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Technical Memo

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File: High class soil technical information for horticulture New Zealand
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1. Purpose

This memo provides technical information on high class soil issues to support Horticulture New Zealand's submission on the Future Proof Strategy. The technical information focusses on the Waikato Regional Policy Statement¹ (WRPS) definition of high class soil and the value of these soils for horticultural production.

2. Introduction

As in other regions across New Zealand, horticultural production in the Waikato is reliant on the availability of high class soil, more so than any other rural production land uses. The limitations of a soil determine whether a specific crop type can be grown sustainably over the long term. The WRPS should be considered the most robust definition for identifying high class soil in the Waikato because it incorporates the concept of soil versatility, and land use capability classes and soil types specifically for the Waikato region. The high class soils it identifies collectively represent the soils in the region that are capable of sustainably supporting horticulture and crop production, with minimal management interventions to overcome any inherent soil limitations. This memo summarises the reasons for providing full protection of all high class soil in the Waikato region, irrespective of Land Use Capability (LUC) class, to secure ongoing availability of soils for horticultural production.

3. Soil versatility

Soil versatility is of fundamental importance for defining high class soil. In essence, soils with higher versatility can grow a wider range of crops with minimal need for interventions to manage soil limitations. The properties of versatile soil are well summarised in "Soils in the New Zealand Landscape"² and are of fundamental importance for defining high class soil.

Highly versatile soil has the following characteristics:

- Occurs on flat land or very gentle slopes < 5°,
- has a potential rooting depth of at least 0.75 m,
- offers little resistance to root penetration,

¹ Waikato Regional Council. 2018. Waikato Regional Policy Statement: Te Tauāki Kaupapahere Te-Rohe O Waikato. Waikato Regional Council, Hamilton.

² Molloy L. 1988. Soils in the New Zealand Landscape – the living mantle. Mallinson Rendel and New Zealand Society of Soil Science, Wellington.

- suffers very few days of soil-water deficit,
- suffers very few days of waterlogging,
- has enough large, interconnected pores to ensure good drainage and aeration,
- has a low content of stones,
- is capable of being cultivated by machines throughout most of the spring period,
- has high structural stability, and
- is not likely to suffer from erosion, flooding or salt contamination.

A versatile soil meets all but a few of these criteria. In general, the soil characteristics provided by versatile soils are essential for horticulture and cropping; lesser soils are generally not suitable for horticulture and cropping.

4. Definitions of high class soil in the Waikato region

There are two main definitions of high class soil used by territorial authorities in the Waikato. The first includes all soils within Land Use Capability classes 1, 2 and 3. The second, and increasingly used definition, is provided by the WPRS, and includes soils within LUC classes 1, 2 and 3 land, with some exclusions that are seen as relevant to the Waikato region, primarily based on limitations for cropping.

LUC 1-3 based definition of high class soil

In my opinion, defining high class soil as LUC 1-3 is too simplistic. It fails to recognise soil limitations within the LUC 3 class that make the included soils unable to support sustainable horticultural and crop production. I outline the main points below:

- LUC 3w - wetness limitation

LUC 3w soils are very poorly drained and at best only able to support shallow rooted crops over the drier seasons (summer and autumn). For these reasons, the range of possible crops is reduced, excluding any horticultural crops that are deep rooted (such as orchards) and crops that require well drained soils (such as avocado and kiwifruit).

- LUC 3s - soil limitation

LUC 3s soils are coarse textured or shallow and have very low water holding capacity. For shallow soils, rooting depth limitations restrict cultivation depth and prevent deep rooted crops. In the Waikato the main soil with a LUC 3s classification is formed from alluvial sands (Waikato soils – or Waikato_1a.1). These soils have limited productive capability beyond pastoral use and are not considered capable of supporting horticultural production without the continual availability of water for irrigation.

- LUC 3e - erosion limitation

In general, LUC 3e is only limited for some horticultural production if slope constraints for machinery use, and soil loss from exposing the soil by cultivation cannot be managed. However, in the Waikato, soils formed in older weathered ashes (e.g. Hamilton Ash Formation) are seasonally limited on these steeper slopes (>7°- 15 slopes) in wetter seasons (winter and spring) due to slow drainage. In contrast soils formed in younger ashes on the same slopes remain well drained and are workable throughout the year, so can support a wider range of horticulture and crops.

WRPS definition of HCS

The WRPS definition for high class soil includes soils on LUC class 1, 2 and 3, with some exclusions that are seen as relevant to the Waikato region. The definition is as follows:

...those soils in Land Use Capability Classes I and II (excluding peat soils) and soils in Land Use Capability Class IIIe1 and IIIe5, classified as Allophanic Soils, using the New Zealand Soil Classification.

5.1 Exclusion of Organic soils (peat soils)

The exclusion of Organic soils³ (often referred to as “peat soils”) is based on the premise that in the long term these soils are not sustainable under any productive land use. The LUC definition in the handbook⁴ states that any soil that can be permanently improved by management (such as drains to reduce the water table) can be classified according to the improved soil and that LUC class assigned. For example, Te Kowhai soils are often mapped as a complex with well drained Horotiu soils. Permanent drainage can improve the Te Kowhai soil’s drainage and they are classed as LUC unit 2w3 (i.e. they are high class soils). Without drains present these soils have a greater wetness limitation are classified as LUC class 3w or 4w (i.e. they are not high class soils).

