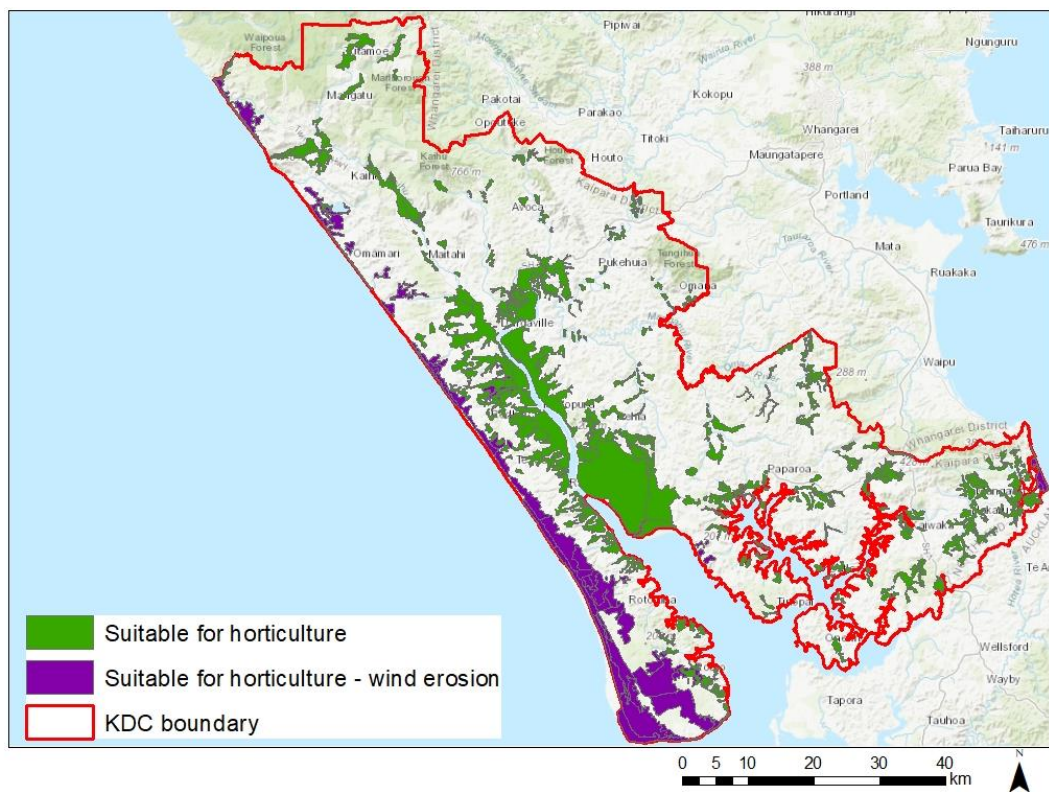


Suitability of the Kaipara District for Generic Horticulture: A Progress Report

Robert Ward, Brent Clothier

October 2019



Confidential report for: NIWA

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EXECUTIVE SUMMARY

We have carried out a GIS sweep of the Kaipara District to determine the extent and location of areas that could support horticulture in a generic sense. This is a non-crop specific assessment for horticulture. Crop-specific analyses will follow later in the project for six specific crops. There are 310,000 ha of land within the boundaries of the Kaipara District Council (KDC).

The four criteria we use for generic horticulture are:

- The Land Use Capability (LUC) classes are: 1, 2, 3 and 4s – 7s. The latter classes are specifically for viticulture. This covers 'good' land without severe limitations.
- The slope of the land is less than 15°. This is to enable trafficability.
- The Growing Degree Days (base 10 ° C) is greater than 800 degree days. This is to ensure fruit maturation.
- The frost-free period exceeds 200 days to ensure no frosts after flowering or before fruit maturation and harvest.

On this basis there are 44,200 ha of land within KDC that is suitable for generic horticulture, or some 14% of the District. The soils on some of this land have poor drainage and shallow potential rooting depths. Mitigation options, such as mounding, will be investigated.

Upon closer examination of the maps, especially for the Pouto Peninsula, we re-visited the LUC criterion used above, for we considered that some of the sandy, wind-erosion prone soils of the District would, with careful management and shelter, be suitable for horticulture. This extends into LUC subclass e for classes 4 through 7. We then considered the type of erosion from the New Zealand Land Resource Inventory (NZLRI), in this case wind erosion (W). This classification is similar to the wind-prone sandy soils of the Manawatu sand-country, which is land that shows that with good management practices it can be successfully farmed. So we then carried out another GIS sweep of KDC's lands using the additional horticultural suitability criterion of:

- The LUC classes 4e – 7e for which wind erosion (W) is a contributing factor. This is land susceptible to surface erosion due to wind.

This realised another 17,000 ha of land that could be suitable for horticulture, although care will need be exercised to assess what indeed are the erosion risks are under horticulture and how they might be mitigated. These soils are, by and large, well-drained and have deep potential rooting depths.

So in sum, a broad GIS sweep of the Kaipara District suggests that there could be 61,000 ha that might be suitable for generic horticulture, or possibly some 20% of the area within the KDC boundaries. Our future work will examine this for crop-specific suitabilities using this broad sweep to identify six Virtual Climate Station Network (VCSN) grids to analyse in more detail for the potential of horticulture in the Kaipara District. Six suitable VCSN grids are identified.



