Report

Revised soil and Land Use Capability criteria to inform the delineation of a Horticulture Precinct (HP) in the Far North District Plan.

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Executive Summary

This report outlines a methodology for revising the soil and Land Use Capability (LUC) criteria to inform the delineation of a Horticulture Precinct (HP) in the Far North District Plan. The main goal is to create a scientifically defensible framework that refines the initial soil and LUC criteria used to delineate the notified Horticulture Zone. This information is intended to inform the spatial extent of a revised Horticulture Precinct based on protecting land suitable for sustainable, horticultural production. The methodology focuses particularly on key Northland crops such as kiwifruit, avocado, citrus, and also considers intensive vegetable production.

The approach addresses the acknowledged limitations and inaccuracies of broad-scale datasets, such as the New Zealand Land Resource Inventory (NZLRI). The NZLRI is often inaccurate for local property-level planning due to its broad scale (designed for 1:50,000 regional use) and historical inaccuracies. The methodology uses a hierarchy of evidence to confirm land suitability , prioritising more detailed S-Map data where available and defaulting to NZLRI data otherwise. It integrates verifiable information from the Land Cover Database (LCDB), Irrigated land datasets, and introduces a multi-tiered classification framework of 'Include', 'Possibly Include', 'Possibly Exclude' and 'Exclude'.

Key Findings and Proposed Criteria

- **Exclusions:** Land with inherent wetness limitations (LUC 'w' subclasses) and specific problematic soil orders (e.g. Ultic Soils) are identified for exclusion from the HP, as these are fundamentally unsuitable for sensitive horticultural crops.
- **Conditional Inclusion:** While LUC Classes 1, 2, and 3 are generally 'Included', LUC Class 4 land is subject to a more thorough, evidence-based assessment. Only LUC 4 areas with compelling evidence of current horticultural use, existing irrigation, misclassified slopes, or favourable S-Map soil properties can be reclassified as 'Include'.
- **Targeted Verification:** A key step in the methodology is the manual expert review using aerial imagery and ancillary data to verify the classifications of all 'Possibly Include' areas and to address potential misclassifications in even the most versatile land classes. These additional categories provide specific guidance to the reporting officer.

This revised methodology has helped to inform a more robust boundary for the Horticulture Precinct. The proposed revision, determined in conjunction with the reporting officer, would remove 1,555.6 hectares from the original notified Horticulture Zone area of 6,882.1 hectares. The resulting proposed Horticulture Precinct would cover 5,326.4 hectares. It is acknowledged that, despite the reclassification, the proposed Horticulture Precinct will still contain some land that does not meet the revised criteria to ensure the overall integrity of the zone and its long-term growth potential.

1 Introduction and Context

1.1 Purpose of the Report

This report outlines a methodology for revising the soil and Land Use Capability (LUC) criteria for the Far North District Plan's notified Horticulture Zone to create a revised proposed Horticulture Precinct. The primary objective of this revision is to establish clear, scientifically based defensible criteria for classifying land into 'Include', 'Possibly Include', 'Possibly Exclude' and 'Exclude' categories. This framework is designed to provide a robust foundation for policy discussions and to inform the Hearings Panel regarding land suitability for intensive horticulture.

The scope of this report is primarily based on soil and LUC criteria but utilises additional spatial data such as irrigated land area data, landcover data and other 'ancillary data'. The analytical focus is on Northland-specific soil and LUC classifications, alongside biophysical data pertinent to the requirements of key Northland horticulture, specifically horticulture crops best suited to deep free draining soils (e.g. kiwifruit and avocado).

1.2 Background: The Far North notified Horticulture Zone and its Strategic Importance

Horticulture is a significant industry in the Far North and in Kerikeri/Waipapa, generating economic activity, supporting employment, and interacting with other parts of the economy.[1] The notified Horticulture Zone (HZ), proposed as a special purpose zone in the Far North Proposed District Plan (PDP), was introduced to protect and promote the horticultural industry in the Kerikeri/Waipapa area. Its core purpose is to safeguard valuable soil resources from incompatible land uses and facilitate sector growth. The HZ is strategically important due to its versatile land and extensive irrigation infrastructure (serving an estimated 5,801 hectares).

The HZ represents a major policy shift from a previous permissive subdivision framework that led to land fragmentation, loss of productive land, and increased reverse sensitivity issues between agriculture and other land uses. The HZ aims to halt non-rural development and subdivision, prevent further reverse sensitivity effects, and protect horticultural infrastructure investments for long-term primary production.

