North Central RCS – Dryland Theme Discussion Paper – Template

Preamble – The North Central Regional Catchment Strategy (RCS) is the principal framework for land, water and biodiversity management in North Central Victoria. This discussion paper has been written to assist in the development of the North Central RCS. The discussion paper attempts to articulate our current understanding of particular issues or assets including setting priorities and will used to seek feedback and guide future direction setting in the RCS.

Introduction

Soil conservation continues to present significant challenges in north-central and northern Victoria. The region has been subject to land degradation since it was first cleared and developed for European agriculture more than 150 years ago. Early last century extensive erosion caused by wind and running water led to enormous soil losses and both Governments and farming communities alike spent vast amounts of time, energy and resources fighting it. The North Central CMA region was not alone in facing these challenges. The problems were endemic across south-eastern and southern Australia and throughout most of the developed countries of the world.

In the second half of last century Australians recognised the need for soil conservation. As a nation we began to explore new ways of managing the land that were less abrasive and more in tune with catchment hydrology. Conservation cropping initiatives meant less cultivation, stubble retention increased the ground cover needed to reduce wind erosion, and perennial pastures introduced to grazing lands improved soil stability through opportunistic water use and a propensity to establish deep roots.

By the late 1970s the region appeared to be on a pathway that would lead to vast improvements in soil stability. Farming communities were experimenting with new technologies that promised greater soil protection, and a commitment to applied soil science promised convergence on sustainable agriculture. This new-found confidence, however, was short-lived as new forms of land degradation emerged.

By the early 1970s the region was experiencing substantive salinity problems. Watertables associated with high salinity groundwater had been rising since the land was first cleared and developed for agriculture. From the 1950s onwards saline groundwater began to intersect the surface of the land effecting dryland salinity. By the early 1990s more than 32,000 hectares of land in the North Central CMA region were salt affected. Salinity, however, was not simply a land degradation problem. Salt washing off saline land together with enhanced saline base-flow contaminated the stream network. Salt exports from the combined Loddon and Campaspe River basins alone exceeded 120,000 tonnes per annum.

The quest to achieve regional soil conservation through sustainable agriculture became much more difficult in the late 1990s. The climate changed abruptly in 1996 as the annual rainfall decreased by about 20 percent. The most notable dearth occurred in the autumn and early spring months shortening the growing season and leading to extensive crop failure. Many farmers keen to gain some return on their financial outlay cut and baled the hay for fodder, or simply grazed it. In both instances this meant less soil cover and a heightened exposure to wind erosion.

The shortfall in growing seasons was protracted. It persisted from 1996 through to 2009 and was unprecedented in more than 150 years of climatic records, but it was not the only change in climate. An increase in late spring and early summer storm activity produced high intensity rainfall events. Indeed,

throughout the extended drought rainfall in November actually rose relative to the long-term average. The difficulty farmers faced with this phenomenon was twofold: Firstly the intensity of the rain placed the soil at risk of water erosion, and secondly the large falls germinated expansive areas of summer weeds. Farmers were forced to repeatedly spray weeds and, once again, the consequential reduction in soil cover gave rise to a much greater propensity for wind erosion.

The climate changed dramatically and abruptly once again in 2010. A negative Indian Ocean Dipole (IOD) coincided with La Nina conditions in the western Pacific Ocean and in consequence south eastern Australia received some of the heaviest rainfall on record.

This heightened exposure to 'droughts and flooding rains' promoted by an altered climate comes at a critical time. Exponential growth in human population is set to increase the number of people on the planet by more than 2 billion over the next 30 to 40 years, and it is accepted that the productivity of the world's soils must increase by at least 70 percent if we are to meet the demand for food. This pressure provides a fundamental context for conservation of the regions soils.

New farming technologies and management system promise a slowing of the rate of soil loss but many advances have been offset by uncertain economic circumstances and substantial increased climate variability. The worst floods on record have followed protracted drought and these circumstances have had a very profound influence on dryland farmers and the land management decisions they have made over the past 15 years.

Farmers continue to invest in soil protection strategies that include, for example, conservation cropping, precision agriculture, rotational grazing, mixed cropping and grazing systems, biological farming and so on. Sustainability land management, however, remains a conceptual goal rather than a meaningful reality. Farming communities continue to be subject to the dynamics of global and domestic markets, financial institutions, climate variability, and so on.