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1 INTRODUCTION

In this Progress Report we describe our initial findings from our investigations into the potential suitability for horticulture across the lands of the Kaipara District Council (KDC). In this first report we assess the potential for generic horticulture, rather than address crop-specific suitability. The latter assessment will be carried out in the next stage of the project. The area of land within the boundaries of the KDC is 310,000 ha.

2 A GIS SWEEP OF THE KDC

To provide an initial GIS sweep across the Kaipara for the suitability of generic horticultural crops, we used the four criteria that we have developed in previous projects. These are that:

- The Land Use Capability (LUC) classes are: 1, 2, 3 and 4s – 7s. The latter classes are specifically for viticulture. This covers 'good' land needed for horticulture and which is without severe limitations.
- The slope of the land is less than 15°. This is to enable trafficability of operations with orchards and vineyards.
- The Growing Degree Days (base 10 ° C) is greater than 800 degree days. This is to ensure there is sufficient warmth between October and April for flowering through to fruit maturation.
- The frost-free period exceeds 200 days to ensure that there are no frosts after flowering, or before fruit maturation and harvest.

The land area covered by the first criterion of LUC classes 13 and 4s-7s is shown in Figure 1. The major land areas fulfilling this criterion are around Ruawai and along on the shores of the northern Kaipara Harbour, as well as pockets in the west between Kaiwaka and Mangawhai. In total there are 14,400 ha of LUC 2, 18,800 ha of LUC 3, 10,800 ha of LUC 4s, and 230 ha of LUC 6s. Thus in total there are about 44,200 ha of land that meets the LUC criterion for generic horticulture, which is 14 % of the KDC's land area.

In Figure 2 is presented the areas covered by the land-slope classes of 0-3 °, 4-7 ° and 8-15 °. There is a lot of flat land in the river valley floors and along the Pouto Peninsula. There are about 50,000 ha of land with slope 0-3 °, 15,100 ha with 4-7 °, and 80,000 ha 8-15 °. In total this sums to 145,100 ha of flat land, to moderately flat land. There is, therefore, nearly four times as much flat land than there is land that is potentially suited to generic horticulture on the basis of the LUC criterion.

We consider that there needs to be over 800 degree days of GDD₁₀ warmth for generic horticulture. For example, apples require a GDD₁₀ of 800. However, kiwifruit require 1000 degree days. In terms of GDD₁₀ there are no limitations for generic horticulture across the lands of the KDC (Figure 3).

To ensure that there are no frosts after flowering, and no frosts before harvest, we consider that for generic horticulture there needs to be a FFP of over 200 days. For this part of the 'winterless' north, this frost criterion is well exceeded (Figure 4).

So in summary, the climate of KDC is highly suitable for generic horticulture, and there is ample flat land. The criterion that determines the potential area for generic horticulture is that of the LUC classes.



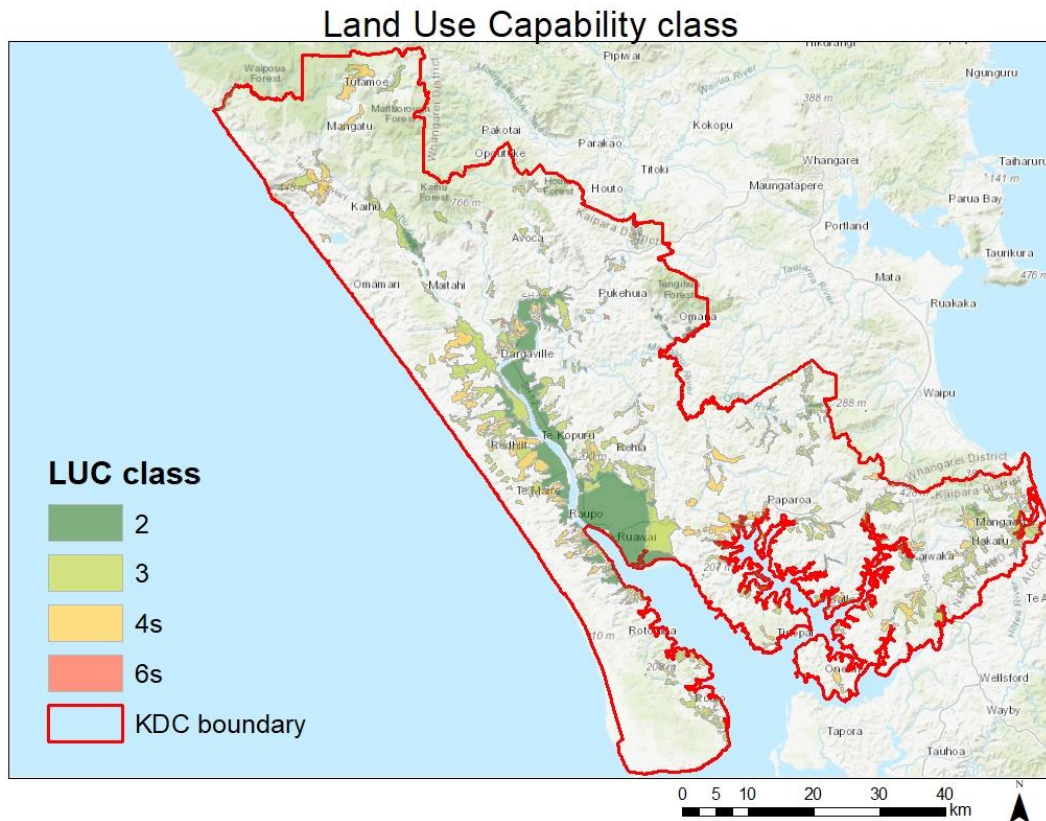


Figure 1. A map of the Kaipara District Council's (KDC) land area that is covered by Land Use Capability (LUC) classes 1, 2, 3, and 4s-7s. There is no LUC 1 land, nor LUC 5s or 7s.

