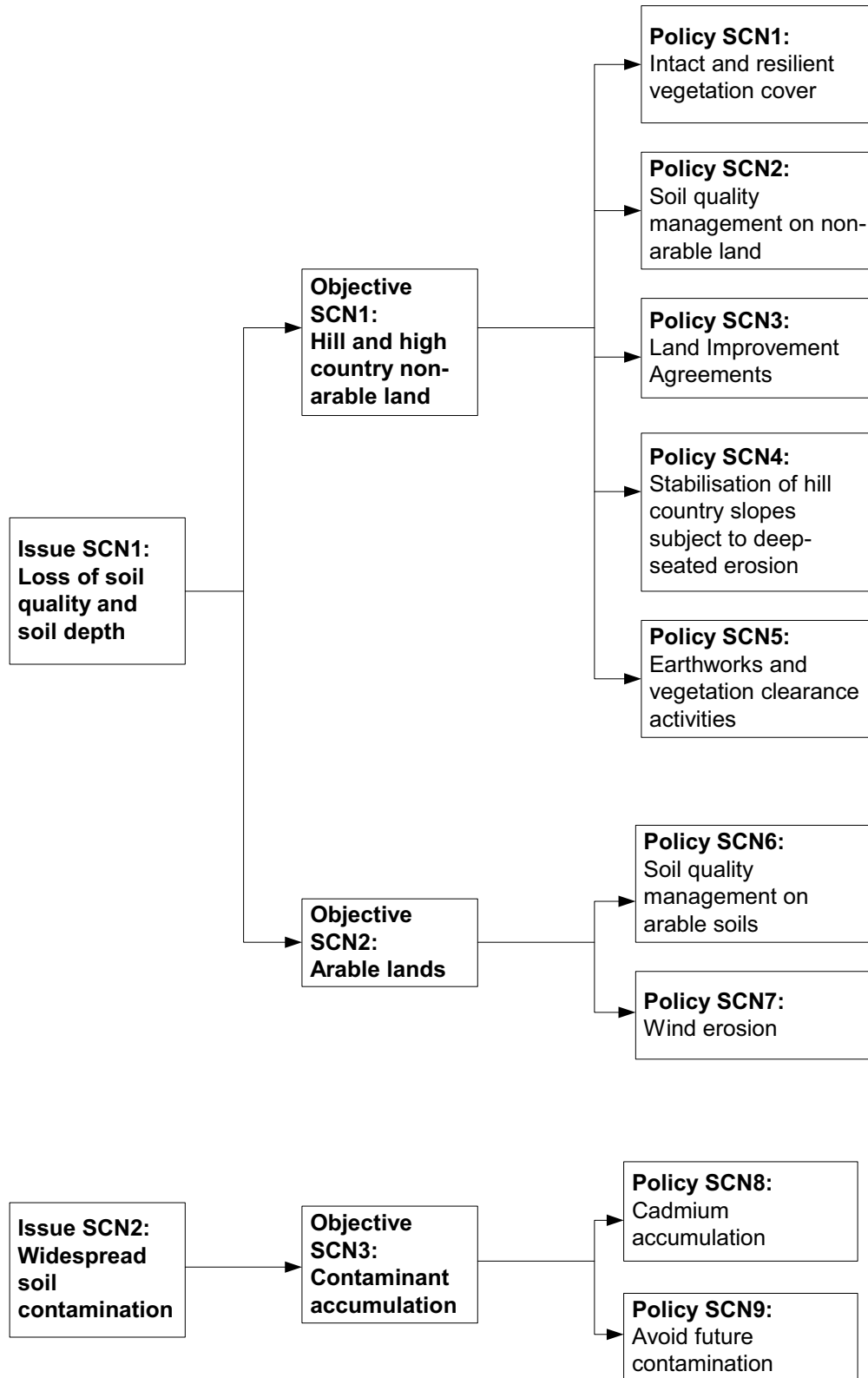


8.5 Issue Resolution

Figure SCN4: Outline of the policy framework for addressing soil conservation issues in Canterbury

This diagram is a summary only. The following sections contain the objectives and policies for soil conservation in Canterbury.



Issue SCN1: Loss of soil quality and soil depth

Land use practices that reduce soil quality, or that result in a reduction in the health, extent or protective capacity of the vegetation cover, can lead to induced erosion and a long-term loss of the life-supporting capacity of the soil resource.

In Canterbury the major concerns are:

- (a) a long-term, cumulative decline in soil quality in some parts of the non-arable hill and high country used for pastoral farming for the last 150 years. This has resulted in a reduction in the extent and resilience of the vegetation that, in turn, exposes soils to an increased risk of erosion;
- (b) an increased risk of slope destabilisation and soil erosion resulting from vegetation clearance and earthworks activities on erosion-prone soils of the hill and high country; and
- (c) a reduction in soil quality and the creation of small aggregate size in arable soils under cultivation and intensive grazing activities. This increases the risk of soil erosion by wind and water.

The consequences of induced erosion include:

- (i) degradation of water quality and aquatic habitat through increased sedimentation and inputs of phosphates that promote aquatic weed growth;
- (ii) impacts on natural values including a loss of indigenous biodiversity and loss of indigenous habitat;
- (iii) a loss of cultural values for the land including its mauri and mahinga kai;
- (iv) adverse effects on sites of significance to Ngāi Tahu;
- (v) a loss of important landscape and amenity values;
- (vi) impacts on the social and economic wellbeing of the community through the loss of soil productivity and reduced ability to meet the reasonably foreseeable needs of future generations; and
- (vii) the creation of situations where property and built assets, including network utility facilities, may be damaged by land instability.

Objective SCN1: Hill and high country non-arable land

On all hill and high country non-arable land, maintain soil quality and an intact and resilient vegetation cover sufficient to minimise the risk of induced erosion, safeguard the life-supporting capacity of the soil, and prevent, as far as practicable, the movement of soil into water bodies. For the purposes of this objective:

- (a) An intact vegetation cover means:
 - (i) at least 80 percent ground cover, where species greater than 30cm tall occupy more than 50 percent of the canopy cover. This will include the tall tussock grassland, shrubland and forest ecosystems; and
 - (ii) at least 90 percent ground cover where:
 1. the species greater than 30cm tall occupy less than 50 percent of the canopy; or
 2. the canopy species are less than 30cm tall, such as introduced

pasture and short tussock grassland communities.

- (b) A resilient vegetation cover will require:**
- (i) plant species able to retain their stature, vigour and biomass under prevailing land use and environmental conditions;**
 - (ii) species able to retain soils in situ under the prevailing geological and environmental conditions;**
 - (iii) inclusion of the indigenous species components of any undeveloped areas, particularly the tall tussock component of the undeveloped tussock grasslands;**
 - (iv) soil nutrient levels sufficient to maintain plant vigour; and**
 - (v) soil organic matter levels sufficient to maintain soil structure, water-holding capacity and soil fauna.**

Explanation and principal reasons

This objective addresses all hill and high country non-arable land that would naturally have had a vegetative cover over the soil. It is not intended that an intact vegetation cover should be achieved over areas that naturally would have a predominance of exposed regolith, such as screes or rock outcrops. Hill and high country land includes all land above 600 metres in altitude and all land with a slope greater than 20 degrees (regardless of altitude). Non-arable land refers to land that is unsuitable for cultivation or cropping, regardless of how it is being managed. The undeveloped areas of the hill and high country, include all land where there have been no regular inputs of fertiliser or addition of seed to establish and sustain a pasture component in the vegetation. Indigenous species will dominate the vegetation cover, together with any naturally established exotic species such as browntop and *Hieracium*.

The single most important factor in safeguarding the life-supporting capacity of the soil is a healthy vegetation cover that is resilient to environmental stresses and that provides an intact soil cover. This is particularly critical in harsh environments, such as the high country, where vegetation growth or establishment is severely limited, and soil development rates are extremely slow. (See Appendix SCN1(a) and (b) for a description of the high country soil environment groups.)