Vision/Objective : What is the long term aspirational vision guiding the protection of soil in the North Central CMA region?

The challenge is to provide both food security and ecological integrity for the benefit of both current and future generations. Our goal must be to arrest the insidious loss of productive grazing and cropping soils throughout northern and north central Victoria. We will only achieve this by working collaboratively with the farming communities of our region.

We need to devise and deliver socially acceptable sustainable farming practices more resistant to threatening processes that include wind and water erosion, soil acidification, organic carbon loss, structure decline and climatic variability.

The need for regional soil conservation is not restricted to food production. The offsite impacts of soil loss and salinity occurring on private land impinges on the integrity of public assets. Sediment lost from farmland accumulates in the stream network. It fills the deeper pools that are integral to biological function. Salts derived from rising watertables and saline groundwater discharge add to the salt-load and salinity of rivers streams, wetlands and reservoirs.

The range of ecosystem services provided by good soil management practiced by the farming community is extensive and measurable in terms of the health of aquatic environments, the maintenance of environmental water quality, the removal of nutrients and toxins from water supplies and so on.

Soil like air and water is essential to most life-forms and in this context soil conservation is an essential plank in any discussion re intergenerational equity. Farmers that protect there soils recognise it is in their

interests to do so because they sustain the productive and financial value of their enterprise into the future. Farmers that conserve their soils, however, also provide security for future generations.

The benefits of soil conservation are in this sense shared across farmers interested in maintaining their productive resource (private benefit), and the need to provide for food security and maintenance of environmental assets for future generations (public benefit).

Aspirations and Goals

1. Our aspiration is that our local communities throughout the region will develop and adopt sustainable soil management practices that maintain and/or improve the productive capacity and ecological integrity of the land for the benefit of both current and future generations.

2. Our goal is to have our local farming communities acquire the confidence, knowledge and experience they need to adopt sustainable land use.

Geomorphic framework for consideration of regional soils

The soils of the dryland terrain within the North Central CMA region vary in sympathy with the geological and geomorphic character of the land. Lighter sandier soils are formed on the unconsolidated marine and aeolian sediments of the Murray Basin in the Mallee lands west of Kerang. Red and grey vertisols are formed on the alluvial soils of the Riverine Plains and on the foothills of the Western Uplands.
Red and yellow sodosols are the dominant soil types found on the meta-sedimentary rocks on the slopes of the Western Uplands, and red friable earths and grey clays are found on the basaltic plateaus of the upland valleys.

Figure 1 – Geomorphic map of the North Central CMA region that illustrates the distribution of fundamental soil-landscapes (uplands, foothills, basalt plains, Riverine Plains, Mallee lands etc.

Investing in regional soil protection

Focus areas for investment in regional soil protection are developed after careful consideration of a range of biophysical and social factors that include the following:

- The productive capacity of the soil/land in the context of food security and ecosystem services
- The propensity for soil damage based on the physical attributes of the land including soil type, climate, land use, and land management.
- The cohesiveness of defined farming communities including their capacity to work together in a collaborative alliance to achieve local area soil conservation