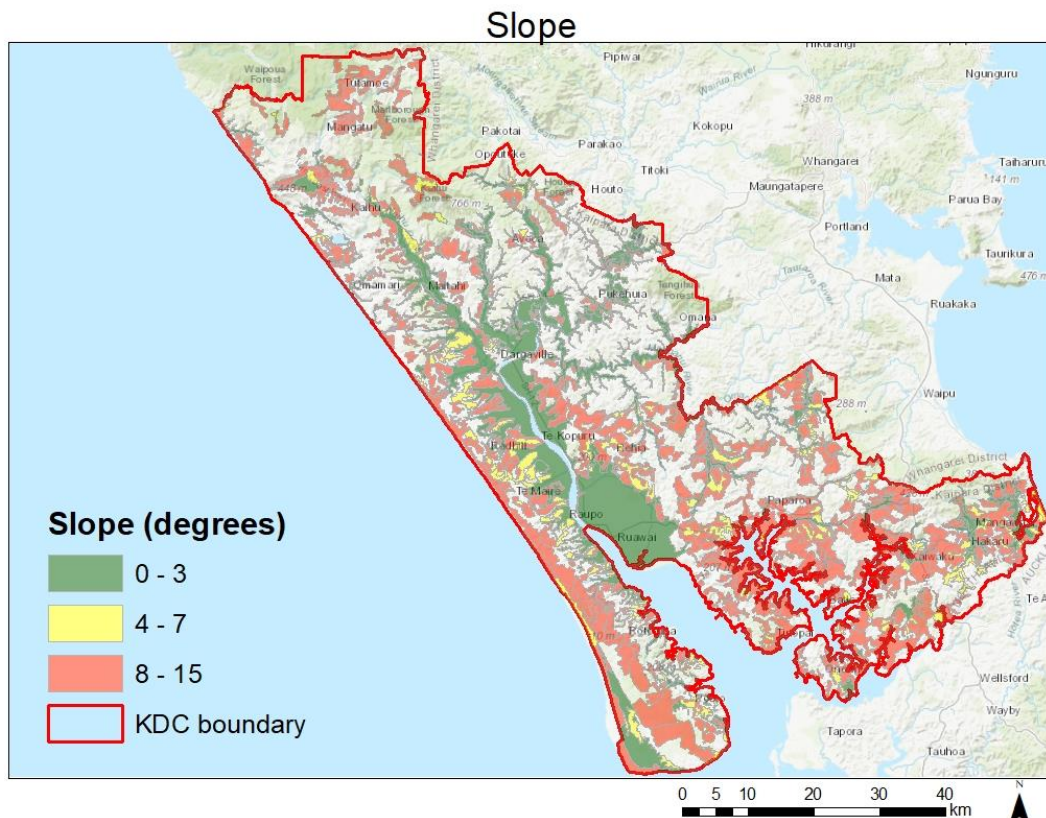


Figure 2. A map of the Kaipara District Council's (KDC) land area that is covered by land of slope classes 0-3°, 4-7 ° and 8-15 °.



