13 Land and Soils

13.1 Land and Soil: Main Points

Pressures

- Historically, land use change has had the greatest effect on soil health and erosion. This is largely related to catchments being cleared of their original vegetation, and subsequently converted into pasture.
- Unsuitable land management practices can place significant pressures on soil health. Stock overgrazing and increased stocking densities on farms increases the potential for soil compaction, pugging and erosion.
- Exotic forestry now occupies approximately 10 % of the region, and has positive effects on soil erosion and subsequent water quality when the trees are growing and fully established. However, soils can be adversely affected during harvesting and planting.

State

- Information on soil types, geology, slope and drainage have been used for classifying land in the Northland region. The New Zealand Land Resources Inventory (NZLRI) assesses capability based on eight land use capability classes.
- The most widespread form of erosion on pastoral land in Northland is gully erosion. Sheet erosion is also common throughout the region.

Response

- The Revised Proposed Soil and Water Plan for Northland contains rules relating to land disturbance and vegetation clearance.
- The Council also promotes sustainable land management through environmental education, field days, and by supporting industry Codes of Practice.
- A sustainable land use monitoring programme has been proposed, and work has already started on the '500 soils' project to assess soil health and on updating aerial photos of the region to assess land use change.
- District Councils are largely responsible for land use. District Plans contain rules controlling land use, such as those for subdivisions.

13.2 Northland's Land and Soil Resources

The Northland region consists of a wide variety of landforms, soil types and associated land uses. Landforms range from young active sand dunes along the coasts to relatively old greywacke, and volcanic peaks and hills in inland areas. A notable feature of the region is that it has few high mountain ranges with no part being more than 800 metres above sea level. There are few areas of flat, low lying land, the most notable lowland areas being adjacent to the Awanui and Northern Wairoa Rivers.

The low relief, absence of any ash deposits from recent ash showers, warm moist climate and the original vegetation have combined to cover much of Northland in strongly leached, mature, heavy clays. Generally, topsoils are thin and subsoils are of low fertility. The main exceptions are the fertile volcanic soils, young alluvial deposits and the young soils developing on unstable steep slopes.

The cover of the original indigenous forest has strongly influenced soil properties. Trees with acid litter, such as kauri, totara, rimu and kahikatea, have produced strongly leached soils, with the kauri producing the well-known gumland soils. By contrast, the broadleaf trees, including puriri, kohekohe, taraire and tawa, have returned the nutrients to the soil through rapid decomposition of dead leaves and branches to give fertile top soils.

13.3 Regional Policy Statement Objectives

The Regional Policy Statement objectives are:

- **The maintenance, and where possible, enhancement of the life-supporting capacity of soils, especially those which have potential to support intensive primary production.**

- **The protection of the soil resources, including soil quality and soil quantity, from degradation or loss as a result of unsustainable land uses and land use practices.**

- **The safeguarding of the life-supporting capacity of water and ecosystems from the adverse effects of unsustainable land uses and land use practices.**

- **The avoidance, remedying or mitigation of the adverse effects of plant and animal pests on the use of land, including its potential for primary production and natural ecosystems.**

13.4 Issues

Inappropriate landuse activities may adversely affect soils in many ways. Issues of prime concern in Northland include:

1. Erosion in high risk areas.

2. Soil health.

3. Availability of highly productive soils for primary production.

4. Significant indigenous flora and fauna.

13.5 Pressures Affecting Land and Soil Resources

13.5.1 Land Use

Historically, the greatest pressure on land has come as people have attempted to adapt it for their own purposes. The greatest impacts have come from clearing land to create farmland, largely pasture for sheep and cattle. Land has also been cleared for horticulture, urban development and the expansion of transport links.

The main impacts have been associated with the clearance of large areas of indigenous forests, but other environments (such as dune areas) have also been affected. Rivers have been straightened and wetlands drained for flood control purposes. The effects have been significant.

