Action – Weed Management Strategy. • Prevent new weed problems • A significant reduction in the impact of existing weed problems. • A Victorian community that is fully aware of economic, social and environmental impacts and threat of weeds, and has the knowledge to minimise their damage.

(Regional)	North East Region Weed Action Plan 2001-2005 • Prevent the introduction of weeds that pose a significant threat to the region's environmental values and/or agricultural industries • Increase weed control by all land managers in the region through education, coordination, and leadership. • Encourage community weed control programs that contain and reduce the impact of established priority weeds through integrated land management approaches. •
Link to RCS – Resource Condition Target	RCT2.3 - Reduce the annual impact by a number to be determined of priority and ecologically significant pest plant infestations in high priority areas on all land by 2013. RCT10.1- Reduce the impact of ecologically significant weeds on private land by 20% from 2003-2023
Link to implementation of the Salinity Action Plan.	• Encourage landholders to follow the recommended practice for weed control in all works that are undertaken in the program • Provide landholders with information on Spiny Rush and its control. • Encourage on-going weed control programs as part of all works • Increase awareness of benefits of control through the salinity newsletter and other extension activities.

Table 44 - Relationship of salinity to pest animal management in the North East.

Pest Animals	
Description of the Threat	Rabbits are considered to be the most serious vertebrate pest to revegetation management. Hares, foxes and wild dogs are also a problem in the North East.
Contribution to recharge	Pest animals also damage young trees and vegetation.
Impact on Salinity Management Activities	Rabbits and hares eat newly planted trees, shrubs and pastures, and along with fox's use tree belts as harbours.
Policy associated with the management of this threat. **(State wide)**	Victorian Pest Management, A Framework for Action – Rabbit Management Strategy. • Reduce the economic impact of rabbits to a cost-effective level and sustain this level through ongoing maintenance programs. • Reduce the physical degradation of natural resources caused, or initiated, by rabbit activity. • Minimise land degradation caused by rabbits and promote recovery of the degraded areas so the viability of natural ecosystems, endangered and vulnerable native species and ecological communities, is maximised. Victorian Pest Management, A Framework for Action-Fox Management Strategy. • To enhance the native fauna values impacted by

(Regional)	foxes through the protection and promotion of viable populations of endangered and/or threatened fauna, as well as increasing populations of non-threatened prey species of fauna on both public and private lands, based on state wide priorities and agreed action plans. • To protect the productive resource base by cost effectively and sustainably reducing the economic impact of foxes North East Rabbit Action Plan • Achieve an integrated rabbit management approach, involving all levels of responsibility. • Aim to manage rabbits in the North East Catchment to the point where the impact from the pest has been decreased to levels acceptable to the community and where effective rabbit control is manageable at a decreasing level of resource.
Link to RCS – Resource Condition Target	RCT2.4 – Reduce the annual impact of priority and ecologically significant pest animal infestations in high priority areas on all private land b 2013. RCT11.1- Reduce the impact of pest animals on private land by 20% from 2003-2023.
Relationship to Salinity Strategy	• Encourage landholders to undertake pest control before and after works. • Advise landholders on ways to guard new plantings and remnant protection from rabbits and hares. • Encourage landholders to manage weeds to prevent harbours for pest animals • Increase awareness of benefits of control through the salinity newsletter and other extension activities.

Table 45 - Relationship of salinity to soil acidity management in the North East.

Soil Acidity	
Description of the Threat	The North East Region has the most acid soils in Victoria with 70% of the catchment having soils with a pH of less than 4.4 (CaCl2).
Contribution to recharge	Acid soils can be a limiting factor in the establishment and persistence of perennial pastures. Perennial pastures reduce recharge.
Impact on Salinity Management Activities	Lime applications required to offset soil acidity add to the cost of perennial pasture establishment.
Policy associated with the management of this threat. **(State wide)** **(Regional)**	The Impact of Acid Soils in Victoria (2002) Acid Soils Strategy. • Raise community awareness of acid soils through focused awareness programs • Promote best practice North East Soil Health Action Plan (2001) • Improve awareness of the agricultural and environmental benefits of improving soil health • Maintain the long term production and sustainability of the soils in the region while minimising the

	negative off-site impacts of poor soil management. • Provide managers with the tools to monitor and manage soil health
Link to RCS – Resource Condition Target	RCT 1.1 – Improve surface soil (0-10cm) acidity levels of all agricultural land to better than pH 4.5 (measured in CaCl2) by 2023.
Relationship to Salinity Strategy	• Include soil testings as an eligibility requirement for pasture funding. • Include the requirement of lime application in pasture programs funded by the salinity program where soil is identified as acidic. • Increase awareness of benefits of soil health through the salinity newsletter. • Encourage the adoption of perennial pastures where there is a salinity benefit • Encourage optimum management grazing practices for recharge mitigation • Increase awareness of the benefits of managing soil acidity through the salinity newsletter and other extension activities.

Table 46 - Relationship of salinity to soil health management in the North East.

Soil Health	
Description of the Threat	Soil structure decline impedes the movement of air, water, and nutrients and inhibits plant growth. This may lead to waterlogging, increased run-off and increased groundwater recharge. Which in turn can lead to erosion and transport of nutrients and sediment to waterways.
Contribution to recharge	Loss of soil structure inhibits plant growth and may increase recharge through reduced evapotranspiration
Impact on Salinity Management Activities	Increased cost of recharge mitigation associated with soil preparation (eg. Ripping, mounding, and gypsum application for tree growing)
Policy associated with the management of this threat. (Regional)	North East Soil Health Action Plan (2001) • Improve awareness of the agricultural and environmental benefits of improving soil health • Maintain the log term production and sustainability of the soils in the region while minimising the negative off-site impacts of poor soil management. • Provide managers with the tools to monitor and manage soil health
Link to RCS – Resource Condition Target	RCT2.1- Reduce the number of active gullies as at December 2005 in priority areas defined in the NESHAP (2001) by a minimum of 30% by 2023.
Relationship to Salinity Strategy	• Encourage landholders to manage stock on waterlogged and saline areas – through fencing and strategic grazing. • Encourage the management of discharge sites by planting salt tolerant pastures/plants to prevent erosion. • Encourage landholders to use techniques such as mounding if waterlogging is an issue at a tree-

	planting site. • Encourage good pasture management to maintain good coverage. • Encourage land class fencing and incorporate it in to on ground works. • Increase awareness of the benefits of good soil health through the salinity newsletter and other extension activities.

Table 47 - Relationship of salinity to removal of native vegetation in the North East.