Loss of the vegetation cover will leave soils exposed to erosion agents such as wind, water and frost. Tall vegetation provides greater shelter from these climatic elements than low-lying vegetation and provides greater root depth to stabilise the soil. This can compensate for some reduction in ground cover intactness under tall vegetation.

A resilient vegetation cover will be composed of species able to maintain plant growth and soil processes under the climatic and geological limitations of the environment and to recover from any land management disturbances. Plant vigour and biomass production must be sufficient to maintain soil fauna and microbial populations and to provide nutrients for continued plant growth in addition to any grazing or harvesting of the vegetation, such as the harvesting of production forests. The more resilient the vegetation, the less input in terms of management and nutrients will be required to maintain a healthy cover. This will be important for non-arable lands where management inputs are often dictated more by prevailing economic conditions than by the current condition of the vegetation.

Indigenous vegetation communities have evolved in these environments and are adapted to the conditions. Undisturbed indigenous vegetation will provide the highest, ongoing level of protection for soil conservation. Introduced pasture species may be dependent, even for their short-term stability, on continued inputs of fertilisers and frequent replenishment by oversowing. Management regimes that retain indigenous components of the vegetation, particularly the tall tussock component of the undeveloped high country grasslands, will help to sustain the long-term resilience of the vegetation cover.

Policy SCN1: Intact and resilient vegetation cover**On hill and high country non-arable land:**

- (a) Where vegetation cover meets the thresholds specified in Objective SCN1, encourage landholders to maintain the intactness and resilience of the vegetation cover by:
- (i) ensuring that any changes to vegetation cover or composition do not result in a loss of resilience or intactness; and
 - (ii) managing the combined grazing pressure of domestic and feral animals to:
 1. maintain an intact and resilient vegetation cover; and
 2. avoid creating conditions that could initiate or exacerbate soil erosion.
- (b) Where the vegetation cover has been depleted below the thresholds for intactness and resilience identified in Objective SCN1, encourage landholders to take measures to restore an intact and resilient vegetation cover by:
- (i) reducing the combined grazing pressure of domestic and feral animals to levels that allow for a cumulative improvement in the vegetation cover. This may require the temporary or long-term destocking of the depleted area;
 - (ii) restoring existing indigenous vegetation communities, or enhancing the indigenous components of the vegetation communities, particularly in the undeveloped areas, where this will improve the resilience of the vegetation and contribute to soil conservation and the protection of indigenous biodiversity and habitat; and
 - (iii) replacing indigenous species with exotic species only in circumstances where this will improve vegetation resilience in the long-term.
- (c) Priority for restoration of depleted vegetation cover should be directed to those areas where:
- (i) a high proportion of topsoil remains in exposed areas; or
 - (ii) the extent of bare ground is less than 40 percent; or
 - (iii) the current condition is causing, or is likely to cause, adverse effects on important natural, landscape or amenity values, sites of significance to Ngāi Tahu or the loss of indigenous biodiversity; or
 - (iv) there is an associated risk to water quality in water bodies and to mahinga kai values.
- (d) The measures taken to achieve (a) or (b), should not result in:
- (i) the introduction or spread of any undesirable plant species, or encourage the spread of any plant pest species identified in a regional pest management strategy for the region;
 - (ii) significant adverse effects on important natural, landscape or amenity values, sites of significance to Ngāi Tahu, mahinga kai values, or the loss of regional indigenous biodiversity; or
 - (iii) significant adverse effects on stream flows, in particular activities will have to comply with the permitted activity requirements for flow-sensitive catchments identified in Chapter 5 Schedule WQN15.

Explanation and principal reasons

While any vegetation cover is better than no cover, from a soil conservation point of view, the more resilient the vegetation, the greater its ability to withstand harsh climatic conditions or pressures of land use activities, such as grazing, and maintain a protective cover for the soil. Any change to the species composition of the vegetation, or the replacement of an established vegetation cover, should not be undertaken if it is likely to reduce the ability of that vegetation to protect the soil in the long-term.

SCN1(1)(a): Where vegetation cover meets the thresholds for intactness and resilience, this should not be compromised by any management regime that cannot sustain that vegetation cover in the long-term, or that introduces a change in vegetation cover that reduces its resilience. The replacement of native species on low-fertility soils, with introduced pasture species requiring high-fertility conditions, will not be sustainable if nutrient inputs are not able to be maintained in the long-term. The conversion of grassland to forest cover may have both positive and negative effects for soil conservation. While a tree cover provides protection for the soil, the harvesting of production forests has the potential to compromise the protective capacity of the vegetation cover leaving soils exposed for the interval between harvest and the establishment of the next crop. This exposure can be minimised by prompt and effective post-harvest remediation or by the harvesting and replanting of small portions of the forested area each year.

SCN1(1)(b): Domestic stock are often not the only grazers in the non-arable hill and high country areas. Feral animals such as wild deer, rabbits, pigs, goats and possums will also put pressure on the vegetation cover through grazing and trampling. Landholders will need to identify the combined grazing pressure of both domestic and feral animals to determine sustainable domestic stocking rates. While current domestic stocking rates in the undeveloped areas of the high country are generally kept at low levels they may not be sustainable in the long-term if feral grazing pressures increase. Ongoing monitoring and management of feral animals will be necessary to maintain a resilient and intact vegetation cover. Grazing pressure that is too heavy will reduce plant vigour and stature, and over time may lead to changes in species composition or intactness that expose soils to a greater risk of erosion.

SCN1(2): Where the current vegetation cover does not meet the thresholds for intactness and resilience in Objective SCN1, options need to be explored to restore or establish a cover that will meet those thresholds. The choice of option will depend on the physical environment and the composition of species remaining on the ground. Once the vegetation cover has been depleted, it may be very difficult to restore in the harsher climates of the hill and high country. There is a greater chance of restoring vegetation cover in areas below the high altitude land - the rate of vegetation growth and recovery is likely to be faster here. Loss of the topsoil component of the soil will expose a less fertile and more weakly structured subsoil which will present much greater limitations for the establishment of a healthy vegetation cover.

Examples of management options are:

- (a) destocking or limited seasonal grazing in association with the control of feral animals;
- (b) the addition of fertiliser to encourage and maintain vegetation vigour and biomass;
- (c) over-sowing and top-dressing where there will be ongoing maintenance of the vegetation cover in the long-term;
- (d) introducing appropriate legumes;
- (e) forestry planting, where there is a low risk of wilding spread;
- (f) restoration ecology techniques to restore or re-establish the former indigenous vegetation cover; and
- (g) use of irrigation to establish and maintain a productive vegetation cover.

SCN1(2)(a): Grazing pressure on areas of depleted vegetation must be managed at a level that will allow for successive improvement in the vegetation cover up to the achievement of the thresholds for intactness and resilience specified in Objective SCN1. Where feral grazing animals are present, this will affect the sustainable stocking rate for domestic animals. While the control or removal of any feral animals should be a priority, in some circumstances recovery of the vegetation may only be achieved by the removal of all grazing animals.

SCN1(2)(b): Retaining and restoring any indigenous components of a depleted vegetation cover will improve the ability of the vegetation to return to the thresholds for resilience and intactness, particularly in the undeveloped areas where soil nutrient levels are often inherently low. The re-establishment of an indigenous cover will also have benefits for a range of other values held by the wider community, particularly the improvement of local indigenous biodiversity and habitat, and the protection of important cultural, amenity and landscape values that stem from the indigenous character.

SCN1(2)(c): Many of the options for restoration of depleted land will involve the use of introduced species and increased levels of nutrient inputs to enable vegetation establishment. These options should only be adopted where the species and their dependent management regime are sustainable in the long-term, and where their use will increase the resilience of the vegetation cover.

SCN1(3): In setting priorities for restoration work, the policy recognises that resources will be limited, and effort should be directed to areas where there is the greatest chance of recovery, and where there is the greatest community gain from the restoration. Also, priority will be given to areas where off-site adverse effects are likely to result if restoration is not undertaken. This includes effects on water bodies as a result of sedimentation. Depleted areas of vegetation that are not considered a priority under this policy may have to be put aside until further resources are made available for restoration work, or until new or improved technology becomes available to improve the effectiveness of restoration of these areas.