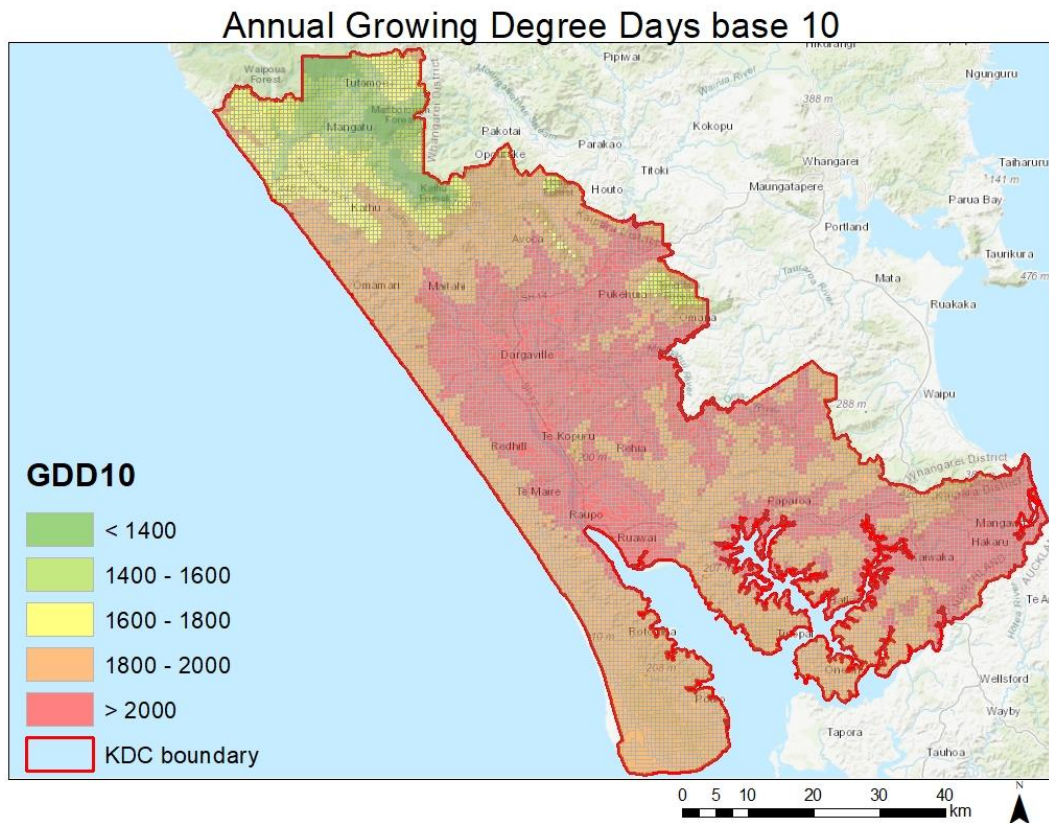


Figure 3. A map of the Kaipara District Council's (KDC) land area where the Growing Degree Days (base 10 °C) (GDD_{10}) are < 1400, 1400-1600, 1600-1800, 1800-2000 and > 2000 degree days.

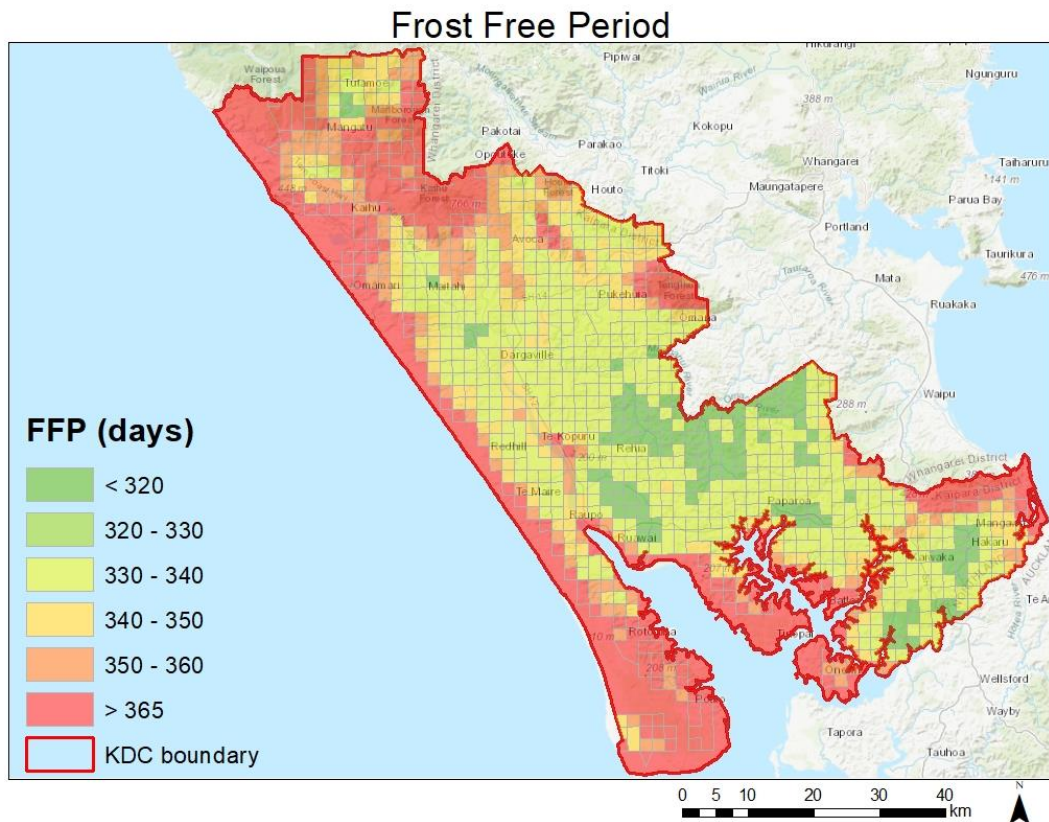


Figure 4. A map of the Kaipara District Council's (KDC) land area where the Frost Free Period (FFP) is < 320 days, and > 365 days, with gradations of 10-day divisions in between.



In Figure 5, we show the intersection of all four criteria for the potential suitability of the lands within the KDC for generic horticulture. These areas are around Ruawai, the coastal parts of the northern Kaipara Harbour. As well there are some pockets to the north and east of the KDC.

In total, these four criteria suggest there are about 44,200 ha of land that is potentially suitable for generic horticulture. That is about 14% of the KDC's area.