Direct Removal of Native Vegetation	
Description of the Threat	Removal of remnant native vegetation.
Contribution to recharge	Removal of native perennial vegetation, especially in high recharge areas, allows more rainfall to become recharge.
Impact on Salinity Management Activities	Removal of native vegetation counteracts the works undertaken by the salinity program to increase perennial vegetation to reduce groundwater recharge
Policy associated with the management of this threat. **(State wide)** **(Regional)**	Victoria's Native Vegetation Management – A framework for action. • Maintaining ecological process provides productivity, salinity, water quality, and other land management benefits Victorian Biodiversity Strategy (1997). • Increasing the awareness of the need to conserve biodiversity • Detailing strategic frameworks to prevent further loss of habitat, and a focus for better management of existing habitats and the continuation of natural ecological processes • Highlighting the habitats, major threatening processes and environments that require urgent attention. Draft North East Native Vegetation Plan • Native vegetation classes are to be maintained at 1999 levels. • A net gain in extent and quality is to be pursued. • Improving the management and connectivity of remnants will enhance the network and quality of vegetation on roadsides, streams, and private land. Biodiversity Action Plans (catchment specific plans) • Summarise key biodiversity assets of the bioregion, and the actions that are required to achieve statewide biodiversity goals.
Link to RCS – Resource Condition Targets	RCT7.1- Improve the quality of priority EVCs (as determine by the NE Native Vegetation Strategy) by 10% of the 2005 levels measured by habitat hectares by 2023. RCT8.1- Achieve on-going "net-gain" for all EVCs ensuring a positive gain in extent, distribution and quality at anytime as measured against the previous

	year until at least 2023. RCT8.1a – Increase where possible the extent of native vegetation for endangered EVCs to 15%, and the extent of native vegetation for vulnerable EVC's to 30% relative to 1750 extent levels by 2023. RCT9.1- Maintain or improve the 2003 conservation status of 80% of threatened flora and 60% of threatened fauna species by 2023.
Relationship to Salinity Strategy	Encourage landholders to: • Retain and mange remnant vegetation. • Plant new areas to native vegetation. • Plant trees for firewood/plantations • Applications for vegetation removal should be assessed in the context of salinity management • Increase awareness of the benefits of native vegetation through the salinity newsletter and other extension activities.

Table 48 - Relationship of salinity to habitat decline in the North East.

Habitat Decline	
Description of the Threat	Habitat decline occurs in response to grazing, insect attach, weeds, disease and old age. Paddock trees at Springhurst have declined by 47% over the past 29 years. Decline occurs along waterways and threatens habitat. Loss of understorey is also a common problem.
Contribution to recharge	Loss of native perennial vegetation, especially in high recharge areas, allows more rainfall to reach the groundwater
Impact on Salinity Management Activities	Salinity can lead to tree deaths and loss of habitat Loss of native perennial vegetation can lead to salinity
Policy associated with the management of this threat. **(State wide)** **(Regional)**	Victorian Biodiversity Strategy (1997). • Increasing the awareness of the need to conserve biodiversity • Detailing strategic frameworks to prevent further loss of habitat, and a focus for better management of existing habitats and the continuation of natural ecological processes • Highlighting the habitats, major threatening processes and environments that require urgent attention. Draft North East Native Vegetation Plan • Native vegetation classes are to be maintained at 1999 levels. • A net gain in extent and quality is to be pursued. • Improving the management and connectivity of remnants will enhance the network and quality of vegetation on roadsides, streams, and private land.
Links to RCS – Resource Condition Target	RCT7.1- Improve the quality of priority EVCs (as determine by the NE Native Vegetation Strategy) by 10% of the 2005 levels measured by habitat hectares by 2023. RCT8.1- Achieve on-going "net-gain" for all EVCs

	ensuring a positive gain in extent, distribution and quality at anytime as measured against the previous year until at least 2023. RCT8.1a – Increase where possible the extent of native vegetation for endangered EVCs to 15%, and the extent of native vegetation for vulnerable EVC's to 30% relative to 1750 extent levels by 2023. RCT9.1- Maintain or improve the 2003 conservation status of 80% of threatened flora and 60% of threatened fauna species by 2023.
Relationship to Salinity Strategy	• Encourage landholders to retain and manage remnant vegetation. • Consider and encourage the use of new plantings of trees/understorey/grassed based pastures to provide habitat and linkage of habitat through corridors. • Increase awareness of the benefits of habitat through the salinity newsletter and other extension activities.

Table 49 - Relationship of salinity to water quality in the North East.

Other Water Quality – need clarification	
Description of the Threat	Sediment, nutrients and salinity in run-off waters
Contribution to recharge	Not applicable
Impact on Salinity Management Activities	Heritage rivers must be maintained at least to their current condition.
Policy associated with the management of this threat. **(State wide)** **(Regional)**	Victorian River Health Strategy (2002) Healthy rivers, streams and floodplains which meet the environmental, economic, recreation and cultural needs and future generations. White Paper – Securing Our Water Future Together (2004) Secure, reliable water supplies for our homes, our farms and industry while meeting the needs of the environment. North East Regional River Health Strategy (2006) Our rivers are managed to support ecological health whilst meeting our social and economic needs. Draft Ovens Basin Water Quality Strategy (1998) Maintain and/or improve water quality of surface, groundwater and riverine environments within the Ovens Basin. Draft Upper North East Water Quality Strategy (1999) Improve water quality and riverine environments in the Kiewa and Upper Murray (including Mitta Mitta) Catchments. Regional Rural Drainage Management Strategy (1999) Implement measures which reduce the impact of waterlogging and lead to improved agricultural productivity. Kiewa River Streamflow Management Plan Report (Draft Feb 2002). To manage groundwater interactions to retain their

	contribution to stream flow.
Links to RCS – Resource Condition Target	RCT 5.1 – 5.1c Maintain or improve stream index conditions of streams.
Relationship to Salinity Strategy	• Encourage landholders to stabilise saline discharge areas to reduce runoff of high salinity water into streams. • Manage existing perennial-based pastures including native grasses. • Encourage landholders to undertake works that improve plant water use potential to reduce recharge. • Encourage activities to protect the heritage rivers, such as planting native species in riparian zones. • Discourage inappropriate drainage works that have potential to lead to saline water runoff.

9.8 Roles and Responsibility

The implementation of this plan will involve a number of groups and individuals they are:

NECMA - will provide the necessary investment framework for the strategic planning across the region. DPI is a service provider (Partnership Agreement) to the CMA for the delivery of its program. The NECMA will through the Land Advisory Committee provide executive support and provide strategic direction for the program delivery.

DPI - will continue to provide the integrated land management planning on behalf of the NE CMA as part of the delivery of the Regional Catchment Strategy.

DSE - At the State level will provide the necessary investment framework to guide the plan implementation. At the regional level DSE staff will work through an integrated approach with DPI staff in delivering the Action Plan.

Landholders: The entire plan relies on the support of the community and landholders who manage the private land areas to implement the programs referred to in this Action Plan. A large component of the works require significant community and landholder input. Farm planning will be an essential way that program staff can engage with the community.

Local Government: Local government across the NE region has responsibility for many of the land management issues mentioned in this plan, particularly vegetation protection, statutory planning and road management. DPI and other agency staff will need to continue engage with local government to ensure there is adequate planning and implementation.

Community Groups: Landcare and other community groups play a critical role in delivering many of the programs that the NECMA and DPI undertake. There are fifty (50) Landcare groups across the NECMA region. Without an organised community framework this plan cannot be effectively delivered. The salinity priority areas are within a significant number of Landcare group boundaries. The delivery of the programs will be undertaken using the Local Area Plans that have been developed by groups as well as other developing processes.

Other Agencies: There are a large number of other organisations who play a role in this Plan. Some detail is mentioned in the previous section on Multiple Outcomes

9.9 Assumptions

- That the objectives are achievable.
- That the management options are suitable and effective in control of recharge and discharge.

- That the GFS are accurate – eg: mapped true to the ground, and that the process is occurring as described and that the management option is correct.
- That without a plan watertables will continue to rise and threaten assets.
- That by increasing perennial vegetation (trees/pastures) to the allocated percentage (10%) salinity/watertables will be controlled.
- Biodiversity condition – EVC declining, this plan aims to improve this by linking resources together.
- The proposed land management systems will deliver a 50 percent reduction in groundwater recharge that will realise salinity benefits that begin to accrue within 10 years of establishment and become fully effective after 20 years.
- Salinity benefits will be realised through a fifty- percent reduction in stream salt loads and a fifty percent reduction in degraded saline land areas over the life of the plan.
- Management strategies are configured to negate a 2 percent annual increment in salinity. This figure is the suggested long-term incremental increase in salinity in Victoria. It is presented herein in the absence of any greater knowledge or insight into the actual long term rate of change.