SCN1(4): This policy recognises that some adverse effects may occur, particularly where vegetation restoration affects other values both on land and water, such as the natural character of land and adjacent water bodies, ecological, cultural or landscape values, or the protection of indigenous biodiversity. The key focus for this policy is the re-establishment of a protective cover to prevent the onset of soil erosion. A measure of the significance of any adverse effects on values will depend on whether those effects outweigh the benefits of restoration.

Undesirable species of plants will include those:

- (a) that have the potential to invade and displace established areas of vegetation, for example Hieracium;
- (b) that create the risk of wilding invasion into areas of high natural or cultural values or important landscape areas, for example wilding conifers, including pines, Douglas-fir and larch;
- (c) whose introduction to the landscape would adversely affect important natural, cultural or amenity values associated with the landscape. For example, the introduction of trees, or the reversion to scrub, in important "open" tussock grassland landscapes.

Where there are other operative plans, or other legislation governing the management of depleted areas of hill and high country land, any activity under this policy should not be undertaken in a manner that is inconsistent with those plans or statutes.

For example, Regional Pest Management Strategies, prepared under the Biosecurity Act (1993), identify species of plants and animals which may be undesirable in certain circumstances due to their impacts on the productive or biodiversity values. Landholders must comply with any policies and regulations in the strategy for control of identified pest species. Other chapters of this plan have policies and rules relating to the management of vegetation: Chapter 5 Water Quantity controls the planting of trees in catchments where this

may increase the frequency and severity of summer low flows, and Chapter 4 Water quality has rules for the application of fertiliser in the vicinity of water bodies.

Methods

The methods to implement this policy do not include any rules. During the life of the plan the effectiveness and efficiency of this non-regulatory approach will be monitored. Any changes to the present methods, including any need to consider adding rules to the mix of methods, will be based on that monitoring.

The methods used or to be used to implement Policy SCN1 are:

Method SCN1(a) Information and Promotion

Environment Canterbury will work with landholders, resource care groups, Federated Farmers and land management agencies to:

- (a) provide practical information related to:
 - (i) sustainable use opportunities for the hill and high country non-arable land that also recognises any associated risks to the environment;
 - (ii) new technologies for vegetation management on non-arable hill and high country land;
 - (iii) the range of techniques to restore areas of depleted vegetation cover;
 - (iv) the benefits and adverse effects of different restoration techniques, and methods to evaluate any risks attached to those techniques;
 - (v) sources of support (financial or technical) for restoring depleted vegetation; and
 - (vi) sources of information for identifying important natural or cultural values, and requirements for the protection of those values; and
- (b) encourage the use of on-farm vegetation monitoring :
 - (i) to monitor the intactness and resilience of the vegetation cover;
 - (ii) to establish sustainable grazing levels by monitoring any changes to the vegetation cover; and
 - (iii) to identify any areas where vegetation does not meet the thresholds specified in Objective SCN1; and
- (c) promote the development of property plans as a tool to identify:
 - (i) priorities for management of vegetation for areas maintaining an intact and resilient vegetation cover;
 - (ii) priorities for restoration of depleted areas of vegetation, based on the criteria specified in clause (3) of this policy; and
 - (iii) strategies for the management of feral animals; and
- (d) support the development of field days and demonstration sites to communicate information and trial new techniques for vegetation management and restoration.

Method SCN1(b) Investigations

- (a) Environment Canterbury will work with research institutions, landholders and other agencies to:
 - (i) collate the various data sets on soils, vegetation and other relevant factors held by different agencies;
 - (ii) develop tools and techniques for managing vegetation cover to maintain resilience and prevent the onset of erosion;

- (iii) improve understanding of the processes (including management requirements and timeframes) of vegetation restoration in depleted areas; and
 - (iv) investigate the options for revegetation of land where a large proportion of the topsoil has been lost through erosion.
- (b) Areas where further information is required include:
- (i) identification of resilient plant species and communities for different hill and high country environments;
 - (ii) ability of different vegetation types to prevent or withstand erosion;
 - (iii) identification of indicator species for trends in degradation and improvement of vegetation communities;
 - (iv) identification of species likely to pose a threat to vegetation resilience in the different hill and high country environments; and
 - (v) establishing the relationship between bare ground extent and soil loss for the range of hill and high country soils.
- (c) Environment Canterbury will work with Te Rūnanga O Ngāi Tahu to identify how land use activities can affect cultural values and priorities for land and water.

Method SCN1(c) Economic instruments

Where it can be demonstrated that there is a net benefit to the region from the restoration of vegetation cover over degraded areas of land, Environment Canterbury will supply, or assist with the supply of, plant material at low cost to landholders to restore a resilient and intact vegetation cover over areas of depleted vegetation. This assistance will be determined on a case-by-case basis and will be directed to priority areas identified in Policy SCN1(c).

Method SCN1(d) Environment Enhancement Fund

Environment Canterbury has established a contestable Environment Enhancement Fund to assist restoration projects where these projects will benefit the indigenous biodiversity of the area. Where the restoration of depleted vegetation is being managed to enhance indigenous biodiversity, then landholders may be eligible to apply for funding through the Environment Enhancement Fund to assist this work.

Policy SCN2: Soil quality management on non-arable land

- (1) Encourage landholders in the non-arable hill and high country to maintain soil quality by:
- (a) replacing nutrient losses from land use activities with nutrient inputs sufficient to maintain vegetation vigour and biomass, but not resulting in nutrients leaching to ground water or discharging to surface water that would be contrary to Policies WQL4 and WQL9 in Chapter 4: Water quality; and
 - (b) maintaining, and where appropriate enhancing, soil organic matter levels to maintain soil structure, water-holding capacity and soil processes.
- (2) The measures taken to achieve (1)(a) should not result in the loss of regional indigenous biodiversity.

Explanation and principal reasons

To maintain soil quality requires a long-term balance between inputs and outputs. If nutrients are lost faster than they are replaced by natural processes or inputs of fertilisers, the life-supporting capacity and productivity of the soil will decline. This will reduce the resilience and intactness of the vegetation cover and increase the risk of erosion.

This issue is potentially significant whenever nutrient demands from stock or vegetation exceed the natural rates of replenishment. Induced nutrient losses in non-arable systems can occur because of:

- (a) the removal of nutrients in animal products;
- (b) the transfer of nutrients in animal excreta from grazed areas to where stock camp; and
- (c) the loss of nutrients associated with burning or harvesting of vegetation (e.g. forest harvesting).

On soils that are naturally fertile, nutrient losses in pastoral systems at low stocking rates are likely to be replenished by the natural processes of weathering, atmospheric deposition and nitrogen fixation. On low fertility soils, even at low stocking rates, fertiliser inputs may be necessary to balance the nutrient losses²⁹. Farm scale nutrient budget models allow the calculation of total nutrient losses in a pastoral situation and will improve the landholder's ability to balance inputs with outputs. This will minimise the risk of leaching to ground water or runoff to surface water.

While the addition of nutrients may be necessary to maintain plant vigour, care must be taken to maintain those species that can survive in the event of the cessation of fertiliser inputs during times of lower economic return. Some fluctuations in soil nutrient levels can be sustained in a pastoral situation, provided that a resilient vegetation cover can be maintained throughout these fluctuations.

Indigenous vegetation should not be displaced by high fertility-demanding pasture regimes in situations where those inputs are unlikely to be maintained in the long-term. This is because the new species will not have the inherent resilience of the indigenous species they have replaced, and will not be able to maintain a protective ground cover once the fertiliser applications cease. Neither should the addition of nutrient inputs cause the replacement of indigenous vegetation by introduced species where this will lead to a loss of important biodiversity values.