The intention behind the inclusion of approximately 33% non-horticultural land within the HZ as notified was to create buffers to manage complex land-use interfaces and mitigate reverse sensitivity, ensuring the zone's long-term integrity and future growth potential. This strategy aligns the HZ with national and regional planning instruments like the Resource Management Act 1991, the National Policy Statement

1 www.fndc.govt.nz/__data/assets/pdf_file/0015/35412/Statement-of-Primary-Evidence-of-Lawrence-Ryan-McIlrath-on-behalf-of-FNDC-Economics-Horticulture-Zone-Topic.pdf.

for Highly Productive Land (NPS-HPL), and the Northland Regional Policy Statement (RPS), all of which advocate for protecting versatile soils/highly productive land and preventing adverse effects from new subdivisions. It is understood that the HZ was not notified specifically to give effect to the NPS-HPL (as it was notified prior to its gazettal), rather its focus was on the protection of the horticultural industry and the land that it utilises as a finite resource requiring protection for the benefit of both current and future generations.

1.3 Importance of Soil and Land Use Capability in Land-Use Planning

Soil and LUC assessment is a fundamental component of sustainable land-use planning. It provides a scientific basis for understanding a parcel of land's inherent capacity for long-term, sustained primary production. The LUC system systematically integrates various physical data, including rock type, soil characteristics, slope, erosion patterns, and existing vegetation, with broader environmental factors such as climate, flood risk, and historical land-use practices, to comprehensively define land suitability. The protection of versatile soils, typically categorised as LUC Classes 1, 2, and 3, is considered paramount for ensuring future food security, particularly in the context of a changing climate. The NPS-HPL formally recognises this imperative by defining HPL based on LUC 1, 2, or 3 classifications derived from the New Zealand Land Resource Inventory digital database.

2 Foundational principles

2.1 Overview of the New Zealand LUC Classification System

The New Zealand Land Use Capability (LUC) system is an eight-class hierarchical method for classifying land based on its inherent capacity for sustained primary production. The system uses various physical data, including rock type, soil characteristics, slope, and erosion patterns, along with environmental factors like climate and flood risk, to determine land suitability.

The classification progresses from Class 1 to Class 8, with limitations to use increasing and versatility decreasing at each step.

- **LUC Classes 1-4** are considered **arable**, meaning they can sustain cultivation, with management requirements increasing from Class 1 (minimal limitations) to Class 4 (moderate to severe limitations).
- **LUC Classes 5-7** are typically **non-arable** but are suitable for pastoral farming or commercial forestry.
- **LUC Class 8** has severe limitations, making it unsuitable for agriculture or forestry. It's best managed for conservation or catchment protection.

Within each of the eight classes, a **subclass** is used to identify the dominant physical limitation. The four subclasses are:

- **'e' (erodibility):** The main limitation is susceptibility to erosion and/or past erosion damage. Slope is also a consideration.

- **'w' (wetness):** The main limitation is a high water table, slow internal drainage, or flooding.
- **'s' (soil):** The main limitation is within the root zone due to factors like shallow soil, pans, rock outcrops, stoniness, low water-holding capacity, or low fertility that's difficult to correct.
- **'c' (climate):** The main limitation is climate, such as a short growing season, inadequate rainfall, or frequent frost.

The concept of 'capability' is dynamic, as it is assessed based on all known technology and management practices at the time of assessment. However, inherent physical limitations, such as geology or persistent wetness, largely remain unchanged. The use of modern technologies like advanced irrigation systems can influence a property's perceived capability.

2.2 Identified Limitations and Inaccuracies of Broad-Scale NZLRI-LUC and FSL Data for Local Planning in Northland

Evidence from Mr Ian Hanmore[2] and Mr Bob Cathcart[3] points to a number of limitations, inaccuracies, and misclassification issues with the NZLRI-LUC database when it's used for local-scale planning decisions. The following section summaries the issues they have identified.

The NZLRI-LUC database and the Fundamental Soil Layers (FSL), while serving as national baselines, have acknowledged limitations and inaccuracies when applied to local-scale planning decisions in regions such as Northland.

One primary concern relates to **scale limitations**. The NZLRI-LUC system was designed for regional-scale use, typically at 1:50,000. At this scale, it provides only an approximate guide for specific sites. The smallest practical area that can be accurately delineated for a 'hooked' unit (a connected land parcel) is approximately 15 hectares, with the average map unit in Northland being around 125 hectares. This inherent limitation means that finer variations in soil type or land characteristics, which can be critical for property-level planning, are often overlooked or aggregated within larger map units.