Note: The above scenarios are based upon 'best assessment' and are to be verified through numerical modelling.

9.10 Incentives

A range of incentives currently exists within the region as well as to create opportunities for new pograms (Table 50). Previous incentives were only available to landholders in a salinity priority area or if they have a saline discharge site on their property. The implementation processes across the region have evolved in the last few years, taking into account programs such as Heartlands to achieve large-scale catchment change. Future programs will be based around an integrated catchment team across agencies and allowing opportunities across sub catchments. The approach of working only in salinity priority areas may evolve to wider areas as other models of community engagement come together such as Multiple Outcomes Projects (MOPs) and tender processes currently being developed across the region.

Table 50 – Incentives to implement works.

Program	Potential Assistance	Program support	Landholder requirement	Conditions
Recharge Control planting.	Program to be reviewed annually within the Regional Catchment Investment Program (RCIP)	Advice and farm plan- including land class fencing	50% cost share based on landholder undertaking works and maintaining site	Plantations must be at least 20 metres wide. Must contain a minimum ratio of 60% trees / 40% shrubs. No support where native grasses are present.
Perennial pasture	Only available if sourced from funds from other areas such as Landcare.	Advice and farm plan	Potential cost share based on landholder undertaking works and maintaining site	Areas west of the Hume Freeway below 600mm rainfall. Not to be planted where it may become a weed or a threat to biodiversity. Limited to current funding held by Ovens Landcare Network. No support where native grasses are present.
Lucerne	Program to be	Advice and	Cost share based on	Soil Analysis required

Establishment	reviewed annually within the annual RCIP	farm plan	landholder undertaking works and maintaining site	
Remnant Protection	Program to be reviewed annually within the Regional Catchment Investment Program (RCIP)	Advice and farm plan- potential use of land class fencing.	Cost share based on landholder undertaking works and maintaining site	Has to protect existing native vegetation or join two or more areas of native vegetation. Can't be boundary fencing. Area must be a minimum 20m wide. Linked to Care of Remnants Incentive Scheme (CORIS).
Integrated Perennial Grass Pasture and Tree establishment.	Program to be reviewed annually within the Regional Catchment Investment Program (RCIP)	Advice and farm plan & contribution to establishment	Cost share based on landholder undertaking works and maintaining site	Area must be east of the Hume Freeway. An offset area a minimum of 10% of the perennial pasture sown must be planted to trees/shrubs. Not to be planted where it may become a weed or a threat to biodiversity. Limited to current funding held by Ovens Landcare Network. No support where native grasses are present.
Discharge area treatment	Contribution to fencing and salt tolerant pasture as per RCIP	Advice and farm plan	Cost share based on landholder undertaking works and maintaining site	Must be mapped as saline. Not to be planted where it may become a weed or a threat to biodiversity.
Targeted Approach	Contribution for site preparation (possibly including site ripping, trees, planting and fencing.	Advice and farm plan, coordination of ripping, mounding, tree planting, trees. Opportunities for land class fencing.	50% cost share Construction of fence and weed control	Within defined focus area, as identified in the regional catchment investment plan each year. Assess potential impact of large scale plantings on catchment yield using models such as 2CSALT.
Use of market based instruments	Linkages with bush tender and other market based instruments	Integrate with regional investment plan programs (RCIP)	Encourage landholders to tender for programs with extension staff encouraging joint projects.	To be determined. Possible examples include Greengraze and Bush Tender

9.11 Budget/Cost Share/Economics of Implementing the Plan

The cost share approach to implementing the plan will follow the basic framework already in existence with the current NESS (Table 51). However there is an opportunity to link the program to other initiatives including:

- Market based instruments (eg, Bush Tender and Eco Tender)

- Increasing the rate for incentives to encourage greater participation
- Multiple outcome projects that provide an increased rate of incentive and labour that demonstrates clear benefits to asset protection and enhancement.

Regional staff are already engaged in a process of Multiple Outcome initiatives to achieve these types of aims.

Table 51 – DRAFT Estimated Annual budget/cost of Incentives/grants in Salinity Priority Areas, based on current cost share. Not final - indicative only.

GFS	Annual target Tree/shrubs	Cost	Annual Target perennial pastures	Cost
Fractured Rock	129	167,700	129	$7,740
Granitic Rock	95	123,500	95	$5,700
Deeply Weathered Fractured Rock	2	4,927	2	$120
Glacial Sediments	3	3,900	3	$180
Upland Alluvium	13	16,900	13	$780
Basalts	1	1300	1	$60
Total	258Ha	$318,227	243Ha	$14,580

Note: no target set for Riverine Plain except for the investigation in to the processes that are occurring. There may be opportunities of funding revegetation programs close to the major rivers where it can be demonstrate that a local GFS is operating in association with river terraces. This costing is only for on-ground works, the costs of implementation activities such as extension and whole farm planning are critical but have not been included along with cost estimates for a research & investigation program are to be determined at a later date.

10 COMPLIANCE WITH MURRAY-DARLING BASIN SALINITY MANAGEMENT STRATEGY

10.1 Salt generation and end of valley targets for North East Victoria

Estimation of the impact of dryland salinity on downstream water users is problematic within the North East Region of Victoria. Few stream-gauging stations with longer-term records are available to estimate stream salt loads. Consequently, there is little opportunity to quantitatively assess the regional distribution of salinity issues salinity through conventional hydrological means.

Where continuous recording stations have been installed to support the estimation of the regions salt and water balance the data generally post dates the 1996 drought period. This 'low flow' information affords little opportunity for regional insight.

The lack of longer-term stream salinity information also lessens the opportunity to link salinity management activities to 'end of valley targets'. In the short to medium term other approaches need to be explored to realise the goal of better understanding the distribution of the regions stream salt loads.

The proposal is to 'synthetically' derive stream salt loads through numerical modelling approaches. In the short term the proposal is to apply a model known as the 'Rapid Appraisal Tool' and over the medium term the intention is to construct a landscape-

groundwater modelling approach using both the '2C' model and the 'Catchment Assessment Tool'.

10.2 The models

10.2.1 Rapid Assessment Tool

The 'Rapid Appraisal Tool' (RA) uses climatic data; landscape attributes sourced from the Groundwater Flow Systems' framework and digital elevation data. The engine for the Rapid Appraisal work is the BC2C (Biophysical Capacity to Change) model developed by CSIRO Land and Water in conjunction with the CRC for Catchment Hydrology. Application of the RA is currently proceeding with the support of Dr. Craig Beverley and his team at DPI (Rutherglen). It is anticipated that this work will be completed during September 06.

10.2.2 Catchment Assessment Tool

In the medium term (2006/07) the plan is apply the 'Catchment Appraisal Tool' across the North East Region (subject to funding). The CAT model/package has been developed over the past five years by Dr. Craig Beverly of DPI (Rutherglen). The CAT model predicts the regional distribution of groundwater recharge from a range of soil-water-vegetation models and links this layer of information to a landscape-groundwater model that simulates the groundwater flow processes that generate salinity.