Today, pastoral agriculture accounts for over half (53%) of land use in the Northland region. Indigenous forest, mangroves and wetlands are the next dominant (23%) land use. Exotic (planted) forest is also significant (10%). Table 24 summarises the principal land use features of the region.

Table 24: Regional Land Use

Land Use	Area (ha)	Percent of Region
Pastoral Agriculture	670 900	53.2%
Indigenous forest, mangrove and wetlands	423 200	23.2%
Planted Forest	130 700	10.4%
Shrubland	129 800	10.3%
Other (lakes, rivers, coastal dunes, bare rock, mines and quarries)	26 700	2.1%
Urban (developed and open space)	5 600	0.4%
Horticulture	4 900	0.4%
Total	**1 262 000**	**100%**

Source: Landcover Database (1996) Ministry of Agriculture and Forestry

Unsuitable land management practices can place significant pressures on soil health. Stock overgrazing and increased stocking densities on farms increases the potential for soil compaction, pugging and erosion. Stock treading on wet soils reduces the amount of water and air movement in soils, and root penetration becomes more difficult. Consequently, pasture density, rigour, and growth are reduced (Shepherd *et al*. 2000).

Loss of soil quality (soil degradation) can affect the environmental sustainability of the soil, and the economic sustainability of the farming business.

Exotic forestry has positive effects on soil erosion and subsequent water quality when the trees are growing and fully established. However, during harvesting short periods of increased erosion occur due to the loss of vegetative cover. In the long term however, the positive effects of exotic forestry on soil conservation outweigh the negative effects of short-term erosion during harvesting.

The region has a well developed horticultural industry, centred mainly around the growing of avocados, citrus, kiwifruit, kumara, squash and flowers. Around 2,300 ha

are currently planted in fruit crops and 3,500 ha in market gardens. Most fruit crops, particularly citrus and kiwifruit are grown in the Bay of Islands and Whangarei areas. If not managed correctly, cropping can result in soil loss and degradation.

Mining of non-metallic minerals is a significant contributor to the regional economy. High quality ceramic clay operations are based at Matauri Bay and silica sand is taken from the Parengarenga Harbour. Limestone is recovered for agricultural purposes and cement manufacturing. The Portland quarry and associated cement works south of Whangarei is the largest in the country.

13.5.2 Land Use Consents

Numbers of land use consents issued can give an indication of the main types of pressures on soil conservation and quality.

Figure 45 shows an slight upward trend in the number of resource consents valid between 1999 and 2001 that have the potential to affect soil quality. Over that time, the main increase has been in the numbers of consents issued for vegetation clearance.