Where it is uneconomic or inappropriate to apply fertiliser, land will need to be managed to maintain soil nutrient levels and plant biomass. Plant biomass (roots, leaves and litter) is a key source of soil organic matter for maintaining soil structure and for soil fauna and microbial populations to process into nutrients in a form available for plant uptake. Land use activities should be managed at a level that generate excess biomass over that removed by grazing, burning or harvesting of forests, to provide ongoing organic matter supplies for the soil.

The use of burning as a land management tool is addressed through the Proposed Land and Vegetation Management Regional Plan, Part IV: Land Management Fires, Canterbury Hill and High Country. Therefore, there are no rules for the management of burning activities in this chapter.

Methods

The methods to implement this policy do not include any rules. During the life of the plan, the effectiveness and efficiency of this non-regulatory approach will be monitored. Any changes to the present methods, including any need to consider adding rules to the mix of methods, will be based on that monitoring.

The methods used or to be used for implementing Policy SCN2 are:

²⁹ Metherell, A.K 1997. *Soil Nutrient Budgets*. Unpublished technical report prepared for the Canterbury Regional Council

Method SCN2(a) Information and promotion

Environment Canterbury will promote the use of:

- (a) nutrient budgets and nutrient budget models to improve the effectiveness of replacing nutrient losses at the farm block level and to minimise the likelihood of nutrient loss into water bodies;
- (b) grazing management techniques such as spelling, retirement or nutrient inputs, that maintain sufficient vegetation to protect the soil and sufficient litter to maintain soil organic matter levels; and
- (c) workshops, field days and demonstration farms as opportunities to explain new techniques and demonstrate practices to maintain soil quality.

Method SCN2(b) Investigations

Environment Canterbury will work with research organisations, landholders, and other agencies involved in hill and high country land management to:

- (a) develop a nutrient budget model, based on the Overseer model for the arable soils, for the undeveloped parts of the hill and high country tussock grasslands that is suitable for use by landholders at a grazing block scale;
- (b) identify those situations where enhancement of soil organic matter is desirable to improve soil quality;
- (c) identify resilient vegetation species and communities that are suited to the range of soil fertility levels found in the undeveloped non-arable hill and high country;
- (d) investigate the links between soil nutrient levels and vegetation condition and trend for the development of suitable indicators of soil quality and vegetation resilience; and
- (e) identify the extent of soil nutrient loss occurring as a result of successive harvesting of forestry plantations in the hill and high country soils, to determine whether there are any long-term sustainability issues for nutrient management under forestry operations.

Policy SCN3: Land Improvement Agreements

Maintain existing Land Improvement Agreements where their terms and conditions continue to assist soil conservation outcomes.

Explanation and principal reasons

This policy applies to both non-arable hill and high country land, and to arable land under Objective SCN2.

Land Improvement Agreements (LIAs) negotiated by the regional council or the former catchment authorities were established under s30 of the Soil Conservation and Rivers Control Act 1941, to formalise the payment of grants or subsidies for works relating to soil conservation or river control on private and leasehold land. The LIAs usually included a covenant by the owner or occupier, binding them and their successors-in-title, to observe the terms and conditions upon which the loan or grant was made.

LIAs addressing soil conservation management were applied to areas of land where past management had resulted in the loss of vegetation cover, reduced soil quality or an increased risk or induced level of soil erosion. Soil conservation measures in LIAs varied according to the issues, and could include permanent destocking or retirement of the land, fencing, grazing restrictions and the establishment of windbreak shelter. An expiry date was attached to all agreements that did not involve the permanent retirement or destocking of the land. Grants or subsidies were provided to compensate the landholder for the loss of production from the land.

Over 1500 LIAs in Canterbury were established for soil conservation reasons. These need to be reviewed to identify those which have already achieved their purpose, and those which no

longer provide a soil conservation function. Those agreements that continue to serve a useful soil conservation function should be maintained and monitored under the terms of their agreement.

The registration of LIAs against the title was encouraged, but not compulsory. Less than fifty percent of the agreements appear to have been registered. Under the process of tenure review, consent is required from the regional council to the future terms of management of land covered by a registered LIA before a tenure review proposal can be accepted. No similar process of consent is required for non-registered LIAs.

Methods

The methods used or to be used for implementing Policy SCN3 are:

Method SCN3(a) Advocacy

Environment Canterbury will advocate to government and land agencies involved in the tenure review process that the terms and conditions of all LIAs that continue to serve a useful soil conservation function are maintained through the terms of the tenure review proposals.

Method SCN3(b) Investigations

Environment Canterbury will identify those LIAs that continue to assist soil conservation outcomes.

Method SCN3(c) Compliance and enforcement

For those LIAs that continue to assist soil conservation outcomes, Environment Canterbury will monitor compliance with the terms and conditions of the agreement and pursue measures to achieve compliance where this is not occurring.

Policy SCN4: Stabilisation of hill country slopes subject to deep-seated erosion

- (1) On loess-mantled hill slopes and soft rock hill country where soils are susceptible to, or show evidence of, deep-seated forms of erosion (see Figure SCN3), encourage the retention or establishment of a deep-rooted vegetation cover that will contribute to long-term stabilisation of the land.
- (2) Landholders will be encouraged to adopt the following practices:
 - (a) maintain existing areas of tree or shrub cover, improving, where appropriate, the effectiveness of that cover for stabilising the land;
 - (b) on slopes where the existing vegetation cover is inadequate to provide slope stability, plant fast growing species at spacings that are effective in rapidly stabilising slopes. This may allow wide-spaced planting in some situations with ongoing grazing, or it may require close-spaced planting;
 - (c) once slopes are stabilised, encourage the replacement of original trees with long-lived species where this is necessary to provide long-term stabilisation. Preference should be given to the use of indigenous species where these will provide effective long-term stability. Where a permanent forest cover is required to stabilise the slopes, encourage natural succession or planting to restore indigenous forest cover; and
 - (d) manage areas planted with trees for harvesting to provide and maintain long-term stabilisation through all stages of production.
- (3) Plantings to achieve (1) and (2) should:
 - (a) avoid the spread of any plant pest species;

- (b) avoid significant adverse effects on any important natural, landscape or amenity values for the area, or the loss of regional indigenous biodiversity;
 - (c) avoid adverse effects on important cultural values for the area including sites of significance to Ngāi Tahu and mahinga kai values; and
 - (d) minimise adverse effects on stream flows, in particular the minimum flow requirements for flow-sensitive catchments identified in Chapter 5 Appendix WQN4.
- (4) Priority areas for stabilisation will include land that is:
- (a) actively eroding; or
 - (b) at a high risk of erosion; or
 - (c) where off-site effects of erosion could result in adverse effects on important natural, cultural or amenity values.
- (5) The target for implementing this policy will be to have 10 percent of the priority areas identified in (4) planted with a stabilising vegetation cover within three years of this plan becoming operative, and to reach 50 percent of priority areas planted within 25 years.
- (6) In flow-sensitive catchments with deep-seated slope stability problems, where afforestation may affect water yield, the preference is to use wide-spaced tree planting where this will achieve effective stabilisation of the slopes. (See Chapter 5 Appendix WQN4 for a list of flow-sensitive catchments.)

Explanation and principal reasons

The slope failure surface on land subject to tunnel gully, gully, slip, slump or earthflow erosion lies well below the soil surface, and only tree roots are strong enough, and penetrate deep enough, to cross the failure surface and bind the soil. Pasture cover will help to reduce the initiation of tunnel gully erosion but cannot provide long-term stabilisation of these slopes. In areas already converted from forest to pasture cover, adding a deep-rooted vegetation component into the system can reduce significantly the incidence and severity of erosion, without necessarily reducing the value of the land for grazing. The species and spacing of tree plantings will be important in determining the effectiveness of the vegetation cover in a pasture regime.

SCN4(2)(a): A priority for long-term stabilisation will be the retention of existing areas of deep-rooted vegetation, and the improvement of their stabilising ability where this is practicable. For areas where there is no deep-rooted cover, a number of options are encouraged through this policy.