Like the BC2C model the CAT package is intimately linked to the Groundwater Flow Systems Framework. Conceptual models of groundwater behaviour are drawn from the GFS framework along with hydrogeological attributes required to develop the model application. The advantage of the CAT model is that it links a package of soil-water-vegetation models with a three-dimensional groundwater model capable of simulating groundwater processes throughout the region.

Linking the two packages affords opportunities to explore catchment/salinity management 'scenarios' both in terms of optimising local salinity management strategies, and understanding the potential to support catchment management objectives embodied within the Victorian commitments to the MDBC Basin Salinity Strategy.

10.3 High Definition GFS Framework

The work proposed includes re-definition of the present 1:250,000 Groundwater Flow Systems Framework to 1:100,000 resolution. This work has been largely completed it will allow for application of numerical modelling at more detailed scale than currently possible. The resulting map base will also support improved definition in planning for salinity management, and afford improvements in communicating management strategies to all stakeholders.

10.4 Triple bottom line approach

The modelling framework described will provide the North East Region with the tools need to assess the social, economic and biophysical outcomes that follow from implementation of the action plan. It will provide the means of developing and refining targets that meet the needs of the State in realising responsibilities for managing salt-loads within agreed guidelines set out in the Murray-Darling Basin Salinity Management Strategy (2005).

10.5 Summary

Through the following activities the North East Region will gain the capacity and ability to better assess the effectiveness of implementing the Second Generation Salinity Action Strategy in managing to outcomes agreed under the Murray Darling Basin Program.

The specific activities required are as follows:
(a) Application of hydrological and hydrogeological models in estimating salt generated from catchments under average climatic conditions and current land use. This work has been initiated through application of the Rapid Appraisal Tool.
(b) Estimation of salt generated given widespread implementation of the salinity management activities set out in this plan.
(c) Re-definition of the current 1:250,000 scale Groundwater Flow Systems Framework for the North East to the higher definition to 1:100,000 scale.
(d) Application of the Catchment Assessment Tool to the North East Region with the objective of realising a predictive capacity. This will allow for salinity management activities to be assessed in the context of downstream users, and in particular in the context of both within valley targets and end of valley targets specified under the MDBC Basin Salinity Strategy.
(e) Apply the 2CSalt model to the preferred Investment Plan targeted catchments for the NE CMA Region. Initially in 2006/07 this will target the Multiple Outcome project areas of Greta, Carboor-Bobinawarrah, Chiltern and Indigo to test a range of catchment intervention options.

11 Economic Evaluation

Presented below is an assessment of the benefits and costs expected to result from implementing the 30-year program of works recommended in this plan (Table 52 & 53). This assessment is based upon data and assumptions provided by the Department of Primary Industries, Wangaratta and has been calculated over the 50-year period (2001 – 2050) to ensure ongoing benefits captured after the full implementation of the plan are taken into account.

Table 52 - Summary of Present value benefits and costs

Activity	PV Cost: 4% ($' million)	PV Benefit: 4% ($' million)	PV Cost: 8% ($' million)	PV Benefit: 8% ($' million)
Private				
Perennial pasture establishment	22.00	68.17	10.38	28.53
'Break of slope' tree belts	12.04	0.36	7.84	0.15
Tree blocks and farm forestry	12.59	0.95	8.16	0.40
Treatment of discharge sites	0.23	0.005	0.15	0.003
Groundwater pumping	0.07	0.07	0.04	0.04
Public				
Decreased salt loads (Morgan, SA)		3.05		0.79
Decreased salt loads (NE region)		0.19		0.05
Other irrigation areas		not valued		not valued
Agricultural and non-agricultural stakeholders		6.77		1.76
Government contribution	16.62		7.24	
Total	**$ 63.56 million**	**$ 78.92 million**	**$ 33.81 million**	**$ 31.55 million**

Table 53 - Net present values and benefit : cost ratios.

Present Value of Costs	PV – 4% ($' million)	PV – 8% ($' million)
Total PVB	78.92	31.55
Total PVC	63.56	33.81
Net Present Value (PVB – PVC)	15.35	(2.26)
Benefit: Cost Ratio	1.2	0.9

11.1 Private Benefits and Costs

11.1.1 Establishment of deep-rooted perennial grass pastures on recharge areas

One of the preferred practices for reducing recharge on agricultural land where the annual rainfall is less than 600 mm is to sow deep-rooted perennial grass pasture species that remove water from the soil profile. Being perennial, these pasture species grow throughout the year and generally use more water than annual pastures and crops.

The with-plan scenario assumes 107,160 hectares across the priority areas will be converted to perennial pasture over a 30-year period.

Depending on grazing management practises, pastures would need to be replaced between 5 and 20 years. For this report, we assume that pastures are replaced every 10 years. Therefore, for years one to ten, 3572 hectares of pasture would be sown per annum. In years eleven to twenty, 3572 hectares of new pasture would be sown per annum, and further 3572 of pasture would be re-sown. Similarly, in years twenty to thirty, 3572 hectares of new pasture would be sown per annum, and a further 7504 hectares of pasture would be re-sown. From years 31 to 50, only pastures established during the previous 30 year period would be re-sown.

Based on these assumptions, and pasture establishment costs of $220 per hectare, it is estimated that the present value cost of pasture establishment and replacement across the targeted areas from 2000 to 2050 is:

- $22.0 million using a 4 per cent discount rate; or
- $10.4 million, using an 8 per cent discount rate (Table 52)

Establishment of perennial pastures in areas currently growing naturalised or annual pasture species is expected to deliver a number of environmental and economic benefits. With higher water utilisation, and longer growing season, perennial pastures can substantially increase the livestock carrying capacity of an area.

A previous economic study funded by the Murray-Darling Basin Commission and conducted by Ivey ATP found that the average gross margin per hectare for farms in this region is approximately 70 per cent of gross income. This is based on average gross farm income of $414 per hectare, and enterprise costs of $126 per hectare. Therefore, the current gross margin for areas of livestock grazing in each priority area is calculated as 70% of the gross value of livestock production that has been derived from Australian Bureau of Statistics data.

The relative increase in grazing productivity following establishment of perennial pasture will vary depending on a number of factors, including the quality of the original pasture, enterprise mix, and the seasonal conditions. In this analysis, we assume that grazing production will increase by 30% following establishment of perennial pasture.

Based on these assumptions, it is estimated that the present value benefit of pasture establishment and replacement across the targeted areas from 2000 to 2050 is:

- $68.17 million using a 4 per cent discount rate; or
- $28.53 million, using an 8 per cent discount rate (Table 52).

11.1.2 Establishment of 'break of slope' tree belts

This plan also sets a 30-year target for establishing break of slope tree belts in the higher rainfall areas where perennial pasture establishment is not applicable. Strategic establishment of tree belts can be an effective method of reducing recharge in some sub-catchments. Not only can these tree belts reduce groundwater recharge directly under the trees and in the surrounding area, but when strategically planted across break of slopes, they can also intersect sub-surface flows resulting from recharge higher up the slope where appropriate GFS exist.

The tree belt configuration selected for this analysis is a series of 7-row belts (25 m wide and 400 m long). Under this configuration, each planting covers an area of 2 hectares and requires 1.65 km of fencing. While a 6-row belt (21 m wide x 476 m long) configuration was also investigated, the longer boundary edge for each planting added significantly to total fencing costs over the life of the plan.

Based on this configuration and assumed fencing costs of $2250 per km and planting costs of $1500 per hectare, it is estimated that the present value cost of tree belt establishment across the targeted areas over the 30-year implementation phase is:

- $12.0 million using a 4 per cent discount rate; or
- $7.8 million using an 8 per cent discount rate (Table 52).