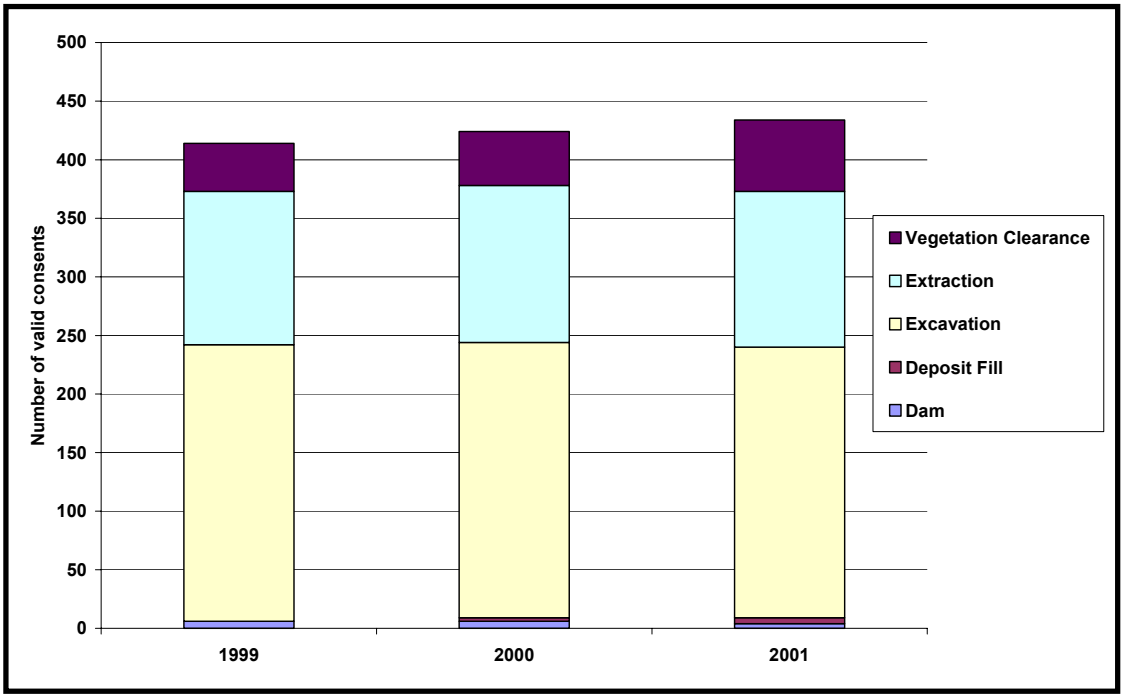


Figure 45: Trends in valid land use consents

Land use consents for these activities are required as they have the potential to cause:

- An increase in erosion and damage to soil structure.
- Significant degradation of water quality and/or increased flood risk by increasing the volume of sediment and nutrients entering the waterways and the amount of debris in streams.

Consents issued by the Council specify conditions designed to reduce adverse effects such as soil entering waterways. Careful design, location, construction, and

maintenance are important in order to avoid major sediment inputs to streams through earthslips or runoff.

13.6 State of Northland Land and Soil Resources

13.6.1 Soil Quality

Indicators of soil quality are required to assess human and natural impacts on soils and to identify sustainable land management practices. For a soil to be rated a good quality, the soil condition must be well matched to its land use. Recognising this, soil conditions suitable for one use (eg. low intensity grazing), may not be suitable for another land use (eg. high intensity dairy farming).

Currently, there is little information on soil quality in the Northland region. To address this information need the Council has entered into the national "500 soils" project. The 500 soils programme will provide the baseline monitoring programme to assess changes in soil quality over time to assist in determining whether the region's soils are being managed sustainably.

Twenty-five sites were assessed for their soil quality by comparing the current chemical and physical condition of the soils against target values for that soil order and land use, and by identifying outlier values (Sparling *et al.* 2001).

Results show that:

- The soil quality for the majority of sites was suitable for that soil type and land use. The greatest risk to soil quality occurred on a sandy loam used for cropping where there was a marked loss of organic matter and soil structural decline. This is a commonly observed trend on other soil types and results from increased mineralisation due to tillage, and decreased organic returns to the soil. Suitable management can reverse this loss of soil quality, and the risk is an on-farm one, rather than an environmental one. However this risk will inevitably increase if the area of high intensity cropping increases.

- A separate trend noted in Northland and other regions is the degree of soil compaction under dairy farming. The incidence in Northland (one dairy farm of the 9 sampled) was much less than in other regions, and at present the trend is not of concern. In general, soil compaction is an on-farm issue, as it can result in lowered production. However, if compaction under dairying became widespread, it could alter the drainage characteristics of catchments, and have potential effects of water levels and quality.

- In contrast to other regions, no excessively high fertiliser levels were recorded. Soil pH under those sites used for pine forests were similar to equivalent sites under indigenous forest, with no evidence of excessive acidification by plantation trees.