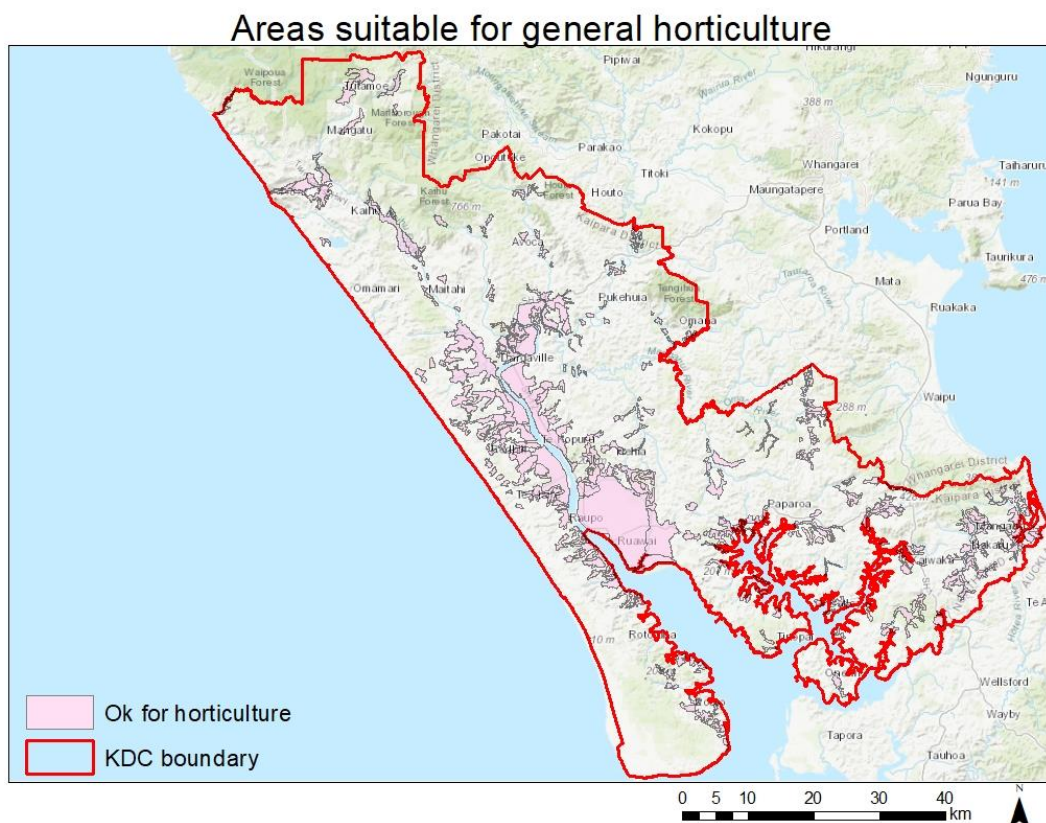


Figure 5. A map of the Kaipara District Council's (KDC) land area that meets all four criteria for the potential suitability for generic horticulture.

3 A GIS 'RE-SWEEP' OF THE KDC

Given our knowledge of farming within the Manawatu Sand Country on the west coast of the lower North Island, we were somewhat surprised that the Pouto Peninsula did not show up as being potentially suitable for generic horticulture. Closer examination of this showed that the predominant LUC classes of the Pouto Peninsula are LUC 4-8e, which is land suffering limitations due to erosion (e), and primarily wind erosion. This is the same for the Manawatu Sand Country (Figure 6), where we know there is intensive agriculture, and some pockets of horticulture. In these cases, through good management practices, the limitations to erosion, particularly wind erosion, are mitigated, especially through the use of shelterbelts.

So it was decided to do a 're-sweep' of the KDC lands using the additional criterion of:

- Land of LUC classes 4e to 8e, and filtered for areas where wind erosion is a contributing factor. This considers that any potential horticulture would mitigate the limitations that are primarily a result of wind erosion, say through shelterbelts.



Manawatu sand country LUC



Figure 6. A map of the Land Use Capability (LUC) classes for the Manawatu Sand Country.