Historical inaccuracies also contribute to the database's limitations. Concerns have been raised regarding the data quality for parts of the Far North District, particularly north of Turntable Hill, Moerewa. This is attributed to limited time spent by original surveyors in the region, which may have led to an overestimation of productive potential in some areas. Furthermore, the process of **digital transfer inaccuracies** from original field maps to digital databases introduced 'rounding off of boundaries' and

2 https://www.fndc.govt.nz/__data/assets/pdf_file/0032/34979/Audrey-Campbell-Frear,-S209,-FS172-I-Hanmore,-Soils-evidence.pdf
3 https://www.fndc.govt.nz/__data/assets/pdf_file/0028/34984/Bentzen-Farm-Ltd,-S167-R-Cathcart,-Land-Use-Capability-evidence.pdf; https://www.fndc.govt.nz/__data/assets/pdf_file/0025/41875/C-Otway-Ltd,-S393-B-Cathcart,-Land-use-capability-report.pdf.

the conversion of curved lines into straight ones. This resulted in a 'diagrammatic representation' that, in some instances, may bear 'little resemblance to what is observed in the field'.

These limitations are consistently highlighted by **discrepancies with ground-truthing**. Property-scale assessments frequently reveal that the broad-scale NZLRI mapping overestimates productive potential and misidentifies soil types at the local level. For example, a detailed assessment of the Voigt Property found that digital maps incorrectly classified the land as highly productive volcanic soils, whereas field inspection confirmed the presence of unsuitable podzolised 'gumland soil'. This disparity underscores the limitations of broad-scale data for precise local zoning.

The NZLRI data itself includes a **disclaimer**, stating that it should only be used at the published or smaller scales. This explicit caution from the data providers reinforces that the NZLRI is not individually suitable for precise local zoning.

3 DATASETS

This section provides a brief description of the various data considered and used for the proposed Horticulture Precinct delineation methodology. Links for these datasets are provided in **Appendix 1**.

3.1 NZLRI DATA

NZLRI Land Use Capability (NZLRI-LUC) - 2021

The NZLRI-LUC data was used as the initial, or 'default,' dataset for the methodology, particularly for areas lacking more detailed S-Map data. The database classifies land based on its inherent capability for sustained primary production. The methodology's focus on LUC Classes 1, 2, and 3 aligns with the Northland Regional Policy Statement's direction to protect versatile soils, which in the Far North context[4], are considered the best arable soils for horticulture. A key role of the NZLRI-LUC data was to provide an indication of these areas, while also acknowledging that some LUC 4 land may also be considered suitable for horticulture. A key role of the NZLRI-LUC data was to provide an indication of these areas, while also acknowledging that some LUC 4 land may also be considered suitable for horticulture. The methodology used the LUC unit (e.g. 3s2) to inform the initial classification of land as 'Include', 'Check', or 'Exclude'. In addition to the LUC class, the NZLRI subclasses were also important for this initial classification, with specific limitations such as wetness ('w') being used to inform decisions. It is acknowledged, however, that the NZLRI data has limitations and inaccuracies for local-scale planning.

4 Versatile soils means land classified as Land Use Capability 1c1, 2e1, 2w1, 2w2, 2s1, 3e1, 3e5, 3s1,3s2 and 3s4; https://www.nrc.govt.nz/media/clxj0ndy/regionalpolicystatementfornorthlandmay2016updatedmay2018.pdf.

NZLRI Slope - 2021

This dataset, which is part of the NZLRI, provides slope information as a series of slope classes aligned to the LUC class. The data is a key factor in determining the suitability of land for mechanised horticultural operations, as well as assessing erosion risk. The methodology uses this data to apply exclusions for slopes greater than 15 degrees, as they generally limit safe machinery operation.

3.2 S-MAP

The more detailed S-Map layer for the Far North District (specifically south of Kerikeri) is anticipated to offer significantly improved linework and finer detail, corroborating the revised methodology's emphasis on S-Map as the superior data source for local-scale planning.

At the time of developing this method, S-Map coverage for the notified Horticulture Zone area was very limited (302 ha of the original area), however, full S-Map coverage for the entire area is scheduled to be available in August 2025[5]. This revised method has included provision to utilise S-Map once fully available. **Figure 1** shows the extent of S-Map data.