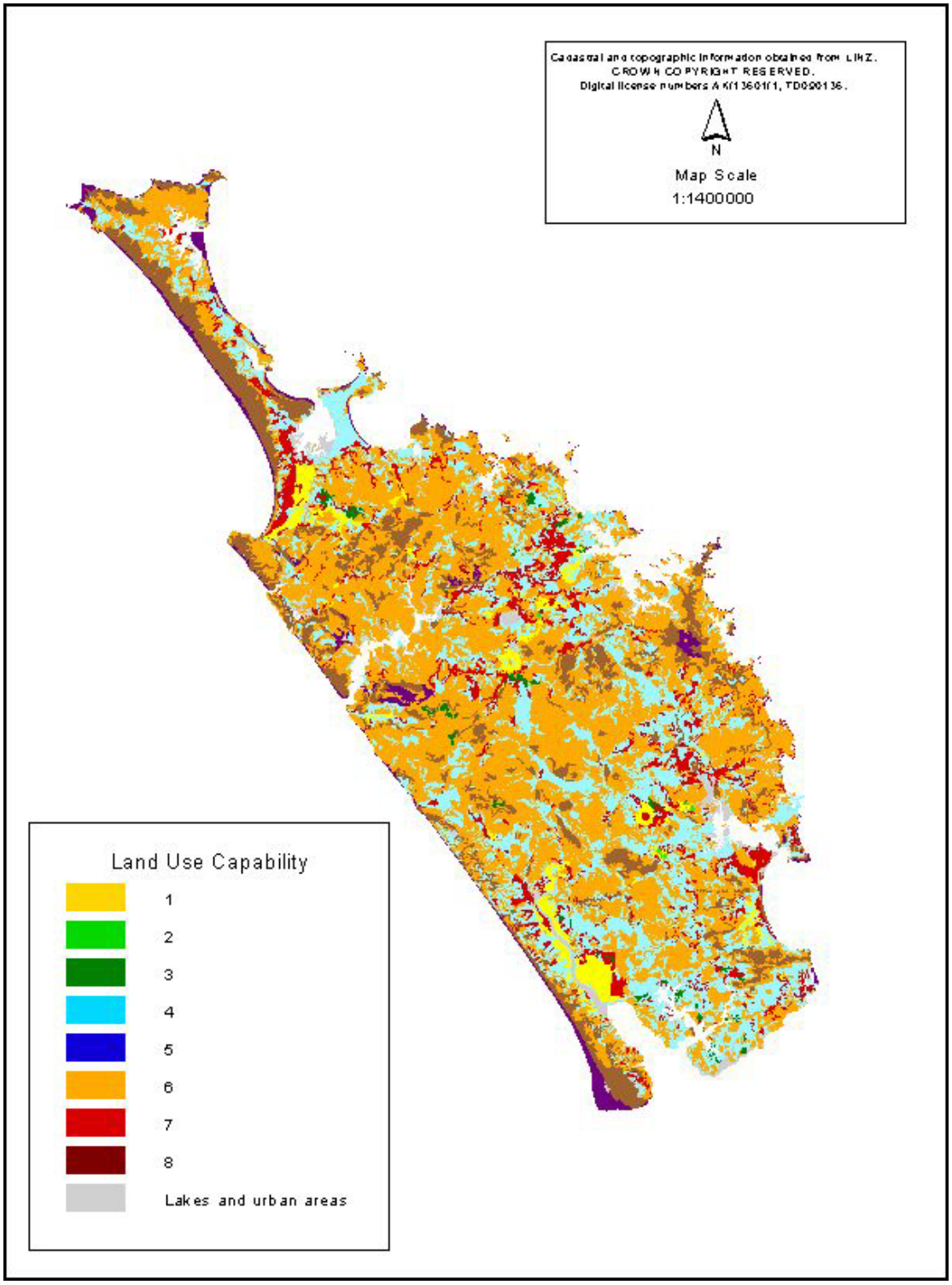
13.6.2 Land Use Capability

Information on soil types, geology, slope and drainage have been used for classifying land in the Northland region. The New Zealand Land Resources Inventory (NZLRI) assesses capability based on eight land use capability classes.