Map : Regional Map of Asset

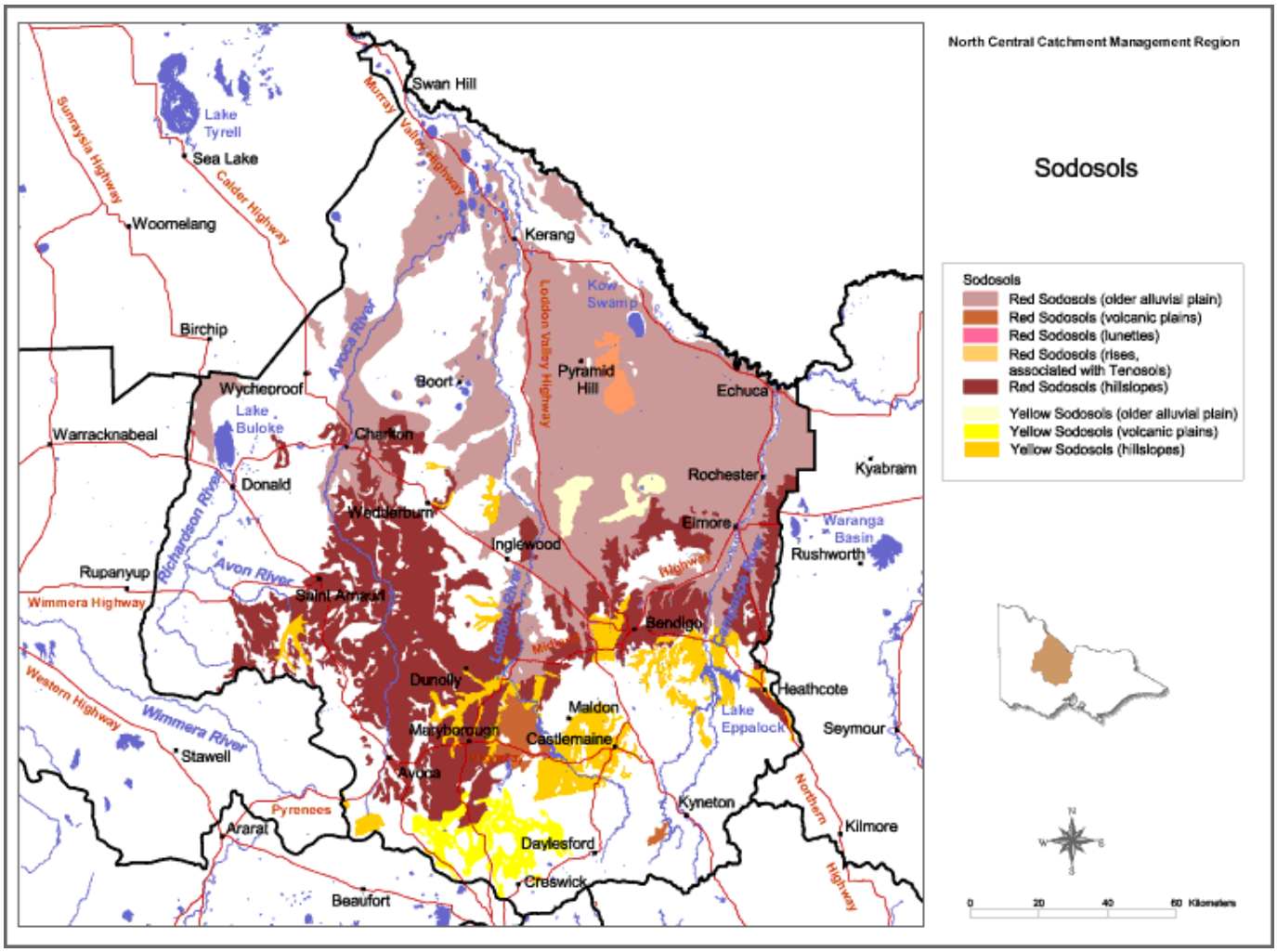

Figure 1 - Distribution of red sodosols in the North Central CMA region (map to be updated with DPI soils map when we receive the .shp files for the geomorph from DPI. At present there is no soils map for the CMA region)

Land Use

Dryland (non-irrigated) land comprises about 2 million hectares, or 90 percent, of the North Central CMA region. For the most part land use is cropping and grazing. In the late 1990s that value of agricultural production from dryland terrain was estimated at $380 million dollars. Sixty percent of revenue is derived from cereal cropping despite cropping areas comprising less than 30 percent of the land area.

Figure 3

Map illustrating land use in across the North Central CMA area (in prep)

Risks

Threatening processes and risks to land health

The primary threats to irrigated land assets are:

1. Enhanced climatic variability
2. Loss of soil structure
3. Loss of soil carbon
4. Wind and water erosion
5. Dryland salinity
6. Community capacity to deliver practice change

Enhanced climatic variability

Enhanced climate variability post the mid 1990s has raised considerable challenges for regional farmers. Shorter growing seasons have led to crop failure and reduced ground cover leaving the land more exposed to wind erosion. In the grazing lands the more arid conditions have meant a reduction in pasture diversity, and in turn this has also left the land with less ground cover making it more susceptible to erosion.