SCN4(2)(b): The policy emphasises the need to achieve a stabilising vegetation cover as quickly as possible to minimise the risk of initiating or exacerbating erosion. The onset of erosion may be difficult to remedy or to mitigate - protection against erosion will be much more effective. Once a stabilising cover has been achieved, a range of options can be considered that may contribute to the protection of other values held by the wider community. Once eroded, however, this type of land is unlikely to recover its full productive potential, even in the long-term. Any restoration of a stabilising vegetation cover will be more difficult to achieve.

SCN4(2)(c): For slopes where the risk of erosion from soil disturbance is very high, an undisturbed deep-rooted cover will provide the greatest stabilisation. Encouraging natural succession back to an indigenous forest cover will be promoted in this situation as it will achieve slope stabilisation as well as contributing to the enhancement of indigenous biodiversity values for the area.

SCN4(2)(d): Plantation forestry may be an effective option for stabilising these slopes, provided harvesting is undertaken in such a way that slope stabilisation is not jeopardised, and replanting is achieved within a reasonable time to maintain slope stability. The roots of harvested trees will continue to provide some support to the slopes in the short-term, so replanting should be timed to continue providing that support.

SCN4(3): The introduction of exotic species of trees for stabilisation will have to take into account the desirability of introducing those species into the landscape, and any subsequent risk of the uncontrolled spread of those species. The Regional Pest Management Strategy identifies responsibilities of landholders for control of the planting and spread of pest species of plants. No plantings for slope stabilisation should conflict with these responsibilities. Nor should exotic species be used where they would compromise other important values held by the wider community, such as the protection of indigenous biodiversity, sites of significance to Ngāi Tahu, or important landscape values for the area.

SCN4(3)(c): A conflict may arise in catchments where replacement of short vegetation cover with tall vegetation is likely to increase the frequency, duration and severity of summer low flows. Chapter 5 Water Quantity identifies catchments sensitive to the effects of vegetation change and limits the planting of new areas of tall vegetation in these catchments as a permitted activity. Where a consent is required to plant new areas of forestry, the benefits of tree planting for slope stabilisation and the susceptibility of the area to deep-seated forms of erosion, will be matters for consideration in deciding whether to grant that consent.

SCN4(4): The policy recognises that resources are likely to be limited and need to be directed to those areas where the likelihood of erosion occurring is greatest, and particularly where that erosion is likely to result in adverse effects off-site. This will assist the identification of areas to be planted to achieve each of the targets set in SCN4(5).

SCN4(5): Progress with slope stabilisation has already been made by some landholders, with the support of Environment Canterbury and its predecessors, planting some slopes where erosion has already taken place. Areas with past or present evidence of erosion have been mapped for the region. The identification of areas with a high risk of erosion under pastoral management will need to be undertaken. Establishing priorities for stabilisation will enable resources to be directed to those areas where the risk of erosion is highest. Priority should be given to protection of any existing areas or components of deep-rooted vegetation in these situations, and advocating the retention and extension of those areas.

SCN4(6): Widely, or strategically spaced plantings of trees have been used successfully in some circumstances to achieve slope stability on slopes susceptible to deep-seated forms of erosion. In catchments sensitive to the effects of afforestation on water yield, where a closed canopy cover of tall vegetation will cause reductions in stream flows, and particularly reductions to low flow, alternative planting options should be tried that use widely spaced plantings of trees, or scattered plantings where this is able to achieve the stability required.

Methods

The methods to implement this policy do not include any rules. During the life of the plan the effectiveness and efficiency of this non-regulatory approach will be monitored. Any changes to the present methods, including any need to consider adding rules to the mix of methods, will be based on that monitoring.

The methods to be used to implement Policy SCN4 are:

Method SCN4(a) Information and promotion

Environment Canterbury will work with landholders, resource care groups, Federated Farmers and land management agencies, to develop a targeted programme for the establishment of effective stabilising vegetation cover on all land identified in Policy SCN4. To assist progress towards the target set in the policy, Environment Canterbury will:

- (a) provide information to identify areas that are considered a priority area under the criteria listed in Policy SCN4(4);

- (b) provide information and fact sheets on appropriate species and spacings of tree plantings for slope stabilisation;
- (c) promote the development of property plans as a tool to:
 - (i) identify areas where soils are subject to deep-seated forms of erosion;
 - (ii) set priorities for establishment of a stabilising vegetation cover; and
 - (iii) identify appropriate species and spacings to integrate the requirements for stabilisation with any other identified management issues for vegetation management;
- (d) provide information on assistance available for the protection and enhancement of existing areas of indigenous forest. This will include frequently updated information on the establishment of covenants, applications to Environment Enhancement Fund, and assistance available for fencing and pest control;
- (e) facilitate links between landholders and plant suppliers, such as Trees for Canterbury and Trees for Survival, so that landholders can have a reliable source of plant materials for slope stabilising plantings;
- (f) provide information on funding agencies available to provide financial assistance for the establishment of tree cover; and
- (g) provide information on the identification of important natural or cultural values associated with the loess-mantled and soft rock hill slope areas, and any vegetation management requirements for the protection of those values, particularly any requirements that may conflict with management for slope stabilisation.

Method SCN4(b) Investigations

Environment Canterbury will work with research institutions, landholders, resource care groups, and land management agencies to increase understanding of the long-term stabilisation and management of these soils. Areas for further investigation include:

- (a) identifying the frequency and extent of landslips and rates of recovery over areas of land susceptible to deep-seated forms of erosion;
- (b) identifying which species of deep-rooted trees are most appropriate for establishing on moisture-deficient areas of land; and
- (c) identifying the range of physical and management factors that contribute to an increased risk of deep-seated forms of erosion on loess-mantled and soft rock hill slopes.

Method SCN4(c) Economic instruments

Where it can be demonstrated that there is a net benefit to the region from the planting of trees to stabilise slopes subject to deep-seated forms of erosion, Environment Canterbury will supply, or assist with the supply of, plant material at low cost to landholders. This assistance will be determined on a case-by-case basis and will be directed to priority areas identified in Policy SCN4(4).

Method SCN4(d) Environment Enhancement Fund

Environment Canterbury has established a contestable Environment Enhancement Fund to assist restoration projects where these projects will benefit indigenous biodiversity and enhance the health of the wider ecosystems in the region. Where tree planting for land stabilisation will also benefit indigenous biodiversity values, then landholders will be eligible to apply for assistance.

Policy SCN5: Earthworks and vegetation clearance activities

- (1) Wherever any earthworks or vegetation clearance activity is carried out that increases the risk of soil erosion, the best practicable method for reducing the amount of erosion likely to occur as a result of that activity should be adopted.
- (2) Earthworks and vegetation clearance activities that have the potential, regardless of the method adopted, to result in significant induced soil erosion, or to lead to significant off-site effects, should not be undertaken unless effective measures are in place to:
 - (a) minimise the risk of induced erosion occurring;
 - (b) contain the movement of any sediment transported in runoff generated from the activity site;
 - (c) undertake land rehabilitation necessary to stabilise and revegetate the site; and
 - (d) avoid any significant adverse effects of erosion or sediment deposition on:
 - (i) water bodies, including their aquatic habitat and beds, associated wetlands and their flood-carrying capacity;
 - (ii) areas important for the protection of indigenous biodiversity, including indigenous flora, and the habitats of indigenous fauna;
 - (iii) sites of significance to Ngāi Tahu, including wāhi tapu;
 - (iv) sources of mahinga kai;
 - (v) important landscape features and amenity values for the area; and
 - (vi) property or built assets including network utilities.
- (3) Priority areas for the management of activities in (2) will focus on:
 - (a) all land above 900 metres altitude;
 - (b) all land with a slope greater than 25 degrees; and
 - (c) all soft rock and loess-mantled hill slopes greater than 20 degrees
 (See Figures SCN2.1 and SCN2.2).

Explanation and principal reasons

This policy is an extension of Chapter 7 Policy 2 of the Canterbury Regional Policy Statement and provides some criteria for the identification of land at greatest risk of induced erosion as a result of land disturbance by earthworks or vegetation clearance activities. This will include areas where soils have low inherent stability, and where vegetation recovery is limited after disturbance.