Strategically placed tree belts provide production benefits to landholders by acting as a windbreak for crops and pastures, as well as providing shade and shelter for livestock. In this situation, the tree belts are being located primarily to help control recharge of groundwater, and placement may not necessarily be optimal for shelter purposes. Therefore, we assume that benefits to agricultural production in paddocks adjoining tree belts is equal to any production loss resulting from planting agricultural land with tree belts. It is also assumed that some landholders may conduct strategic harvesting of these tree belts for firewood and, to a lesser extent, forestry production. As such, it is estimated that tree belts will generate a nominal net benefit to landholders of $5.00 per ha per annum 10 years after their 30-year staggered establishment.

Based on these assumptions, it is estimated that the present value benefit of tree belt establishment across the targeted areas over the 50-year planning horizon is:

- $356,800 using a 4 per cent discount rate; or
- $149,320, using an 8 per cent discount rate.

11.1.3 Establishment of tree blocks and farm forestry

This plan also sets a 30-year target for establishing tree blocks and to a lesser extent farm forestry in the higher rainfall areas across recharge areas and upslope of saline seeps. The average tree block configuration selected for this analysis is 173.2 metres square, which covers an area of 3 hectares and requires 0.69km of fencing.

In this analysis, it was assumed that on average, fencing costs are $2250 per km, planting costs are slightly higher than for tree belts at $2100 per hectare, and that annual maintenance costs estimated at $150 per hectare apply. Based on these assumptions, it is estimated that the present value cost of tree block establishment across the targeted areas staggered over the 30-year implementation phase is:

- $12.6 million using a 4 per cent discount rate; or

- $8.2 million, using an 8 per cent discount rate (Table 52).

While the majority of the tree blocks established will be for salinity control and biodiversity enhancement, there will be some opportunity for more commercial uses, such as firewood production and farm forestry. As such, it is estimated that tree belts will generate, on average, a net benefit to landholders of $10.00 per ha per annum 10 years after their 30-year staggered establishment. While more widespread commercial farm forestry would be expected to generate significant benefits to landholders and the broader community, these greater benefits have not been factored into this analysis.

Based on these assumptions, it is estimated that the present value benefit of tree block establishment across the targeted areas over the 50-year planning horizon is:

- $946,110 using a 4 per cent discount rate; or
- $395,940, using an 8 per cent discount rate (Table 52).

The tabulated benefits from the various tree planting regimes are just the private benefits to the landholder. As noted, these benefits are low because:
- Most plantings are for non-commercial or only semi-commercial purposes;
- Establishment costs occur in the year the trees are planted while the benefits are 10% in yr 1, 20 % in yr 2, ..., 100% in yr 10-50
- Tree establishment is staggered over the 30 year time frame

The public benefits to the broader community from implementing the tree planting and other remedial activities are listed separately under the headings:
- Decreased salt loads
- Decreased are of saline land
- Environment
- Tourism

11.1.4 Treatment of discharge sites

This plan recommends establishing saline pastures across 50 per cent of all saline seeps in the priority areas, staggered over the 30-year implementation phase. For this analysis, it is assumed that the treatment consists of fencing off all affected sites and establishing these areas with salt tolerant grasses. It is also assumed that the average saline seep covers an area of 2 hectares, that the cost of fencing is $2,250 per km and the cost of establishing saline pastures is $170 per ha. Consequently there is an average annual $10.00 per hectare net change in agricultural production three years after each hectare of land is treated.

Based on these assumptions, it is estimated that the present value costs of saline pasture establishment across the targeted areas over the 50-year planning horizon are:

- $232,290 using a 4 per cent discount rate; or
- $151,230 using an 8 per cent discount rate (Table 52).

Based on these assumptions, it is estimated that the present value benefits of saline pasture establishment across the targeted areas over the 50-year planning horizon are:

- $4,650 using a 4 per cent discount rate; or
- $2650 using an 8 per cent discount rate.

11.1.5 Groundwater pumping

The introduction of groundwater pumping as a means of reducing the watertable level and to support local irrigation and livestock water sources is being considered as part of this plan. However, as this plan gives a non-specific target for this activity, the amount of $3,447 per annum as quoted in the earlier NESS has been assumed. As per the previous strategy, it is also assumed that the present value benefits from this activity would match the costs.

Based on these assumptions, it is estimated that the present value cost and benefit of groundwater pumping across the targeted areas over the 50-year planning horizon is:

- $74,050 using a 4 per cent discount rate; or
- $42,170 using an 8 per cent discount rate (Table 52).

11.1.6 Promotion of cropping systems

Finally, this plan also sets a non-specific target for landholders in certain areas to adopt modified cropping practices to maximise plant water utilisation. While such actions are likely to generate net benefits to the landholders implementing these changes, the absence of definitive targets and yield response data has meant that any associated benefits have not been included in this analysis.

11.2 Public benefits and costs of decreased salt loads

11.2.1 Murray River at Morgan

In the previous NESS, it was estimated that there would be a 2.8 per cent annual increase in Murray River water EC levels at Morgan South Australia due to the deterioration of water quality in the North East region.

While calculating the benefits to downstream water users drawing water from the Murray River was excluded from the terms of reference from this project, these benefits were calculated based on the assumptions that:

- implementing the 30-year program of works recommended in this plan will begin to reduce salt load increases 10 years after each implementation year and become fully effective from year 20 onwards. For example this means that land use changes introduced in year 10 will be fully effective in year 30, while those introduced in year 11 will be fully effective in year 31.
- a fully effective plan will result in salt load increases over current levels being reduced by 50 per cent.
- a mitigation benefit of $100,000 per EC will apply (MDBC figures).

Based on these assumptions, it is estimated that the present value benefit from reductions in salt loads to Murray River water users over the 50-year planning horizon is:

- $3,720,660 using a 4 per cent discount rate; or
- $1,029,530 using an 8 per cent discount rate.

11.2.2 Household and business water users

At present, surface water salt loads in the North East region are imposing annual costs of:

- $509,240 per annum on households within the region; and
- $704,370 per annum on commercial and industrial businesses within the region.

These figures were calculated based on a detailed assessment of the number of domestic and commercial water users in each town, the quantity of water consumed, and the source of water used to supply each town.

Under the 'without-plan' scenario, it has been estimated that these annual costs will increase over the 50-year planning horizon reaching:

- $1,722,790 per annum for households; and
- $1,010,990 per annum for commercial and industrial businesses by 2050.

This increase is due to both projected increases in surface water salt loads and projected population changes in each urban and rural town that source its water supply from surface water supplies.

The benefits to household and business water users in the region were estimated by assessing the yearly time-step benefits that would be captured directly by the projected reduction in salt load increases associated with the plan. Changes in yearly time-step costs that would be attributed solely to population changes were isolated from the analysis to ensure only those benefits attributable to changes in salt loads were counted.

Based on this analysis, it is estimated that the present value benefit from reductions in salt loads to urban water users located within the region over the 50-year planning horizon is:

- $194,430 using a 4 per cent discount rate; or
- $50,250 using an 8 per cent discount rate.

11.2.3 Other irrigation areas

Other irrigation areas that draw water from the North East may also benefit from the implementation of this plan. However, as with the previous NESS, these benefits were not quantified due to the highly dynamic and interrelated nature of the Murray-Darling Basin.

