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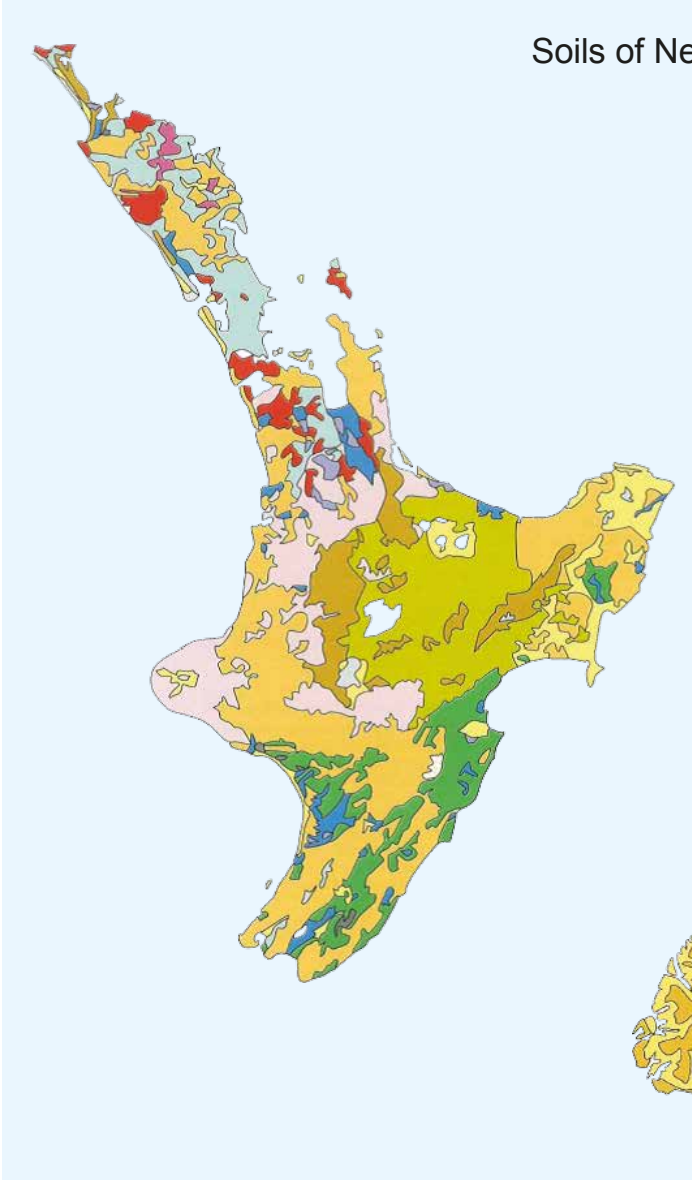
Planted forest soils

New Zealand planted forests environmental facts.

Planted forest soils provide many benefits including growing timber and fibre, cleaning water through filtering, and regulating flooding by storing water.

New Zealand has a wide diversity of soil types. They are generally young and naturally acidic with low levels of nitrogen, phosphorus, and sulphur. Planted forests are typically on low fertility or steep terrain land that is not suitable for agriculture.

Best management practices and ongoing improvements are needed for planted forest soils to continue to provide multiple benefits to New Zealanders. This includes maintaining fertility in a low nutrient input production system, especially as many of New Zealand's planted forest soils are now supporting their third rotation There are also challenges in reducing soil loss through erosion in steep, erodible country, particularly during harvesting.



Soil

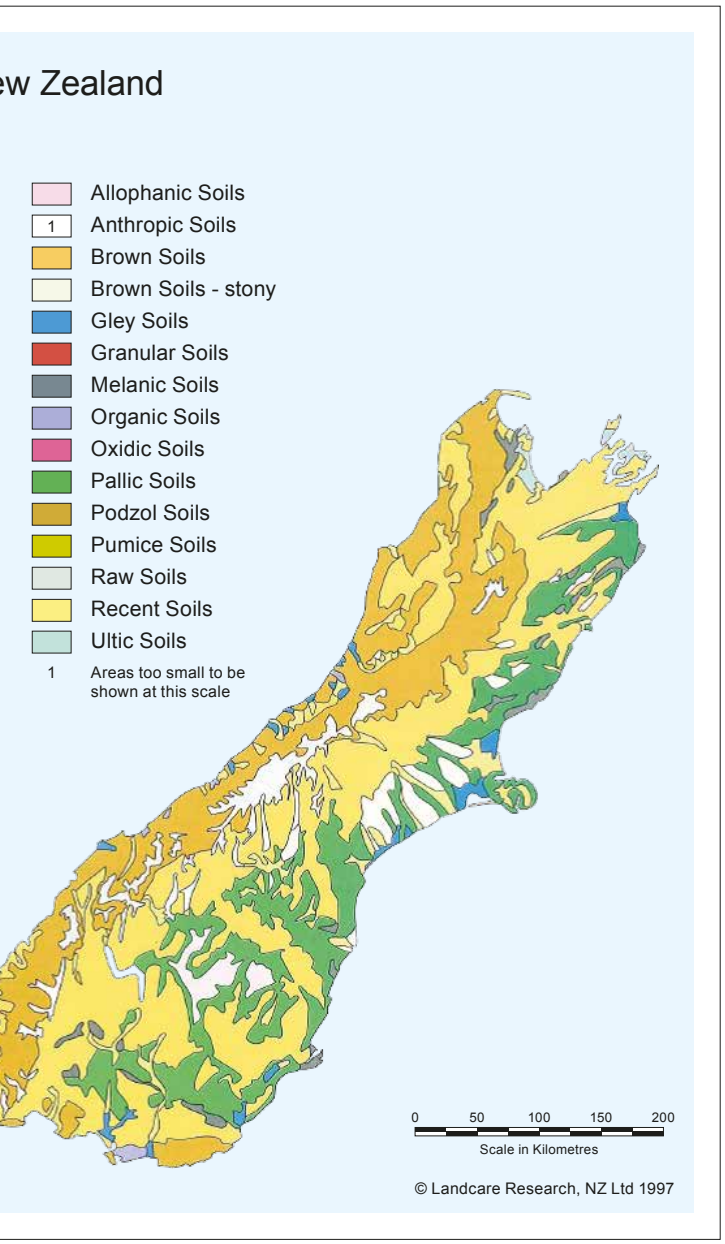
Soil is a media for plant growth, recycles nutrients and organic matter, stores carbon and holds and supplies water. Delivering these benefits is largely determined by the physical, chemical and biological properties of the soil.