On slopes greater than 25 degrees, soil particles become easily mobilised when disturbed or exposed. Soils on soft rock and loess-mantled hill slopes are inherently weakly structured and at risk of large scale erosion, including slope failure. High altitude lands above 900 metres are subject to harsh climates which limit the establishment or recovery of vegetation cover. The amount and intensity of rainfall will influence the risk of erosion from land disturbance - both high intensity rainfall and long-duration, lower intensity rainfall may increase the risk and severity of erosion processes. The stabilisation and revegetation of exposed sites will be critical for reducing the risk of erosion following these activities.

Failure to contain runoff and any sediment generated from land disturbance may lead to sediment movement into water bodies or onto land further downslope. Sediment in water

bodies may lead to adverse effects on water quality, and on the health of the instream aquatic environment. Sediment movement downslope may affect particular values of the land for indigenous biodiversity, cultural importance, landscape, amenity or recreation. The proximity of these soils to transport and communications facilities, and the adverse effects of erosion or slope instability on the functioning of those facilities, will also be key factors to take into consideration in identifying the risks associated with land disturbance activities.

If soils are treated as a non-renewable resource, in terms of sustaining their potential for present and future generations, then the consequences of inducing erosion will be a long-term loss of the productivity and availability of soils for many generations. The identification of the extent of these areas in the region, the extent of erosion that has occurred to date, and activities carrying a high risk of inducing erosion, will form the basis for investigations into effective methods for management of these areas in the future. This will be a high priority for Environment Canterbury to enable it to implement this policy effectively.

Methods

The methods to implement this policy do not include any rules. During the life of the plan the effectiveness and efficiency of this non-regulatory approach will be monitored. Any changes to the present methods, including any need to consider adding rules to the mix of methods, will be based on that monitoring.

The methods used or to be used to implement Policy SCN5 are:

Method SCN5(a) Information and promotion

Environment Canterbury will promote more sustainable land management practices by:

- (a) providing information on the location of erosion-prone soils in the region; and
- (b) providing information and fact sheets on best practices for tracking, earthworks and vegetation clearance activities that will minimise the risk of erosion, and control off-site effects of erosion or sedimentation.

Method SCN5(b) Investigations

- (a) Environment Canterbury will work with research institutions, landholders and other land management agencies to investigate:
 - (i) the extent of soils in the region at risk of erosion from earthworks and vegetation clearance activities, particularly those priority areas with a moderate to high risk of erosion identified in Policy SCN5(3);
 - (ii) the types of land disturbance activities that pose the greatest risk of erosion;
 - (iii) the most effective methods, including controls, for reducing that risk; and
 - (iv) standards appropriate for carrying out earthworks and vegetation clearance activities on erosion prone land.
- (b) The results of these investigations, including any proposed change to the mix of methods to implement the policy, will be incorporated into the Soil conservation chapter of the Proposed Natural Resources Regional Plan, either by way of a variation on the proposed chapter, or by a plan change to the operative chapter.

Method SCN5(c) Territorial authorities

When administering subdivision consents, territorial authorities shall take the erosion-proneness of soils into account when determining controls for earthworks and vegetation clearance activities.

Objective SCN2: Arable lands

On all arable land:

- (a) maintain the life-supporting capacity and productivity of the soil to meet the needs of both current and future generations by:**
 - (i) maintaining or enhancing long-term soil quality; and**
 - (ii) progressively reducing the loss of topsoil by wind or water erosion to as close as possible to zero. Over the next 25 years, progress towards this objective will be aimed at reducing the average erosion rate for any area of arable soils to less than 0.25 millimetres per year; and**
- (b) prevent, as far as practicable, the movement of soil into water bodies.**

Explanation and principal reasons

It is accepted that arable land will continue to be used for cropping, and that this carries some risk of erosion of the topsoil, particularly where cultivation is undertaken. To sustain these soils in the long-term, however, requires net soil loss at any site to be reduced as close as possible to zero. The objective uses the average erosion rate for any site in setting targets to progress towards the objective, acknowledging that the risk of induced erosion will vary from year to year depending on the severity of the weather conditions. However, it should also be noted that the concern for soil conservation is to minimise the loss of soil from any site, so the objective is that the target should not be exceeded on any area of arable soil. Under the RMA, sustainable management of the soil must consider intergenerational effects, and a long-term goal for maintaining life-supporting capacity should extend out many hundreds of years. In terms of the length of time New Zealand has already been occupied, this is not unreasonable.

Wind erosion events occur widely across the plains. Measurements of erosion losses, using caesium sampling from four intensively cultivated sites, have identified rates of soil loss up to 1mm/year, averaged over 40 years. It is likely that this rate is at the upper limit of erosion losses, however, much of Canterbury's arable soil is shallow (10-30cm topsoil layer), and, therefore, smaller losses will still be significant over the long-term. An extensive sampling programme is required to establish a more accurate picture of the extent and severity of erosion across the arable soils, and to monitor the effectiveness of any changes in land management practices.

Cropping of arable soils also leads to a reduction in soil organic matter levels from lowered inputs of vegetative material and a more rapid breakdown of existing organic matter under cultivation. Poor soil structure, resulting in unstable aggregates, can result when soil is intensively cultivated over several years.

From a soil conservation perspective, short-term fluctuations in soil quality factors in arable soils are not considered significant in themselves. The concern for arable soils is when soil quality factors are degraded over the long-term and the risk of induced erosion is increased. Maintaining soil quality is an important way of reducing the risk of soil erosion.

Clearly, this is a long-term objective, and the progress anticipated over the first 25 years may not be sufficient to sustain these soils in the long-term. The objective recognises that it will take time and education to bring about widespread changes in management. Ongoing progress towards zero net loss must continue beyond the first 25 years. Monitoring of the soil resource over the next 25 years will provide a basis for identifying the rates of erosion and the effectiveness of different management practices in reducing the risk of erosion. The priority will be to concentrate on areas where there is the greatest risk and where the greatest amount of soil loss is occurring.

Soil lost from arable farmland by wind or water erosion may end up deposited in water bodies causing adverse effects on the instream habitat and the flood-carrying capacity.

Policy SCN6: Soil quality management on arable soils

- (1) Encourage landholders to adopt arable farming practices that maintain or enhance those soil quality factors important for minimising the risk of induced erosion by wind or water, in particular:**
 - (a) soil organic matter levels;**
 - (b) aggregate size and stability; and**
 - (c) soil fauna and microbial activity.**
- (2) Over the first 10 years following the plan becoming operative, progress to achieve the targets set in Objective SCN2 will be at least 90 percent of farmers consistently maintaining good soil quality from year to year.**
- (3) Priority for adoption of good management practices will be in those areas of moderate to high erosion risk (see Figure SCN3), or where adverse trends in soil quality factors have been identified.**

Explanation and principal reasons

Cumulative soil loss through induced erosion is not sustainable and will result in a progressive reduction of the life-supporting capacity and versatility of arable soils. Soil quality factors that maintain the structure of arable soils will provide much of the resilience of these soils against the agents of erosion. Soil organic matter improves the stability of soil aggregates and increases the water-holding capacity of the soil. Soil fauna such as earthworms aerate the soil and create greater infiltration capacity for water throughout the topsoil layer. Earthworms and soil micro-organisms are responsible for breaking down organic matter and releasing nutrients for plant growth. Loss of topsoil will remove that portion of the soil with the highest organic matter and soil nutrient content, leaving soils that are more weakly structured, less fertile and more easily eroded by wind or water.

The focus for this policy will be to encourage greater use of recognised good management practices through the provision of information and demonstration of techniques. Particular attention will be given to new farmers to the region who may not have the same understanding of the issues for management, and to areas where the risk of erosion is highest. The three soil quality factors identified in this policy are indicators of the ability of the soil to resist erosion by wind or water. Monitoring changes and trends in these factors will provide a good indication to farmers of the progress they are making towards the targets set, and the effectiveness of their management practices.