Class I land is considered the most productive in terms of conventional agriculture, horticulture and forestry, while Class VIII land has such limitations that it is considered unsuitable for productive use. The NZLRI shows that the region has only 400 hectares of Class I land and 36,000 hectares of Class II land, which together make up about 3% of the total land area. Most of this highly productive land is of a volcanic or alluvial nature and located in the Kerikeri, Whangarei and Dargaville areas. Almost half of the land in the region is identified as Class VI, a significant proportion of which has a moderate to severe erosion potential. Table 25 summarises the land use capability classes identified in the region.

Table 25: Northland's Land Resource

Land Use Capability	Land Area % ha	Productivity Limitations	Soil Types	Land Use Activities	Locations
I	0.03 3,800	Nil	Volcanic or loam	All types	Maunu
II	2.86 36,060	Soil Moisture	Recent volcanic/peat/ alluvial	Horticulture/ cropping	Kerikeri, Glenbervie/ Ruawai
III	7.19 90,670	Soil moisture/ Rocks drainage/ flooding	Alluvial/ volcanic	Pastoral farming/ horticulture/ cropping	Kerikeri/ river margins Hikurangi Swamp
IV	23.85 300,750	Drainage/ erosion	Sedimentary/ alluvial/ volcanic	Dairying/ sheep, beef forestry	Throughout Northland
V	0.66 8,320	Steep/dry	Limestone/ volcanic	Sheep/beef	Small scattered areas throughout Northland
VI	48.57 612,470	Erosion/ steep/ flooding	Sedimentary /old volcanic/ greywacke	Sheep/beef/ forestry	Hill country Northland, Waiotira
VII	12.14 153,080	Erosion/ steep	Greywacke/ sedimentary	Sheep/ forestry/ land/ retirement	East Coast hill country eg. Mt Tiger
VIII	2.52 31,780	Erosion/ steep	Greywacke/ Old volcanics/ sand dunes	Total retirement from productive use	Cliffs, mudflats and sand dunes throughout Northland
Other (Lakes, Urban, etc)	2.18 27,500				
Total	**100 1,262,000**				



Map 21: Northland land use capability classes

13.6.3 Erosion

The most widespread form of erosion on pastoral land in Northland is gully erosion. The type and seriousness of gully erosion differs from soil type to soil type. The easy, rolling hillcountry derived from shale is particularly prone to gullying. Large amphitheatre-shaped gullies, some 20 metres or more deep, can be found in the Otaika, Pipiwai, Ngawha, and Horeke districts and at scattered localities throughout Northland.

Gully erosion near Otaika

Deep gullies can also develop on the consolidated sands of the Dargaville-West Coast area. Gullies have been recorded over 10 metres deep in these areas, eroding back at a rate of 20 metres during each rainfall event.

Tunnel gully erosion is a particular problem on soils of a certain age derived from sandstone, particularly Waiotira soils. These soils occur on rolling to strongly rolling hillcountry throughout the region and are capable of intensive pastoral farming or production forestry. Willow, poplar, and flame tree poles are commonly planted in tunnel gullies to control erosion.

Sheet erosion has also been recorded throughout the Northland region.

13.7 Response to Land and Soil Issues

13.7.1 Northland Regional Council

Historical Responses

Historically, soil conservation surveys undertaken by the Northland Regional Council's predecessors identified erosion-prone land (mostly steep and unstable hillcountry) that was recommended to be planted in production exotic forest. These recommendations were generally made to minimise erosion and reduce the amount of sediment entering waterways.

Included in this land recommended for afforestation were the watershed protection areas of the upper catchments of the Waipu River (the Brynderwyn Range), Waiotu River, Kaikou River, Mangakahia River, Tangowahine Stream, Awakino River and the Kaihu River. Much of this land was put into exotic forest during the 1970s.

Policies and Plans

The **Revised Proposed Soil and Water Plan for Northland** contains rules relating to land disturbance and vegetation clearance. The Council has targeted most control on those areas at greatest risk; steep land with high erosion potential, and the area adjacent to water bodies which has been defined as the "riparian management zone".