11.3 Public benefits and costs of decreased area of saline land

11.3.1 Prevention

The land directly affected by salinity is predicted to increase 2 per cent per annum without the plan being implemented. The analysis presented is based on the advice that 50 per cent of this increase will be prevented as a result of implementing the 30-year program of works recommended in this plan.

11.3.2 Benefits to agricultural and non-agricultural stakeholders

Land salinisation linked to high saline watertables has been shown to adversely affect infrastructure owned or managed by a range of stakeholders living and working in the rural and urban areas of the region, including:

- Urban and rural households
- Commercial and industrial businesses
- Local governments
- State and federal governments
- Road and rail authorities
- Water, gas and electricity suppliers
- Agricultural producers

Building on the results compiled through a large Murray-Darling Basin Commission study, the cost of salinity damage to infrastructure in the region, has been estimated to currently cost these stakeholders around $1.86 million per annum (Table 54).

Table 54 - Summary of salinity costs under a 'no-plan' scenario.

Stakeholders	Salinity costs (2001) ($/yr)	Salinity costs * (2050) 0% annual expansion ($/yr)	Salinity costs * (2050) 2% annual expansion ($/yr)
Households	103,320	202,450	404,900
Commerce & industry	45,750	61,600	123,190
Local government	520,380	520,380	1,040,770
Government agencies & utilities	431,580	431,580	863,160
Agricultural producers	757,660	757,660	1,515330
TOTAL COST	**$ 1,858,690**	**$ 1,973,670**	**$ 3,267,490**

*: Changes in values shown in Columns 2 and 3 of this table are attributable solely to the ABS changes in expansions of urban and rural populations, measured at the Statistical Local Area.

More importantly salinity costs linked to high saline watertables are expected to increase significantly over the next 50 years, reaching an estimated $3.27 million per annum by 2050 under the most likely 'without plan' scenario. This significant increase is due both to a likely two per cent annual increase in soil salinity across the region and predicted population increases across the urban and rural areas.

The implementation of the 30-year program of works recommended in this plan should generate significant benefits to each of the stakeholder groups identified above. Based on the advice from DPI staff and its consultants the proposed land management changes will deliver a 50 per cent reduction in groundwater recharge. With benefits that begin to accrue within 10 years of establishment and become fully effective after 20 years, the estimated present value of benefits can be established (Table 55). Changes in yearly time-step costs that would be attributed solely to population changes were again isolated from the analysis to ensure only those benefits attributable to changes in salt affected land were counted.

Table 55 - Present value of salinity benefits to all stakeholders (2001 to 2050).

Present Value of Benefits	PV – 4% ($' million)	PV – 8% ($' million)
Households	0.69	0.18
Commerce & industry	0.21	0.05
Local government	1.79	0.46
Government agencies & utilities	1.48	0.39
Agricultural producers	1.95	0.51
Total PVB	**$ 6.12 million**	**$ 1.59 million**

11.4 Environmental benefits of the plan

Environmental improvement is a priority of this plan. However the benefits are too innumerable and immeasurable to quantify in dollar terms. Indirectly, the plan will assist and enhance the environment in a number of ways. While far from exhaustive, these include:

- protection and regeneration of remnant vegetation on and off-farm
- increased range and availability of habitat for native flora and fauna
- improved stream environment for fish
- improved survival of salinity affected trees and reduced effect in the future
- improved soil structure, reduced wind and water erosion (and potential for erosion)
- reduced potential for soil acidity problems due to improved persistence of deep rooted perennial pasture
- stabilised water table levels

It is also possible that there will be some adverse responses to implementing the program this could include:

- changes to fresh water flows in to rivers associated with increased adoption of perennial systems such tree planting across wide areas of subcatchments.
- Reduction of watertable levels during times of high dependency on shallow groundwater supplies
- Introduction of species that may impact on biodiversity assets

11.5 Tourism benefits

Tourism in the region is a major contributor to the local economy. As such, any increase in salinity that may degrade the aesthetic value of the region will represent a major cost to the tourism industry. These types of costs are difficult to quantify and have not been included in this analysis. However it is important to realise that were it possible to quantify the monetary benefits gained to the tourism industry as a result of implementing this plan, then this would contribute significantly to the final benefit : cost ratio.

11.6 Public expenditure

No advice on the nature or cost associated with the government's contribution to the plan was provided. As such, the costs used in the previous NESS have been adopted here (Table 56), after being increased by 25 per cent to account for inflation and the increased scale of works being proposed in this plan.

Table 56 - Present value costs of government contributions.

Present Value of Benefits	**PV – 4% ($' million)**	**PV – 8% ($' million)**
Plan support	2.31	0.84
Research & Investigation	1.58	0.56
Monitoring	3.91	1.41
Environmental	0.88	0.31
Farm tree	3.39	1.23
Pastures	0.36	0.13
Saline Agriculture	0.18	0.06
Groundwater pumping and drainage	0.38	0.14
Implementation	3.65	1.31
Total PV	**$ 16.63 million**	**$ 5.9 million**

12 The Benefit : Cost Analysis

The benefit : cost analysis is a valuable tool that enables people to evaluate the economic impact of implementing the plan in terms of today's dollars, as opposed to the predicted salinity outcome without the existence of a 30-year implementation plan (the 'without plan' analysis). This analysis allows comparison between projects competing for funds and indicates investments, and the selection of the project that may be likely to generate the greatest return.

Based on the data and assumptions used in this analysis, it is estimated that the present value of total benefits to the community over the 50-year planning horizon are:

- $78.92 million using a 4 per cent discount rate; or
- $31.55, using an 8 per cent discount rate (see Table 57).

Based on the data and assumptions used in this analysis, it is estimated that the present value of total costs to the community over the 50-year planning horizon are:

- $63.56 using a 4 per cent discount rate; or
- $33.81 using an 8 per cent discount rate (see Table 58).

As this equates to benefit : cost ratios of **1.2** (under a 4 per cent discount rate) and **0.9** (under an 8 per cent discount rate), this analysis suggests that the plan is economically viable (Table 59). Given the increase in the B:C ratio that would result from environmental and tourism benefits, the plan would appear to be a worthwhile investment for all Victorians.

Table 57 - Present value benefits.

Present Value of Benefits	**PV – 4% ($' million)**	**PV – 8% ($' million)**
Private		
Perennial pasture establishment	68.17	28.53
'Break of slope' tree belts	0.36	0.15
Tree blocks and farm forestry	0.95	0.40
Treatment of discharge sites	0.005	0.003
Groundwater pumping	0.07	0.04
Public		
Decreased salt loads (Morgan, SA)	3.05	0.79
Decreased salt loads (NE region)	0.19	0.05
Other irrigation areas	not valued	not valued
Agricultural and non-agricultural stakeholders	6.77	1.76
Total PVB	**$ 78.92 million**	**$ 31.55 million**

Table 58 - Present value costs.

Present Value of Costs	PV – 4% ($' million)	PV – 8% ($' million)
Private		
Perennial pasture establishment	22.00	10.38
'Break of slope' tree belts	12.04	7.84
Tree blocks and farm forestry	12.59	8.16
Treatment of discharge sites	0.23	0.15
Groundwater pumping	0.07	0.04
Public		
Government contribution	16.62	7.24
Total PVC	**$ 63.56 million**	**$ 33.81 million**

Table 59 - Net present values and benefit : cost ratios.