Regulation, in the first instance, is not seen as necessary or desirable to increase the uptake of good management practices. The understanding and commitment by farmers to reducing the risk of erosion is important to the success of this policy. Information and education will play a pivotal role in its implementation.

Acceptance of the need to change will be indicated by the level of adoption of good practices. However, if there is not a high level of voluntary adoption of good management practices over the next 10 years, then the council will consider regulation as an option in the future when it reviews the provisions of this plan.

Methods

The methods to implement this policy do not include any rules. During the life of the plan, the effectiveness and efficiency of this non-regulatory approach will be monitored. Any changes to the present methods, including any need to consider adding rules to the mix of methods, will be based on that monitoring.

The methods used, or to be used for implementing Policy SCN6 are:

Method SCN6(a) Information and promotion

To increase the awareness and adoption of effective management practices to maintain and improve soil quality, Environment Canterbury will work with landholders, resource care groups, Federated Farmers and land management agencies to:

- (a) ensure:
 - (i) the right messages are taken to landholders and agencies involved in the industry;
 - (ii) use of the most effective methods of information transfer; and
 - (iii) involvement of those landholders new to the industry or the region through the development of specific initiatives;
- (b) make available information, including Fact Sheets and technical guides, on:
 - (i) areas/locations where arable soils face a moderate to high risk of erosion by wind or water;
 - (ii) wind erosion processes, including information on soil quality factors that influence soil erosion by wind;
 - (iii) soil quality indicators and techniques for monitoring;
 - (iv) techniques for maintaining or enhancing soil quality to reduce the risk of erosion, including incorporating crop residues, stubble management, maintaining surface roughness, rolling, and no-till and minimum tillage techniques;
 - (v) any new areas of technology development; and
 - (vi) the range of benefits of alternative management practices identified in (iv), including soil quality benefits, and productive and economic benefits;
- (c) encourage the use of on-farm monitoring of soil quality indicators to establish trends in soil quality and the effectiveness of farm management practices to maintain soil quality and sustain productivity; and
- (d) promote the development of property plans as a tool to identify:
 - (i) priority areas where the risk of induced soil erosion from wind or water is greatest, and
 - (ii) management strategies to minimise that risk.

Method SCN6(b) Investigations

Environment Canterbury will work with landholders, arable research organisations and land management agencies to identify:

- (a) the influence of a range of land use practices on soil organic matter levels, aggregate size and stability and soil organism activity;
- (b) the rate of soil aggregate reformation following cultivation, for the range of arable soil types, and the influence of land management practices on soil aggregate reformation; and
- (c) the relationship between climatic triggers, such as timing and severity of nor'west winds, rainfall frequency and severity, and erosion events.

Policy SCN7: Wind erosion risk

In areas of arable land with a moderate to high risk of wind erosion (as indicated in Figure SCN3), encourage landholders to adopt arable farming practices that minimise the risk of inducing soil erosion and that achieve progress towards the target set for reduced erosion levels in Objective SCN2. In particular, the following will be promoted:

- (a) where cultivation is undertaken, effective measures should be in place to avoid the creation of small aggregates and to minimise the length of time that soils are exposed;
- (b) reduced tillage and no-till techniques for crop establishment should be used where practicable;
- (c) existing windbreak shelter, particularly on non-irrigated soils, should be retained unless it is to be replaced with other, equally effective erosion prevention measures;
- (d) the use of drought-resistant pasture species together with fodder banks and windbreak shelter on non-irrigated soils to maintain an intact vegetation cover and prevent desiccation of soils during times of low rainfall; and
- (e) when drought conditions are developing, encourage early destocking or other management practices to ensure that sufficient vegetation cover is retained to prevent induced erosion.

Explanation and principal reasons

Wind erosion is a significant risk for arable farming on the Canterbury Plains. The use of cultivation for the preparation of fine seed beds creates a significant risk of erosion of exposed soils by strong winds. Strong nor'west winds can occur at any time of the year, although their incidence is high in spring when most cultivation is carried out. While it is recognised that some soils will continue to be cultivated for cropping, Policy SCN7 identifies and promotes measures that can be undertaken to reduce the risk of induced erosion before a vegetation cover can be established, including maximising aggregate size and surface roughness of the seedbed, or rolling, or maintaining soil moisture levels. While it is acknowledged that no one regime can be applied to all situations, this policy promotes the use of no-tillage and minimum tillage practices wherever this is practicable to provide the highest protection for soils from erosion. The priority for this approach will be those parts of the region most susceptible to high winds, shown as areas of moderate and high erosion risk in Figure SCN3.

Soil moisture is an important factor in reducing the risk of soil loss in strong winds. On non-irrigated land, the use of windbreak shelter will help to protect soils from wind erosion and moisture loss, and provide greater protection for the establishment or regrowth of vegetation cover. Shelter takes many years to establish and should be maintained, even on currently irrigated land, unless other, equally effective, mitigating measures are in place. The incorporation of tree planting into the farming system, including planting for production or amenity purposes, can also contribute to the protection of soils from strong winds. Irrigation, while able to maintain a baseline soil moisture level, may still not be effective in preventing the loss of fine soil particles during periods of strong winds. Neither of these practices is a substitute for good soil quality management, particularly the maintenance of aggregate size and stability.

The use of fodder banks, drought-resistant pasture species and early destocking practices will increase the likelihood of maintaining an intact and resilient vegetation cover over non-irrigated pastures. In drought conditions, the regrowth of vegetation following overgrazing may be slow so soils with depleted vegetation cover will be at risk of erosion for increased lengths of time. Trampling of exposed soils by stock will rapidly break down the aggregates into a fine tilth that is vulnerable to erosion by wind or water.

A survey of arable farmers carried out by the Canterbury Regional Council in 1989³⁰ identified that 50 percent of farmers had experienced some wind erosion event on their farms. The survey also showed that the majority of these farmers were still using conventional cultivation techniques. A second survey in 2002/03 showed an increased awareness of the risk of erosion, and this was reflected in an increasing level of adoption of practices to maintain soil quality and minimise the risk of erosion. However, erosion is still occurring each year and there is a need to increase the adoption of effective practices by all arable farmers to meet the targets set in Objective SCN2. The use of demonstration farms to provide working illustrations of a range of effective practices will be a key means to encourage their adoption, particularly for new farmers to the region.

Methods

The methods to implement this policy do not include any rules. During the life of the plan, the effectiveness and efficiency of this non-regulatory approach will be monitored. Any changes to the present methods, including any need to consider adding rules to the mix of methods, will be based on that monitoring.

The methods used, or to be used, for the implementation of Policy SCN7 are:

Method SCN7(a) Information and promotion

Environment Canterbury will work with landholders, resource care groups, Federated Farmers, and agencies involved in arable research and land management:

- (a) to ensure:
 - (i) the right messages are taken to landholders and agencies involved in the industry;
 - (ii) use of the most effective methods of information transfer;
 - (iii) involvement of those landholders new to the industry or the region through the development of specific initiatives; and
- (b) to make available information, including Fact Sheets and technical guides on:
 - (i) areas/locations where arable soils face the greatest risk of erosion by wind or water;
 - (ii) techniques for reducing erosion risk, including incorporating crop residues, stubble management, maintaining surface roughness, rolling, and no-till and minimum tillage techniques; and
- (c) to encourage the adoption of effective management practices to reduce the risk of wind erosion on arable soils by:
 - (i) promoting the use of no-tillage as a way of safely establishing crops and pasture in areas of moderate to high wind erosion risk while minimising the potential for erosion;
 - (ii) promoting the retention and establishment of shelter in non-irrigated areas with a moderate to high risk of wind erosion;
 - (iii) encouraging the installation of irrigation systems that can achieve at least 80 percent application efficiency while co-existing with existing windbreak shelter plantings. This will be most appropriate in areas of moderate to high wind erosion risk;

³⁰ McGuigan, F.J., Wethey, D.C., Maw R.K., and Hutchinson G.K.1993. *Wind Erosion on the Canterbury Plains*. Canterbury Regional Council unpublished technical report 93(4)

- (iv) promoting the use of fodder banks and drought-resistant pasture species by dryland farmers in drought-prone areas; and
- (v) supporting the use of field days and focus farms to demonstrate the effectiveness of different farming practices to reduce the risk of wind erosion.