The Council also promotes sustainable land management through environmental education, field days and by supporting industry Codes of Practice.

Monitoring

A **sustainable land use monitoring programme** has been proposed (Beanland, 1999), work has already started on the '500 soils' project to assess soil health and aerial photos of the region are being updated to assess land use change.

Currently, digital aerial photos are being obtained for the whole of the region. This is a joint project between the Regional and District Councils of the region. Other monitoring includes inspections to determine compliance with resource consents and the investigation of environmental incidents.

13.7.2 Other Responses

District Councils are largely responsible for land use. **District Plans** contain rules controlling land use, such as those for subdivisions.

Northland Regional Council supports several landcare groups. These are involved in a variety of land care activities, some of which are related to soil loss and erosion and streamside management areas. To find out more follow this link http://www.nrc.govt.nz/land/care_groups.shtml.

The Kaipara District roadside planting scheme has involved both Regional and District Councils, in combination with consultants (see **Case Study: Kaipara District Council roadside stabilisation planting**).

13.8 Case Study: Kaipara District Council Roadside Stabilisation Planting

Background

The Kaipara district has an extensive roading network of largely metalled roads, in many cases constructed on unstable sedimentary soils.

In 1998 the Kaipara District Council and their roading contractor Duffill Watts and King approached the Northland Regional Council for advice and information on controlling erosion alongside roads to provide long-term stabilisation.

After several site visits with staff from both organisations and Northland Regional Council Land Management Officers, Duffill Watts and King proceeded in 1998 to plant two unstable sites on Pukehuia Road, which runs from Arapohue to Tangiteroria.

Subsequently Duffill Watts and King requested that the Northland Regional Council carry out total management of any future stability plantings. As this takes up considerable staff time and resources, work is undertaken on a consultancy basis.

Why Use Trees?

Tree planting is not a quick fix for erosion control next to roads, but can be effective where the road is on top of a moving chunk of land. The land may be inherently unstable or accelerated by heavy rainfall, poor watertables, culvert design or unwise spoil dumping. Even trees planted closely together may take five years to make a significant difference, but over the life of the trees (30+ years) they have the ability to bind soil together and intercept underground water with their roots, slowing and stopping many slips.

Most of the land needing to be planted is grazed farmland, and poplar and willow poles with plastic protectors have been used extensively. The majority of the trees are poplars, as they have an excellent root system, are hardy and grow well in Northland, are easy to manage and have a timber value. Several more severe areas have been retired from grazing and intensively planted in alders, blackwood, poplars or a combination of these three species.

Programme Details

Land Management staff photograph sites, draw up a site plan with the landowner, organise trees and planting contractors and check plantings. There is no cost to the landowner for any of the work, although an agreement on each site to protect the trees is signed, with the Kaipara District Council taking responsibility for the maintenance of the trees and the landowner agreeing not to endanger any without consultation. If the trees are felled for timber when mature, any profits after replanting will be split evenly.

What has been achieved?

During the 1999 and 2000 seasons 72 sites were planted with more than 7000 poplar and willow poles or stakes and 1700 seedling erosion control trees. These trees

have generally had excellent survival and growth rates, mainly due to the consistent rainfall over the last two years.
The landowners have been very co-operative. Many are past clients of soil conservation schemes and have previous experience of planting trees for erosion control.

In the Future

The stabilisation trees have been planted close together initially to allow for loss from stock or drought, and to get good root coverage in the ground early. The trees will need pruning and thinning in the future to ensure their health and to prevent shading out of adjacent pasture. In some areas powerlines are a problem and trees in those areas will need to be coppiced (cut down above two metres in height) when near the lines and allowed to regrow. This will limit their height while keeping a good root mass in the ground.

A future timber crop from some sites may be possible, and while the trees will be maintained with this in mind, the primary intention is for erosion control and when the trees are removed the area will be replanted.

Roadside plantings within the Kaipara District