An increase in summer storm activity delivers intensive high rainfall events in late spring and early summer. In The consequence there is a greater risk of water erosion and massive crops of summer weeds. The spraying of weeds leaves the land depleted of vegetation and prone to both wind and water erosion. Increased traffic associated with spraying is also an issue for soil conservation.

Figure 3

Graphic illustrating changes in climate

Loss of soil structure

The loss of soil structure is an ever-present threat to the soils of the North Central CMA region, particularly in the cropping lands. For the most part the land comprises red and grey sodosols with sodic subsoils.

Fine sandy loam topsoils less than 10-15 centimetres thick rest over silty clay sodic subsoils. This architecture leaves the land prone to land degradation. Plant growth is particularly dependant on the conservation of topsoils in these strongly texture contrast soils and in the absence of careful management productive capacity is mitigated.

Loss of soil structure in the sodosols is intimately linked to land management. The challenge is to avoid exposing the sodic subsoils and to maintain sufficient organic matter to avoid the dispersion issues associated with sodicity.
Conservation tillage techniques that retain crop residues for soil carbon are important, as are the range of technologies that deliver this outcome. Minimum tillage and Zero Tillage techniques also raise a number of other issues including herbicide resistance.

Farmers that manage mixed cropping and grazing enterprises on sodosols commonly have issues with soil structure, particularly where animals graze moist cropping soils. The mechanical breakdown of surface soils is an issue for most farmers in this situation.

Loss of soil carbon

The loss of soil carbon is intimately linked to the loss of soil structure. There is a need to further explore, develop and adopt farming systems that maintain soil organic carbon and allow for greater soil resilience in the face both wind and water erosion.

The challenge is to (a) identify best-practices that deliver on this objective, (b) have regional farming communities understand and embrace these, and (c) promote their adoption on a scale that is significant in terms of regional soil conservation.

Regional databases comprising soil chemistry have improved significantly in recent years. There remains, however, a need to further research the capacity of farming systems to deliver improvements in soil organic carbon. Most of the current analyses indicate soil organic carbon given existing management is of the order of 1.5 to 2 percent.

Wind and water erosion

Wind and water erosion are significant issues throughout the North Central CMA region. They are of particular concern in the lands that support the red sodosols and grey vertisols of the mixed cropping and grazing lands on the Riverine Plans and within the northern foothills of the Western Uplands.

Community capacity to deliver practice change

Regional soil conservation cannot be successfully achieved without the involvement of motivated local communities intent upon achieving it. A rich history of soil conservation over more than six decades has shown this to be true. Local groups working collaboratively with supportive agencies dedicated to protection of the soil as a resource achieve the best outcomes. Group conservation schemes delivered soil conservation from the 1950s through to the early 1980s. Landcare groups adopted the soil

conservation challenge in the late 1980s and 1990s, and today 'Sustainable Soils' groups are advancing the cause.

In spite of changes in the times and names of the groups over many years the principles applied in realising regional soil conservation both in Australia and overseas have remained more or less the same. The best results are achieved when local farmers work together in collaborative knowledge-based programs that have immediate application to their local area and local enterprises. The agencies facilitate, guide, support and enable such arrangements.

Community ownership of regional soil conservation is the most important tenet in contemporary times. Regional communities must own their own programs, develop their own plans, apply for the funding they need to implement them and be intimately involved in their delivery. Successful outcomes are established by groups acting as autonomously as possible.

Regional Investment Model – Priority Setting

Investing in soil protection within the North Central CMA Region

Regional soil conservation cannot be achieved on a meaningful scale and within appropriate timeframes through the adoption of the simple transactional approaches that have more relevance in the protection of high value localised environmental assets. The North Central CMAs is compelled to work at larger scales in an effort to secure environmental outcomes that are significant from both a regional and national perspective. Soil is dispersed natural capital comprising the land base of northern and north central Victoria.

The North Central CMA investment in soil conservation is, by necessity, multi-faceted. For the most the CMA does not deliver actual works on the ground that result in improved soil security. Instead, it works with regional farming communities in defined areas to establish local soil protection groups, and the members of these groups become responsible for delivering practice change. The CMA supports the group develop and deliver locally relevant socially acceptable soil protection strategies.