Land Use Capability class

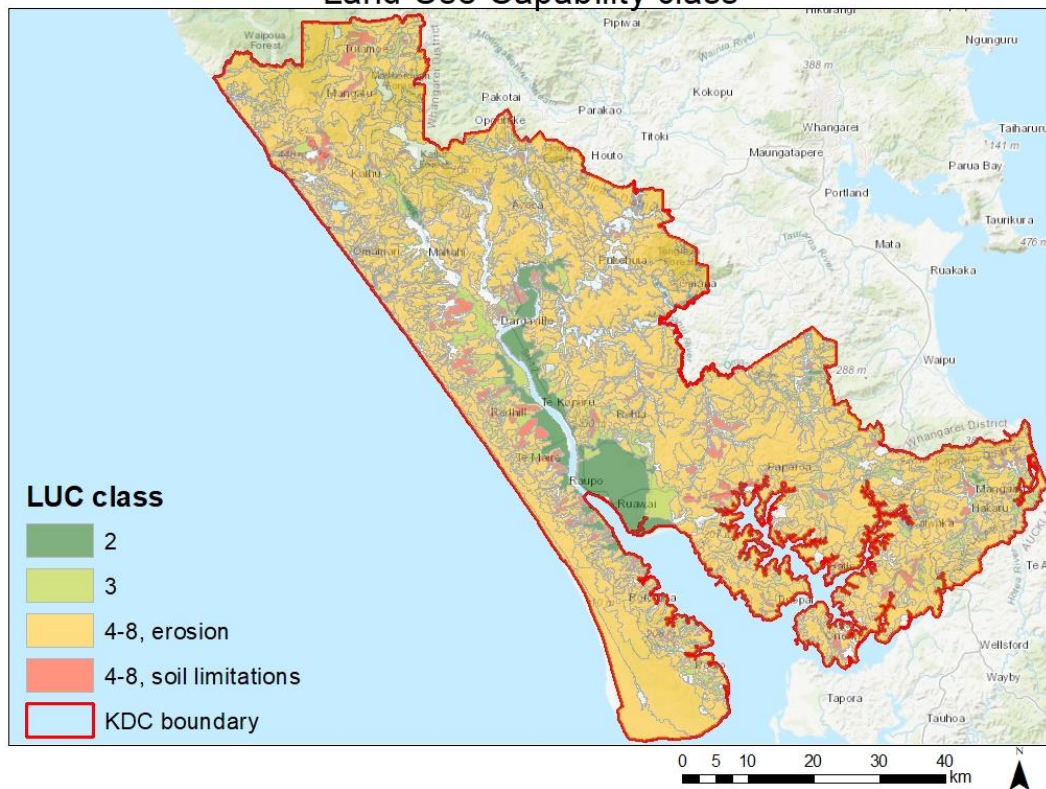


Figure 7. A map of the Kaipara District Council's (KDC) land area that comprises LUC 2-3, plus LUC 4-8e, and 4-8s.



A map of the KDC showing LUC classes 2, 3, and 4-8e is given in Figure 7, along with LUC classes 4s-8s. There are some 237,500 ha of land in the classes 4e-7e. When a 're-sweep' of the KDC lands is carried out using the additional criterion of LUC 4-7e, along with the four previous criteria, another 17,000 ha of land is potentially suitable for horticulture, if wind-erosion risks are mitigated (Figure 8).

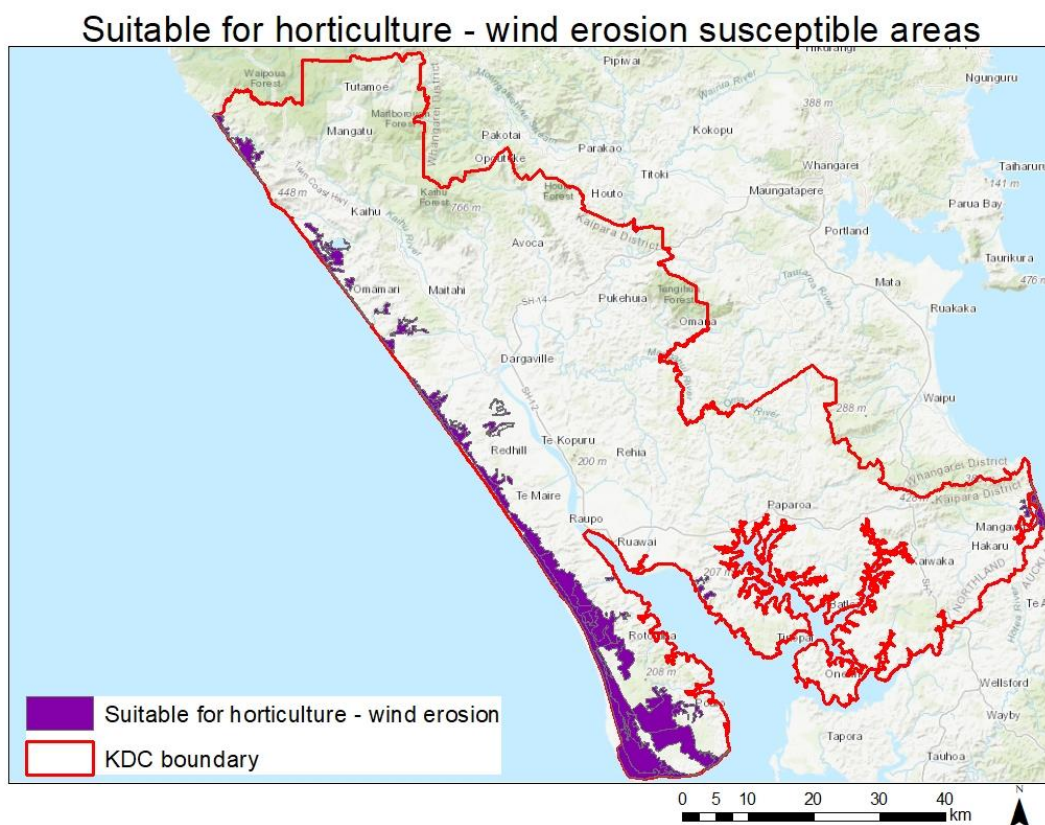


Figure 8. A map of the Kaipara District Council's (KDC) land area that comprises Land Use Capability (LUC) classes LUC 4e-8e filtered for wind erosion, and meets the slope and climate criteria set-out for the potential suitability for generic horticulture.

When this area of wind erosion-prone land (Figure 8) is added to the earlier suitability map of Figure 5, we obtain a map of the areas of land within the KDC that we consider potentially suitable for generic horticulture (Figure 9), as long as there are mitigations to overcome any soil and erosion limitations. In Figure 9, we have separated out the original GIS sweep (green), with the 're-sweep' (purple).