Method SCN7(b) Investigations

Environment Canterbury will work with landholders, arable research institutions, and land management agencies:

- (a) to investigate:
 - (i) factors of seedbed preparation that increase, or decrease the risk of wind erosion, and techniques to monitor these factors;
 - (ii) the relative effectiveness of different management practices on reducing the risk of soil erosion under the local conditions prevailing in Canterbury;
 - (iii) the relationship between soil loss and soil renewal rates for arable soils in Canterbury;
 - (iv) the design of efficient irrigation systems that can be operated in conjunction with windbreak shelter to improve the efficiency of water use as well as reduce the risk of erosion.; and
- (b) to identify the extent and severity of erosion of arable soils by undertaking further sampling for caesium analysis across the range of arable soils in Canterbury.

Issue SCN2: Widespread soil contamination

The widespread contamination of soils by substances that are persistent, immobile and toxic and have the potential to cause long-term adverse effects on:

- (a) **soil quality factors, soil processes and the life-supporting capacity of the soil;**
- (b) **the versatility of the soil for productive uses; and**
- (c) **cultural values of the land including its mauri and versatility to produce mahinga kai.**

Objective SCN3: Contaminant accumulation

The widespread accumulation of any potentially contaminating substance that is persistent, immobile and toxic in the soil does not reach concentrations likely to:

- (a) **reduce the life-supporting capacity of the soil, including the health and functioning of soil ecosystems;**
- (b) **reduce the productivity and versatility of soils for future uses; or**
- (c) **impact on important cultural values associated with the land, including its mauri, sites of significance to Ngāi Tahu, and mahinga kai values.**

Explanation and principal reasons

The nature of persistent contaminants is that they can be difficult or impossible to remove once they have accumulated. Widespread contamination of soils affects the availability and quality of these soils at the regional level.

Land use practices that lead to accumulation of persistent contaminants in the soil will ultimately threaten the long-term life-supporting capacity and versatility of those soils. This

may take many decades or even centuries to reach significant levels, but it is an irreversible process.

The reason for this objective is to avoid creating any contamination problems that cannot be remedied.

Policy SCN8: Cadmium accumulation

Encourage manufacturers and users of phosphatic fertilisers to minimise the accumulation of cadmium in soils.

Explanation and principal reasons

Under Chapter 7 of the CRPS, Policy 7, activities that have the potential to result in the contamination of land should not be established or continued unless their adverse effects can be avoided. Contaminants such as cadmium that affect the growth or functioning of soil micro-organisms, have the potential to cause significant adverse effects on the quality of soils if they accumulate to toxic levels.

Cadmium does not break down in the soil, nor are there currently any effective ways of removing cadmium from the soil once it has accumulated. The only way to prevent adverse effects of cadmium accumulation on soil health is to limit the input of cadmium to the soil.

Cadmium accumulation is also known to have adverse effects on the health of humans, plants, animals and soil ecosystems, but the threshold for causing these effects is widely disputed. Further investigations will be undertaken to identify the cadmium concentration level likely to cause adverse effects to soil ecosystems in arable soils in Canterbury. It is accepted that phosphate fertilisers are important for maintaining soil fertility in arable soils and will continue to be used for intensive agriculture activities, however, the continued accumulation of cadmium in the soil over time will risk reaching levels critical to soil health and versatility. Those involved in the production or use of phosphate fertilisers should strive to minimise the amount of cadmium accumulating in the soil.

The fertiliser industry's voluntary agreement to supply superphosphate fertiliser with a cadmium content not exceeding 280mg Cd/kgP is a good step towards reducing the rate of accumulation of cadmium in the soil. The inclusion of cadmium into the fertiliser quality assurance programme "Fertmark" now requires that member companies comply with this threshold for all phosphate fertilisers. Opportunities to reduce this concentration still further will be investigated. The use of low cadmium phosphate fertilisers, and more efficient use of fertiliser inputs, will also contribute to reducing the rate of cadmium application and accumulation in these soils.

Methods

The methods to implement this policy do not include any rules. During the life of the plan the effectiveness and efficiency of this non-regulatory approach will be monitored. Any changes to the present methods, including any need to consider adding rules to the mix of methods, will be based on that monitoring.

The methods used or to be used to implement Policy SCN8 are:

Method SCN8(a) Advocacy

Environment Canterbury will:

- (a) advocate to the fertiliser industry for the development of a code of practice for minimising the accumulation of cadmium in the soil as a result of fertiliser use; and
- (b) advocate to fertiliser manufacturers for the clear labelling of cadmium concentrations on all phosphate fertiliser products, including compliance with the "Fertmark" standard where this is achieved.

Method SCN8(b) Information and promotion

Environment Canterbury will work with landholders, resource care groups, Federated Farmers and land management agencies to minimise the accumulation of cadmium in the soil by using opportunities to:

- (a) increase farmer awareness of the risks of cadmium contamination;
- (b) provide information on the level and extent of cadmium contamination, including trends in cadmium accumulation; and
- (c) encourage the efficient use of phosphate fertiliser through the use of nutrient budgets.

(Refer to methods under Policies WQL4 and WQL9 in Chapter 4: Water quality dealing with the use of fertilisers and the management of their effects on water quality.)

Method SCN8(c) Investigations

Environment Canterbury will work with research institutions, landholders and the fertiliser industry to investigate:

- (a) the extent and severity of cadmium accumulation in Canterbury;
- (b) the effects of cadmium on soil ecosystem functioning and the thresholds for significant adverse effects for soil ecosystems in Canterbury;
- (c) the setting of targets/thresholds for cadmium levels in phosphate fertilisers and in the soil that will not result in the long-term reduction of the life-supporting capacity of the soil;
- (d) opportunities and costs for further reductions in cadmium concentrations in phosphate fertilisers; and
- (e) techniques for the removal of cadmium from the soil.

Policy SCN9: Avoid future contamination

Any future land use that has the potential to result in the widespread and persistent contamination of soils should not be established or continued unless effective measures have been taken to avoid significant adverse effects on the soil environment.

Explanation and principal reasons

To prevent further incidences of land contamination and to maintain the versatility of the soil. There are a number of agencies, in addition to Environment Canterbury, that have a role in the monitoring and screening of new substances introduced for land management purposes. The Environmental Risk Management Agency (ERMA) has the responsibility for implementing the Hazardous Agricultural Substances and Noxious Organisms (HASNO) Act 2000 which screens all new introductions of plants, animals and chemical substances for agricultural purposes. The Foundation for Arable Research (FAR) is funded by arable farmers to investigate aspects of arable farming systems, and has worked on the removal of cadmium from phosphate fertilisers. This policy identifies the need to integrate the work of a range of agencies to ensure that new substances introduced for land management purposes are not used in situations that could lead to widespread contamination of the soil.

Methods

The methods to implement this policy do not include any rules. During the life of the plan, the effectiveness and efficiency of this non-regulatory approach will be monitored. Any changes to the present methods, including any need to consider adding rules to the mix of methods, will be based on that monitoring.

The methods used or to be used to implement Policy SCN9 are:

Method SCN9(a) Information and promotion

Environment Canterbury will work with landholders, manufacturers, management authorities and agencies for research and land management to reduce the risk of further land contamination by:

- (a) providing information on any new substances that have the potential to cause long-term and widespread soil contamination;
- (b) ensuring that new substances are adequately screened for their potential effects on soil quality and soil processes; and
- (c) increasing the awareness of the dangers of using substances that are persistent and toxic to the soil.

Method SCN9(b) Investigations

Environment Canterbury will support the investigation of new or existing soil contaminants that are likely to be applied on a widespread basis to soils in Canterbury. Some examples of contaminants that could be investigated include: copper from horticultural sprays; and fluorine from phosphatic fertilisers. Investigations will identify the nature of the effects of each contaminant, and the extent of its application to soils in Canterbury.