Three factors are important in considering CMA investment. We are driven by (a) the need to provide future generations with food security and environmental integrity, (b) a desire to work with competent community groups that display preparedness to pursue soil conservation outcomes, and (c) a compelling need to attain sustainable land use in soils that are inherently sensitive in the face of contemporary land management.

A summary of the North Central CMA Investment Strategy for Soils is presented in in table 1.

Investment Principles				
Productive Capacity	Community Preparedness	Propensity for damage	Prospects for success	Land area protected

Priorities for investment in regional soil protection		
Criteria for investment	Justification	Priority
Productive capacity of soil landscapes	Sub-regions that contribute most to food security	Riverine Plains and foothills of the Western Uplands
Community cohesiveness and preparedness	Need to work with cohesive community groups with a demonstrated capacity to develop and deliver local soil protection programs	Landcare, cropping and other community-based land protection groups with a strong natural resource management ethic
Propensity of the soil to be damaged by threatening processes	Soils that have a high propensity for land degradation within contemporary climates and land management	Red sodosols and grey vertisols
Prospects for success	Is the objective achievable	Riverine Plains and northern foothills
Land area protected	Opportunity for adoption of sustainable practices over large areas	Riverine Plains and northern foothills

Figure 2 - Criteria for investment in soils within the North Central CMA Region

A. Productive Capacity

The productive capacity of soil-landscapes in North Central Victoria is a very significant factor in considering where and how time and effort and resources are best invested expended to achieve regional soil conservation and land protection outcomes. At the broad scale the North Central Region can be divided into five soil-landscape classes. These are summarised in Table 3.

Soil landscape	Description	Land Use	Investment priority
Alluvial Plains of northern Victoria	Alluvial sediments of the Riverine Plains and the Natte Yallock Basin	Mixed cropping and grazing	High
Eastern Mallee Plains	Aeolian sands over marine sediments in the semi-arid lands of northern Victoria	Cropping with some grazing	Moderate to high
Basaltic plains and scoria cones	Soils formed on Quaternary basalts in the upper catchments	Grazing, cropping and horticulture	Moderate to high
Foothills of the Western Uplands	Red sodosols on weathered meta-sedimentary rocks	Mixed cropping and grazing	Moderate to high
Hilly terrain of the Western Uplands	Red and yellow sodosols on moderate to steep hilly terrain	Grazing	Low to moderate

Figure 3 - Productive capacity of soil landscapes

Productive capacity accounts for soil type, climate, land use and the extent of the soil-landscape throughout the region. It is a first-pass measure of areas within the North Central Region that should be considered high priority in the context of future food security. The soils of the Riverine Plains and the adjacent foothills are important in this context.

B. Community cohesiveness and preparedness

Soil protection programs and projects are most often resourced over relatively short time periods when considered in the context of the length of time required for community groups to advance substantive sustainable land management programs. \

Even projects resourced over three to four years struggle to build and implement enduring and meaningful community-based land protection programs that obviously preserve the resource base for future generations. There is little time to build cohesive communities prepared to work collaboratively in achieving sustainable land management. Accordingly our investment strategies target more experienced groups that have worked well together in the past. We encourage these groups to involve their less-experienced neighbours.
Community preparedness is a very strong part of our investment strategy, particularly where other criteria such as soil type and productivity capacity are met. The CMA looks for opportunities to work with groups that have demonstrated a capacity to work collaboratively to achieve natural resource management outcomes in the past. These strategic alliances produce the best results in the shortest possible timeframe and, accordingly provide the best return on investment.

C. Propensity for soil damage

The third factor used to guide investment in soil protection is the sensitivity of the soil to circumstances that mitigate soil health. Propensity for damage is indicative of resilience recognising that some soils are able to sustain their productive and environmental values in the face of threatening processes far better than others.
Propensity for soil damage reflects the inherent biophysical properties of the soil and their arrangement or architecture within the soil profile. This in turn provides a sense of how they are likely to respond to the range of land management practices.

A simple biophysical consideration of the soils of the region leads easily to the conclusion that the red sodosols and grey vertisols of the northern plains and foothills are most sensitive and most at risk.
The inherent properties of these soils that result in a high propensity for damage are:

- A thin fine sandy loam topsoil (A horizon), less than 10 to 15 cm deep that is essential for plant establishment and rigorous plant growth
- A poorly structured, highly dispersive sodic, poorly permeable silty clay 'B' horizon

The risk of further soil loss from the sodosols should not be understated. The productive and environmental capacity of most of the Riverine Plains and northern foothills of the Western Uplands is intimately linked to the conservation of the thin topsoil.