There are two distinct areas: the coastal strips along the northern Kaipara Harbour, with isolated pockets to the north and east, and next the west side of the Pouto Peninsula. These two different areas present different opportunities and requirements for mitigations.

The soils of the Pouto Peninsula are well-drained (Figure 10, left) and the have a potentially deep rooting zone (Figure 10, left). These soils would be well-suited to generic horticulture production, although shelterbelts would be required. As well there would most likely be the need for irrigation. The soils of the coastal plains on either side of the northern Kaipara Harbour are imperfectly, or poorly drained, with the potential rooting depth limited to 150 to 440 mm. For generic horticulture here, mounding of the soil along the row of the crops to provide a sufficient rooting depth might well be needed. This is a common practice elsewhere in Northland. Given the shallow rooting depth, even with mounding, irrigation is also a likely requirement. Shelter would also be a likely requirement here as well, given the likely influence of westerly winds.

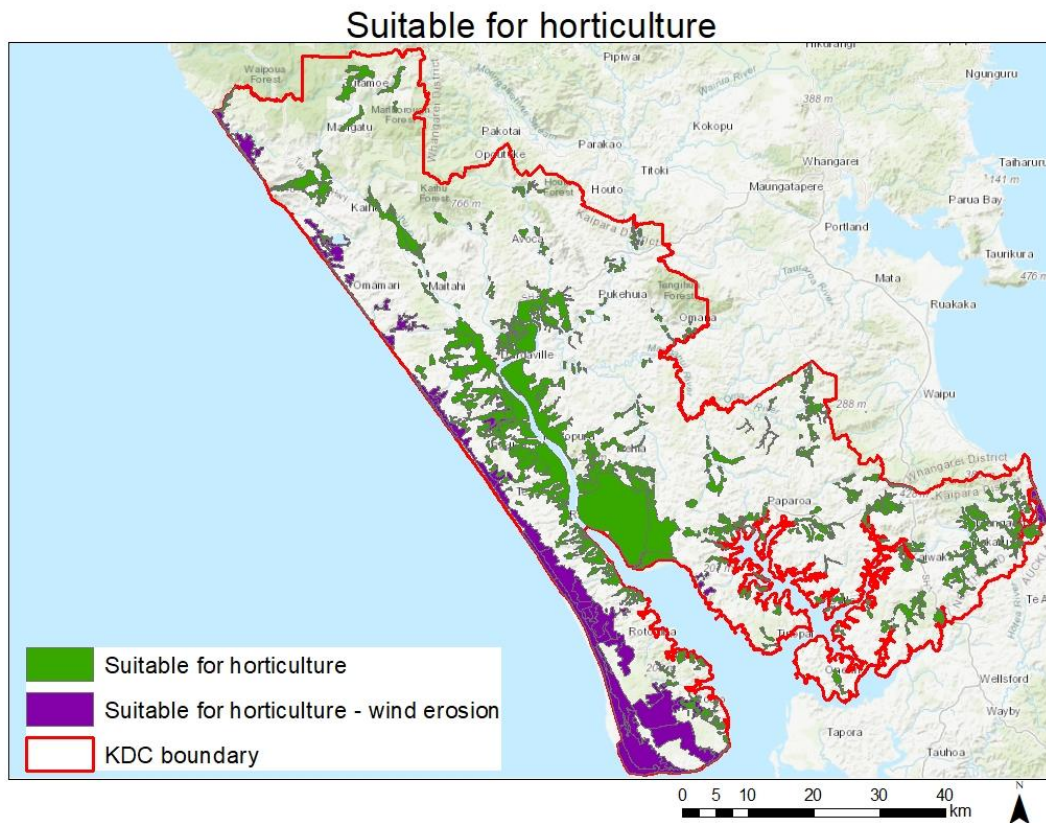


Figure 9. A map of the Kaipara District Council's (KDC) land area that is potentially suitable for generic horticulture based on LUC 1-3 and 4s-7s (green), and that based on LUC 4e-7e filtered for wind erosion (purple).