Present Value of Costs	PV – 4% ($' million)	PV – 8% ($' million)
Total PVB	**78.92**	**31.55**
Total PVC	**63.56**	**33.81**
Net Present Value (PVB – PVC)	**15.35**	**(2.26)**
Benefit: Cost Ratio	**1.2**	**0.9**

13 Performance Reporting

The procedures for reporting on the performance of catchment based salinity management strategies remain poorly defined within most regions impacted by dryland salinity in South Eastern Australia.

There is a general tendency to define salinity hazard on the basis of the area of land considered subject to shallow watertables. The corollary of this is adoption of performance measures that consider the influence of catchment management strategies on the basis of the spatial extent of shallow groundwater. The approach is particularly flawed in that it is not possible to rigorously report on the spatial distribution of management-induced changes in the extent of watertables across most large catchments/river basins. .

A more informed approach recognises the value of reporting trends in watertable elevation in response to the range of management activities practiced at sub-catchment/farm scales. The approach is particularly powerful when constructed within a GFS approach. This affords the opportunity to report contextually against knowledge of the component landscape processes influencing groundwater behaviour.

The main elements of a landscape/GFS approach are well documented in the dryland salinity evaluation framework developed under the National Land and Water Resources Audit.

For the most part the performance of activities promoted within the plan can be assessed through further consideration of existing observation bores and piezometers, and the establishment of new observation bores to monitor the performance of substantive treatments. The strategy should identify key bores for reporting on:
(a) baseline trends within each of the GFS of the North East, and
(b) the performance of management strategies in influencing watertable behaviour. Where resources permit, electronic recording should be considered for performance monitoring as this more detailed approach affords a far more informed overview of vegetation-landscape-groundwater interactions.

The essential elements of an evaluation framework for this plan would involve the following activities.

- A review of all groundwater observation bores constructed throughout the region
- Assignment of all bores to their respective GFS
- Assignment of all bores to landscape positions nominated in the context of GFS (eg. recharge/discharge areas)
- Definition of key bores for recording baseline groundwater trends
- Identification of key bores for performance monitoring
- Potential for rationalising the number of bores/piezometers recorded in favour of more intensive monitoring of alternative sites.
- Consideration of requirements for additional performance based bores/piezometers.
- Consideration of regional trends and extrapolation within the GFS framework to the NE region.
- Reporting in the context of other CMA frameworks (Priority Areas and Catchment Management Units)

13.1 Monitoring and Evaluation

The action plan aims to align with the NECMA Theory of Change Model (Figure 40) which is currently under development. Previous salinity plans have attempted to include an effective evaluation process however most of those actions were in fact only monitoring. Partnerships are a critical component of this process.

In providing this approach the plan aims to link to the eight key elements of:

- Adequate coverage and quality of native vegetation & habitat
- Functional ecosystems-no further decline
- High quality water
- Improved hydrological regimes
- Healthy wetlands
- Stable riverbanks and beds
- Land use matches land capability
- Healthy soil

In order to achieve the above it is recognised that social factors and changes in demographics will influence the long term changes in attitude and practices of land management. Monitoring protocols have also been developed (Table 60).

Figure 40 – Land theory of change model. The plan will use the same concepts as the theory of change model used by the NECMA to for monitoring and evaluation of the RCS.