Gaps in knowledge - *What are the key gaps in knowledge in context of RCS (broad region wide gaps in knowledge ?)*

The knowledge needs of farming communities in the dryland terrain of north central and northern Victoria arise in consequence of (a) the extreme climate variability post the mid-1990s climate change and (b) a growing awareness that many of the current farming practices are not sustainable over the longer term.

Most farming communities understand that the agricultural productivity of their local area is a function of soil health, and that soil health is a reflection of the agricultural practices they deploy. The difficulty they face in conserving soil is in knowing the best practices to adopt in their area given local biophysical conditions, and the local social and economic circumstances.

Even the most experienced farmers with the largest holdings are concerned for the health of their soils in the medium to longer term. Cereal cropping farmers that have practiced minimum tillage over several decades have concerns with herbicide resistance. Farmers with summer weed issues arising from late spring and summer storm activity are concerned that their soils are left barren of vegetation after spraying. Farmers in grazing lands want to move away from high input introduced pastures but they need to know more about soil biology to make that transition. Equally, farmers wanting to increase soil

carbon within their enterprise are struggling to know if this can be achieved. Farmers want to engage in practices that afford greater equilibrium with the altered climatic regime and consequent hydrology, but, once again they are uncertain of how to achieve this. Sustainability remains a conceptual goal.

Perhaps the greatest knowledge need that farming communities have is in understanding how they can best work together as a community in an effort to appreciate their local social and economic and biophysical circumstances that mitigate their ability to protect their soils. Farming communities need to come together to consider the things that drive them to manage the land in as they do, to understand the pressures they place upon the land through their management practices, to appreciate the condition of the land in consequence, and to plan how they might best respond given their local circumstances. Farming communities comprising farming families need to drive a conservation movement concerned with the future of their soils.

sustainable soil management is a social issue as much as it is a biophysical or economic issue. The only hope we have of becoming sustainable is in supporting local communities in an effort to have them adopt, plan for and implement a soil conservation ethic. The role of Government should be to facilitate this approach and to work with local communities in an effort to have them identify the issues they need to resolve to protect their local soils.

Any overall actions, planning required - *Is there additional planning, studies, investigations, information gathering etc that is required in context of RCS ? (Broad region wide issues, eg River and Wetland strategy to be completed 2013).*

As of December 2011 the knowledge needs of eight large Soil Protection communities have been identified through their participation in the North Central CMA 'Farming for Sustainable Soils' (FSS) program.

Each farming community produces a formal Local Area Soil that is loosely based upon the 'Driver-Pressure-State-Response' model. Knowledge needs are identified in a series of workshops and documented within Local Area Soil Protection Plans. These plans become the blueprint for implementation of the range of soil conservation activities that groups will undertake throughout the following growing season.

Knowledge needs are formally identified in group planning processes Groups work in consultation with the North Central FSS Team to identify and engage a range of specialist experienced providers. Formal workshops and training sessions follow from these arrangements.

Discussion Paper Engagement

Local Area Soil Protection Strategies have been developed for eight large Soil Protection Groups throughout the North Central CMA region. Each plan is updated annually to become the blueprint for implementation of local soil protection growing season activities. Activities generally range through (a) baseline soil health assessment, (b) satisfying knowledge needs, and (c) trials that test local soil protection strategies, and (d) monitoring and evaluation to assess the success of the program.

Regional actions for soil protection in the dryland sector of the region are, accordingly, the sum of the actions identified within each of the FSS Soil Protection Groups. At a regional level there is some need to consolidate the outcomes and experiences of the FSS program within a Regional Soil Protection Strategy. This will ultimately become a subset of a Statewide Soil Health Strategy.

RCS direction and recommendations - *Given all information in the discussion paper what are the key components that need to be articulated in the RCS:*

Integration with land and water reform and irrigation modernisation initiatives.