Topsoil contains much of the organic matter and nutrients for plant growth. Soil organic matter improves nearly all soil properties, e.g. moisture retention, soil structure, drainage, nutrient storage, playing a vital role in many soil functions.

Trees can be deep rooting and access water and nutrients deep within the soil profile. An understanding of the deeper soil profile can help unlock long-term sustainable productivity of planted forests.

The forest floor is a key part of forest soil. It is formed from dead biomass (leaves, branches and stems) and is an important pool of carbon and nutrients.

Changes in soil type across a landscape are caused by differing geologies, climate patterns, topography, vegetation,



and time that the soil has been developing. Fifteen main soil orders have been mapped using the New Zealand soil classification system. Seven soil orders cover 94% of the planted forest estate with Brown and Pumice soils making up 65% of the area.

Soil quality

Soil quality is a measure of soil health and includes the soil's biological, chemical and physical condition. This supports and influences the flow of ecosystem services from the land.

New Zealand has national soil quality measures. Planted forest soil data shows they meet soil health targets for acidity, fertility, organic reserves, and physical status.

Planted forests can improve soil quality. Radiata pine forests have been seen to improved soil quality.

- Applying superphosphate to radiata pine on an eroded clay soil in north Auckland improved the soil chemical properties and stimulated tree root activity, which lowered the water table and improved the physical condition of the soil.
- Planting radiata pine on coastal sand dunes north of Auckland, after an initial phase of marram grass and tree lupins, has resulted in productive use of what where moving sand dunes. The development of a topsoil has seen the soil classification change from Raw to Recent soil.

Soils are sensitive to management

Nutrient supply from one rotation to the next. Soil fertility is sensitive to the extent of removal of timber and residues during harvesting.

Research suggests that mineral fertilisers cannot replace the organic matter removed at harvest. The retention of the forest floor, in particular, and tree foliage/branches on site post-harvest, are beneficial to supplying nutrients to the following growing crop.

The impact of harvest activities on soil fertility depends on the size of the initial soil nutrient pool, vulnerability to soil disturbance, and the number of harvesting events that have occurred over time. Sites at greatest risk of nutrient deficiencies are those that have soils already low in nutrients. Low nutrient soils make up about a third of New Zealand's total planted forest area.

The Nutrient Balance Model (NuBalM) offers the opportunity for 'precision nutrient management' for planted forests by predicting the nutrient supply and demand for the planted forest, as well as simulating the effects of interventions (e.g. pruning, thinning or fertiliser addition) when nutrients limit productivity of the ecosystem.

Water supply for crop growth and nutrient uptake. A soil's capacity to supply water is firstly dependent on the rainfall in that area then by the volume (depth) of the soil and its texture, which determine how much water can be stored.

Very few forest soils in New Zealand have water supply limitations. However, seasonal droughts are possible, and this can specifically affect boron nutrition of the crop on soils low in boron. Moisture supply disruptions may also affect wood properties.

Management options for soils where moisture limitations are expected (e.g. on Pallic or Brown soils) are restricted to controlling competing vegetation.

Avoided compaction. Compaction by machine traffic can negatively affect a soil's ability to hold and supply water, and to function as a rooting medium.

Fine textured soils, and wet soils, are generally more sensitive to compaction than coarse textured or dry soils.

Soil physical properties negatively affected by compaction can be improved by soil ripping operations increasing the soil aeration and rooting depth.

Erosion susceptibility. Erosion susceptibility is dependent on rainfall, soil texture, slope, and vegetation cover. Trees protect the soil through networks of roots and water regulation. Soil loss by erosion can be a significant risk, particularly where forests are on steep, highly erodible land during harvesting. About one-third of the planted forests in New Zealand are on land sensitive to erosion.

Soil erosion can contribute to a decrease in nutrient supply and impact on long-term crop productivity. Results from a study in Pakuratahi, Hawkes Bay, shows the loss of soil through shallow landslide erosion resulted in a reduced timber volume of 10% for trees planted within erosion scars.

Managing for maximum benefit

An understanding of the distribution and properties of soils is critical for effective and sustainable long-term forest management. In particular, the period during harvesting requires the most sensitive management, especially the management of harvest residues and loss of soil through erosion.

Planted forests supply valuable environmental and social benefits. To maximise these, the forest sector operates under the RMA (Resource Management Act) plus a range of forestry sector developed manuals, individual company environmental management systems, and, in some cases, Forest Stewardship Council standards.

Key links

General soil information – http://www.teara.govt.nz/en/soils

Fundamental soil layer – http://data.linz.govt.nz

National soils database S-map – http://smap.landcareresearch.co.nz

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Scion is the Crown research institute that specialises in research, science and technology development for the forestry, wood and wood-derived materials and other bio-material sectors.

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