In terms of Organic soils, drainage schemes are considered viable over the medium term but are not always considered permanent over the long term. This understanding is based on relatively new research and monitoring. We know that under any productive land use peat soils subside by about 1.85 cm per year⁵. Eventually this subsidence means that drainage schemes can no longer ensure the viability of the soils (and the classification as high class soils).

5.2 Exclusion of some LUC class 3 soils

The intent is to specifically identify and protect Allophanic soils (volcanic ash soils) on <7 - 15° slopes as these soils have the same qualities as ash soils on lesser slopes due to their texture, structure, and drainage, with only “slight” increase in erosion risk. These soils can still be used for intensive cropping (i.e. there is no real loss of versatility caused by increased slope). In comparison, non Allophanic soils (such as clay loam Granular soils) are not considered as versatile as they are not as well drained and can only be intensively cropped seasonally. Allophanic soils with a LUC 3 classification are within LUC units 3e1 and 3e5 but do not include all soils within these LUC units.

5. Proposed Future Proof Strategy protection of high class soils

The proposed Future Proof Strategy suggests providing greater protection of soils classified as LUC 1, over soils classified as LUC 2 and LUC 3. In my opinion this does not provide adequate protection for horticultural production relying on high class soils, does not align with the most commonly used definition of high class soil in the Waikato region, and is impractical from a field assessment perspective. The inadequacies largely centre around the nature of the soil types and their distribution (soil pattern) in the Waikato region.

6. Soil considerations

6.1. Soil complexes

In reality, soils cannot always be individually delineated when mapped in the field. This is referred to as a soil complex – a soil map unit with one or more soils. A common example of this in the Waikato region is the Horotiu-Te Kowhai complex, which can consist of a mix of three soils across a soil drainage gradient from well drained to poorly drained; Horotiu, Bruntwood and Te Kowhai. Where these soils are classified as different LUC classes (according to the LUC classification), the resulting LUC map unit can have different LUC classes present or be classified collectively. This is the case with the Horotiu-Te Kowhai complex, where LUC class may represent the dominant soil (e.g. LUC 2w3 – if

³ As defined by the New Zealand Soil Classification: Hewitt AE. 2010. New Zealand Soil Classification. 3rd ed. Landcare Research Science Series No. 1. Lincoln, Manaaki Whenua Press.

⁴ Lynn IH, Manderson AK, Page MJ, Harmsworth GR, Eyles GO, Douglas GB, Mackay AD, Newsome PJF. 2009. Land Use Capability survey handbook – a New Zealand handbook for the classification of land. AgResearch Hamilton; Manaaki Whenua Lincoln; GNS Science Lower Hutt, New Zealand.

⁵ Pronger J, Schipper LA, Hill RB, Campbell DI, and McLeod M. (2014) Subsidence Rates of Drained Agricultural Peatlands in New Zealand and the Relationship with Time since Drainage. *Journal of Environmental Quality* 43(4):1442-9.

Te Kowhai soils dominate, or LUC 2s1 if Horotiu soils dominate). The main point to note are that LUC 1 and LUC 2 soils cannot be separated, which is problematic for applying different levels of protection (as proposed under the Future Proof Strategy).

6.2. Soils and LUC classification

In the Waikato region the majority of versatile soils (high class soils) are formed in volcanic ashes. By nature these volcanic ashes mantle the underlying landscape. This gives rise to the situation where the same soil (with the same soil properties) can occur across multiple LUC classes. For example, the Ohaupo soils (Smap siblings Mairoa_6a.1 and Otorohanga_12c.4) are classified as LUC 2 on slopes of 0 – 7°, LUC 3 on slopes >7 – 15°, and LUC 4 on slopes >15 – 20°. Horticulture and cropping is capable of being supported on classes LUC 2 and LUC3. It should also be noted that Ohaupo soils have very similar properties to Horotiu soils (LUC 1), slope being the difference from a LUC classification perspective.

Protection of the full range of soils captured by the WRPS defined high class soils is critical to ensure availability of suitable soil and land for the full range of horticulture and crops. For example only protecting soils on LUC 1 land, will require horticulture and crops occupying LUC 2 and LUC 3 land to be relocated onto LUC 1 land, reducing the overall availability of soils and land for horticultural production.

7. An appropriate high class soil definition

The main factors to consider for retaining available land for horticulture and cropping in the Waikato region are:

1. Horticulture and crop production relies on the availability of high class soils for production, the soils for which span LUC classes 1, 2 and 3.
2. The soil patterns in the Waikato mean that soils in LUC 1, 2 and 3 classes cannot always be delineated.
3. Some LUC 2 and LUC 3 soils cannot support a wide range of horticultural production because of soil limitations.

Adopting the WRPS definition for high class soils provides the best protection for the entire range of high class soils in the Waikato region. Separation of LUC1 from LUC 2 and LUC 3 (akin to elite and prime soils in the Auckland region) is both impractical from a field assessment perspective and would most likely reduce the total availability of soils and land suitable for the full range of horticulture and cropping uses in the Waikato region.

Consistent protection across all high class soil (as defined by the WRPS) is essential for the ongoing viability of the full range of horticulture and cropping production in the Waikato region.