Issue (driver)	Consequence (pressure)	Result (state)	Potential Response
• Below average rainfall in the 10+ years (between 1997 and 2009) resulting in poor or failed crops • Changed seasons have created some new issues such as managing heavy stubbles, flooding, fungal diseases, summer weeds, wet harvests, pest animals such as locusts and mice	• Loss of groundcover and increased risk of wind erosion with failed crops and light stubbles. • How to manage different challenges and priorities each year, e.g. stubble management, summer weeds, wet harvests, fungal diseases, mice	• Soil carbon loss with wind erosion. • Reduced biomass and organic matter production. • Resisting conversion back to practices that impact on carbon levels	• More sustainable management, farming system/land use practices (*machinery/technology upgrades and more knowledge, agronomic skills and risk management)* • Manage seasonal risk and match inputs to potential yield. *(Provide technical advice and use available tools)* • Use new technology to manage soils and crop risk more effectively *(Use GPS, soil testing to map soil types and production zones for variable rate fertiliser, crop type selection etc.)*
• Some farmers have gone back to cultivation prior to sowing due to high cost of chemical options, wet summers and cultural reasons	• Greater risk of soil erosion and soil structure decline	• Soil carbon loss with wind erosion • Reduced biomass and organic matter production • Soil structure decline	• Use chemical and alternative options to cultivation (Provide up to date technical advice on options) • Use new technology to improve effectiveness and reduce costs (e.g. GPS Guidance with no missed or overlap of spraying, Weedseeker technology for reducing chemical use and especially controlling summer weeds which use valuable stored water and nutrients.) • Monitor chemical resistance status

Issue (driver)	Consequence (pressure)	Result (state)	Potential Response
• Increased reliance on chemicals and higher inputs generally with reduced tillage farming. • Herbicide resistance is a bigger management issue with reduced tillage • Some new varieties have different chemical tolerance	• Makes changing practices a higher risk proposition and requires more skills and new knowledge to maintain soil cover.	• Reduced chemical usage can improve microbial activity and improve organic matter.	• Manage risks associated with practice change – (Provide technical advice e.g. chemical resistance, fertiliser inputs etc.) • Use new technology to manage risks, Resistance testing, Precision Agriculture, to help manage risk and match inputs to potential yield and income Use new tolerant varieties to reduce risk of failure and chemical inputs. • Get up to date advice on new varieties and their chemical tolerance and disease traits
• Sheep numbers rebuilding given good relative returns (compared with cropping)	• High sheep numbers and overgrazing increase soil erosion risk	• Soil structure decline	• Manage grazing, stubble, pastures and stocking rates at sustainable levels, Use new grazing cereals and pasture varieties to provide cover and feed early and late in the season, (workshops, trials, farm visits)
• Successive dry and shorter growing seasons has led to a change in pasture composition (loss of ryegrass and sub clover) remaining pasture has excessive barley grass, corkscrew & capeweed. Overall reduction of	• Barley grass and capeweed dominant pasture is undesirable nutritionally and provides insubstantial biomass to protect soil. Reduced pasture cover	▪ Less clover, ryegrass and phalaris roots in soil impacts organic carbon levels. • Harder to produce biomass which means a longer period of bare ground over	• Use of stock containment areas • Re-sow ryegrasses and other pasture species to bulk up pastures • Improved grazing management (workshops, trials, farm visits)

Issue (driver)	Consequence (pressure)	Result (state)	Potential Response
pasture quantity through limited seed replacement of current species	over late spring and summer increases the risk of wind erosion	summer and a loss of soil carbon.	
• Improving the structure of the 'red sodic' cropping soils	• When damaged are prone to wind erosion	• Loss of structure leads to compaction and reduced groundcover and loss of soil carbon	• Improving moisture holding characteristics through additions of soil conditioners and ameliorants (lime and gypsum trials)
• Low commodity prices and rising input prices is compounding poor returns from low yields making farm businesses perform poorly • Less financial viability and ability to change to a more sustainable system.	• Paddocks put under more pressure to increase business turnover with shrinking margins	• Soil carbon loss with wind erosion • Reduced biomass and organic matter production • Soil structure decline	• Manage seasonal risk and match inputs to potential yield and income (Provide technical advice and use Yield prophet) • Use Precision Agriculture tools and mapping to match inputs to paddock yield and soil type and spraying to weed specific areas