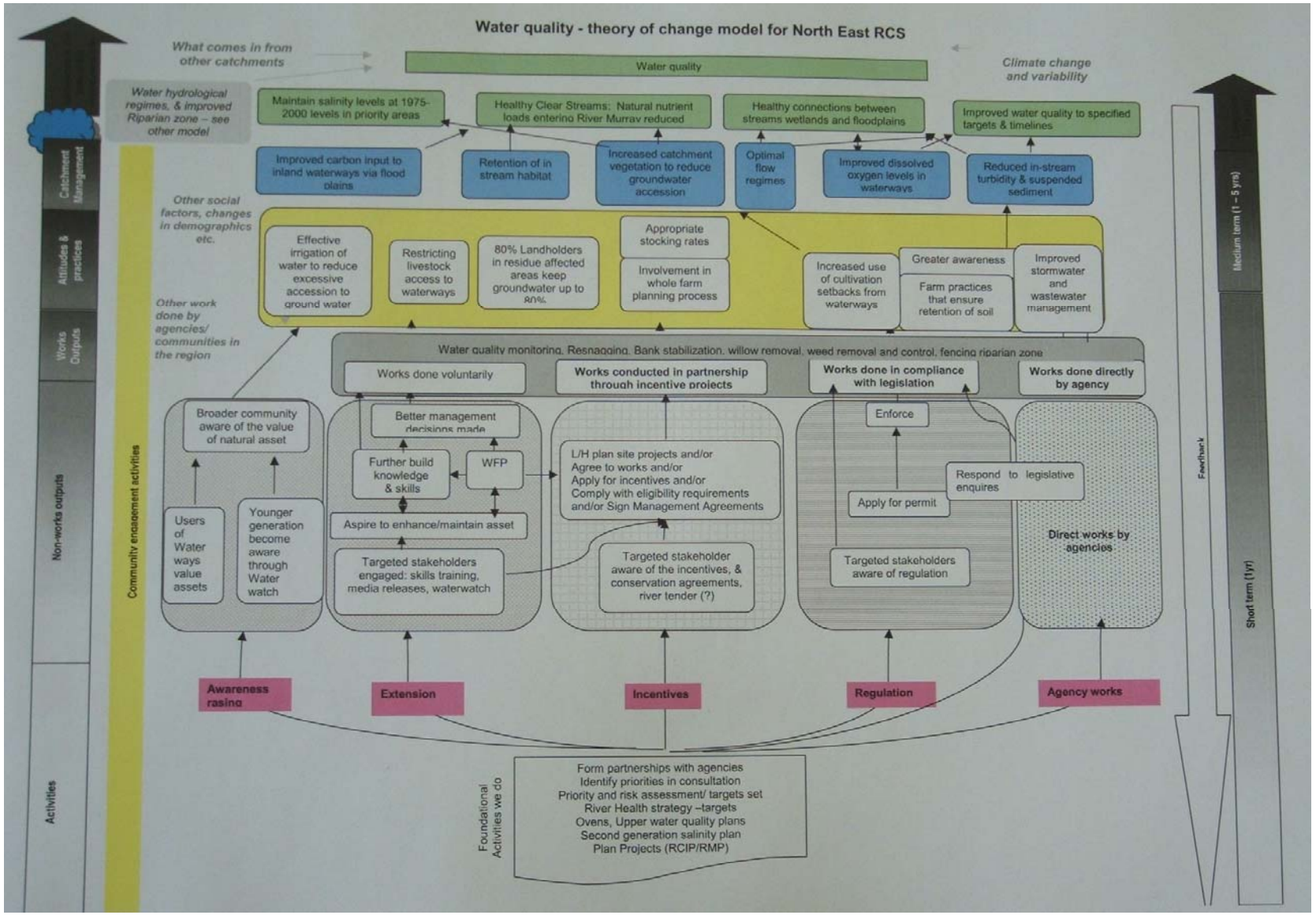


Table 60 – Monitoring Protocols

Outcome	Measurement Process				Measuring Protocols					Reporting	
Resource Condition Target (RCS)	**Indicator**	**Performance measure**	**Benchmark**	**Benchmark confidence level**	**How**	**Who**	**When/Frequency**	**Data**	**Data Timing**	**Frequency**	**Reporting Mechanism**
RCT1.3: Target for reduction of land area threatened by shallow and rising saline water tables to be developed by December 2005 (see assumption L3 in Section 7.3). Reduce area affected by high watertables by 2%	Indicators – 1.Depth to groundwater 2. Groundwater salinity 3. Location and size of salt affected areas.	Increase in area is unacceptable (0), decrease In area is good (1) (or included a graded measure). Monitoring of bore network and the modelled. Determine threshold salinity levels- review with researchers/consultants	Increase in area is unacceptable (0), decrease In area is good (1) (or included a graded measure)	High	Bore monitoring and annual measurement of discharge areas	DPI	Bore monitoring – monthly, discharge mapping annually.	Bores monthly. Projected water tables to be annually. The three State-wide monitoring sites (Rutherglen, Boralma, & Everton) to be every 5years.	PIRVic Bendigo (State groundwater database) – six monthly	Link to RCS timelines	Annually RCS Annual report
RCT3.1: Zero change in contribution to salinity at Morgan from the Ovens River as measured at Peechelba East by 2015 (MDBC 2001). Based on 2000 conditions, utilising 1975-2000 climatic benchmark.	Electrical conductivity (EC) + FLOW. OR Total dissolved solids (TDS) + Flow.	Compliance with the MDBC target - Ovens River at Peechelba East, salinity to be maintained within 100% and salt loads within 101% of current levels.	Basin benchmark period	High	Existing monitoring stations and stream monitoring	MDBC/DSE/DPI	Continuous and monthly	Annual report by DSE Vic Water Quality Monitoring annual reports. Including results against benchmark with interpretation. Available on State-wide Data warehouse (web based) www.vicwaterdata.net Annual report by DSE to MDBC on compliance to	Data available on warehouse site.	Annual	Separate report to RCS annual report card.

								benchmark.			
RCT3.1a: Zero change in contribution to salinity at Morgan from the Kiewa River as measured at Bandiana by 2015 (MDBC 2001). Based on 2000 conditions, utilising 1975-2000 climatic benchmark.	Electrical conductivity (EC) + FLOW. OR Total dissolved solids (TDS) + Flow	Compliance with MDBC target - Kiewa River at Bandiana, salinity and salt load to be maintained within 100% of current levels.	Basin benchmark period	High	Existing monitoring stations and stream monitoring	MDBC/DSE/DPI	Continuous	Annual report by DSE Vic Water Quality Monitoring annual reports. Including results against benchmark with interpretation. Available on State-wide Data warehouse www.vicwaterdata.net Annual report by DSE to MDBC on compliance to benchmark.	Data available on warehouse site.	Annual	Separate report to RCS annual report card

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15 North East Resources

The documents below are technical reports, monitoring reports and educational materials produced specifically for North East Victoria. They are available on the web site or in hard copy from the Wodonga and Wangaratta DPI Offices.

Managing Dryland Salinity with Vegetation in North East Victoria	This document summarises the groundwater processes in specific sub-catchments across the North East. In association with these processes guidelines are provided on how vegetation might be used to manage recharge and discharge. Section six contains general information on the vegetation options such as cropping, pastures, and trees. Published July 2000 Pages 64
Groundwater Monitoring Summary - Year 2000	This brochure summaries the groundwater monitoring program occurring across the North East Catchment Management Authority Region. Selected hydrographs from key bores are included in the centre of the brochure. Information on trends and the impact of climate variation on trends is also included. Published 2000 A3 brochure
Is it Salt?	This brochure contains photos of salinity indicators such as plants, rust, waterlogging bare patches and salt crystals. Published 2002 (2nd Edition) A3 brochure
Understanding Salinity	This brochure presents the causes of salinity in the Rutherglen, Ovens/King Riverine Plain, Indigo Valley East and Everton Upper areas. Hydrogeological cross sections and bore data is included. This brochure also identified high priority areas in the North East and saline discharge sites. Published 2002 A3 brochure
Tree Decline: A North East Perspective	This report documents a research project on tree decline in the North East. A comparison of vegetation decline over a 29 year period was carried out on two properties. The report looks at the ways landholders have been trying to revegetate their properties and the reasons for the tree decline. Published 2003 Pages 20
Managing dryland salinity with perennial vegetation.	This brochure presents perennial vegetation options suitable to the North East for recharge control. These include pastures, crops, alley farming, and farm forestry. Published 2002 A3 brochure
North East Salinity Strategy, Surface Water Salinity, Ovens Catchments – 1999.	This is a report which presents the findings of 1999 surface water monitoring in the Ovens River, Black Dog Creek and Indigo Creek. Sections of this report include information on catchment characteristics, flow, and salinity statistics. Published August 2000 Pages 34
North-East Salinity Strategy Surface Water Salinity Monitoring, Ovens Catchments - 2001	(PDF 1902kb)This is a report which presents the findings of 2001 surface water monitoring in the Ovens River, Black Dog Creek, Three Mile Creek and Indigo Creek. Sections of this report include information on catchment characteristics, flow, and salinity statistics. Published December 2002 Pages 35
Heartlands: Achieving Landscape Change	This brochure outlines the Heartlands project that is occurring in the Byawatha Hills. Includes information on issues, achievements, key messages, monitoring, and evaluation. This is a project the salinity team has been

in the Byawatha Hills.	involved with. Published May 2002 A3 Brochure
A Review of the North East Salinity Strategy and its implementation 1997-2001.	This review was undertaken as part of a Victoria wide review of Salinity Management Plans. The review evaluates the effectiveness the North East Salinity Strategy in terms of the accomplished program goals and ability to address stakeholder needs. The review also makes recommendations for the second generation salinity plan for the region. Published June 2002 Pages 71
Two case studies of re-vegetation programs on farms in North East Victoria.	This document presents case studies of revegetation in the Carboor and Springhurst areas. Topics covered include changes in vegetation cover, site management, benefits of revegetation and comments by the landholders involved. Published August 2002 Pages 21
A Pocket Guide to Monitoring Water Salinity in North East Victoria	Designed to be pocket size, this guide should be kept in the glove box of the ute or somewhere for easy and quick reference. The guide contains information on salinity tolerance levels, salinity levels in local creeks, conversion of common salinity units and a table to record your readings. Published September 2002 A6 Brochure

16 Terminology

Recharge is the process where water moves downward through the soil or regolith layer from surface water to depth as groundwater. This process usually occurs in the unsaturated zone.

Discharge area: Parts of a landscape where groundwater expresses on the land surface. Discharge may occur as liquid water or the groundwater may be evaporated directly from the soil surface.

Groundwater Flow **S**ystem: Are characterised by landscapes that have similar groundwater processes operating which contribute to a common salinity issues. They may operate as a local, intermediate or regional system.

Salt Loads: A measure of the total quantity of salt transported by a stream, measured in tonnes.

Regolith: The mantle or blanket of unconsolidated or loose rock material that overlies the intact bedrock and nearly everywhere forms the land surface. The regolith may be residual (weathered in place), or it may have been transported to its present site. The undisturbed residual regolith may grade from agricultural soil at the surface, through fresher and coarser weathering products, to solid bedrock several feet or more beneath the surface. The transported regolith includes the alluvium of rivers, sand dunes, glacial deposits, volcanic ash, coastal deposits, and the various mass-wasting deposits that occur on hillslopes.

17 For Further Information Contact:

Peter Ockenden
DPI Wangaratta
Cnr Ovens & Ford Street
Wangaratta Vic 3677
Ph 0357238674
Email: peter.ockenden@dpi.vic.gov.au

Kylie Macreadie
DPI Wodonga
1 McKoy Street
Wodonga Vic 3690
Ph 0260437922
Email: kylie.macreadie@dpi.vic.gov.au

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