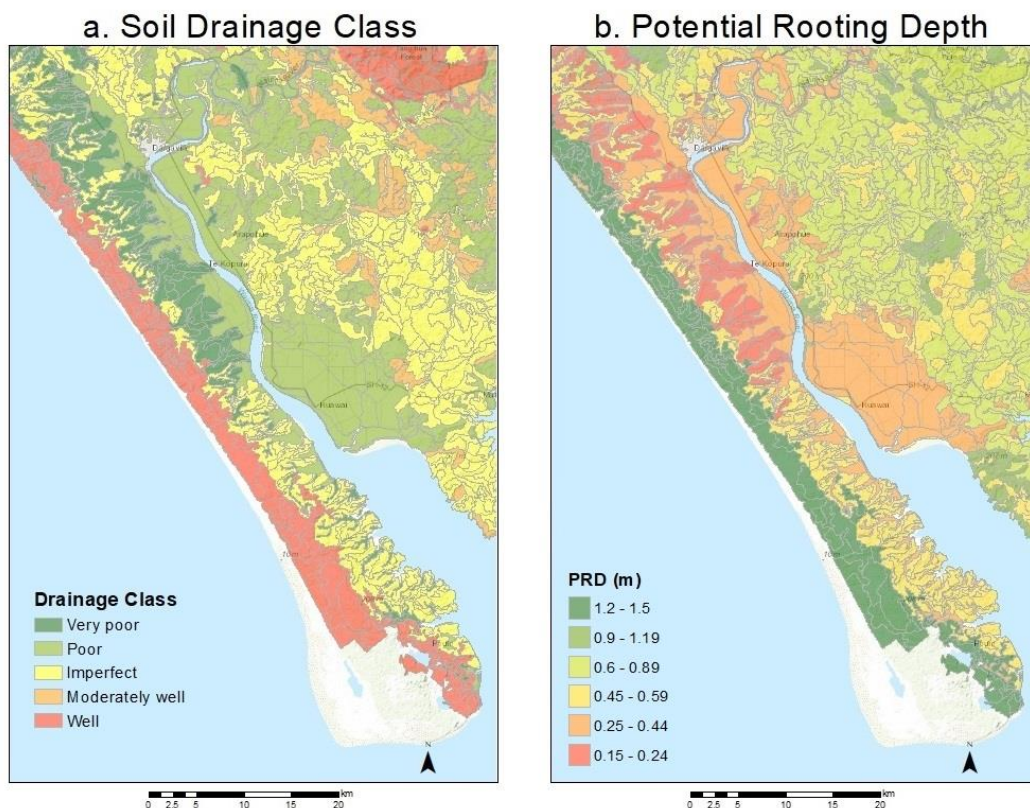


Figure 10. A map of the south-western parts of the Kaipara District Council (KDC) showing soil drainage classes (left), and potential rooting depths (right).



4 CROP-SPECIFIC ANALYSES

To go beyond this generic assessment, we will next be carrying out a series of crop-specific analyses. These analyses will use Virtual Climate Station Network (VCSN) data to predict the phenology of the various selected crops and assess the risk and mitigation options.

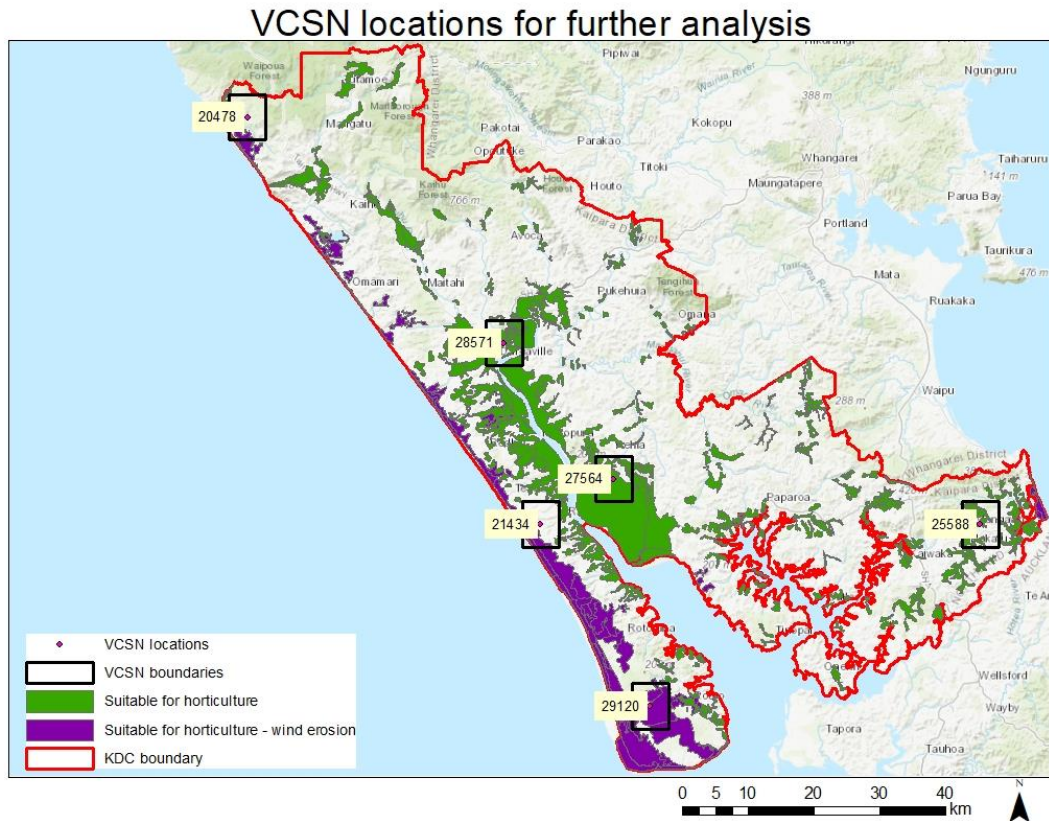


Figure 11. The areas with the Kaipara District Council’s (KDC) boundaries that are potentially suitable for generic horticulture (from Figure 9), along with the 5 x 5 km grid squares associated with the Virtual Climate Station Network sites we propose to use for detailed crop specific analyses of horticultural suitability.

Given the potential areas that appear suitable for horticultural crops (Figure 9), we propose using the following VCSN grids, which are from north to south: 20478, 28571, 27564, 21434, 29120 and 25588. The 5 x 5 km grid squares associated with these VCSN sites are shown in Figure 11.