5 Email correspondence with Emily McKay from Landcare Research (MWLR), dated Friday, June 27, 2025.

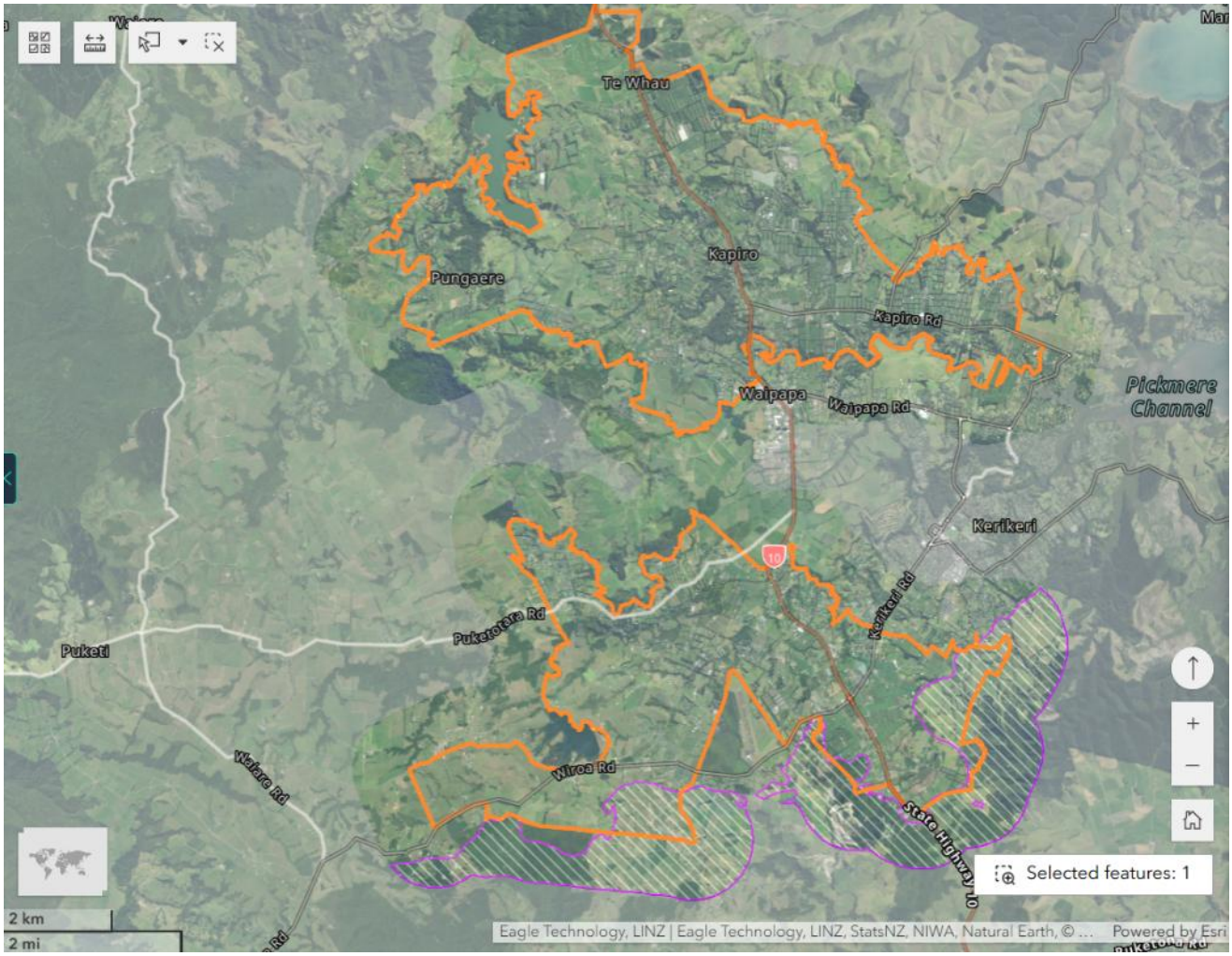

Figure 1: Extent of available S-Map data (purple boundary) covering the notified HZ area (orange) and 1km buffer area.

S-Map includes separate layers that are spatially available and useful for informing the spatial extent of a revised Horticulture Precinct area, specifically the soil classification layer and the soil characteristics layers for soil drainage and soil depth. These three data layers are considered spatially and contextually superior to the NZLRI data. Therefore, the methodology uses S-Map data in place of NZLRI data where S-Map coverage is available. For areas without S-Map data, the methodology defaults to using the NZLRI dataset to provide the initial land classification.

S-Map Soil Classification (Soil Order) - Aug 2024

The S-Map soil classification layer provides the New Zealand Soil Classification (NZSC) soil order for different areas. Certain soil orders, such as 'Ultic', 'Podzol', 'Gley', or 'Organic', are considered inherently unsuitable for sustained intensive horticulture due to severe limitations.

S-Map Soil Drainage - Aug 2024

S-Map is a modern digital soil map of New Zealand that provides more detailed soil information than the NZLRI. The S-Map Soil Drainage layer classifies soils based on the likelihood of seasonal wetness. The methodology uses this dataset to explicitly exclude soils that are 'Poorly drained' or 'Very poorly drained', as these are fundamentally unsuitable for sensitive horticultural crops. Imperfectly drained soils are assigned a 'Possibly Include' status for further investigation.

S-Map Soil Depth - Aug 2024

The S-Map Soil Depth layer provides information on the depth of the soil, which is a key attribute for horticultural suitability, particularly for deep-rooted crops like kiwifruit. The methodology uses a threshold of 0.60 meters. If the soil depth is less than this threshold, the area is assigned a 'Possibly Include' status, triggering a need for further assessment.

3.3 LAND COVER

LCDB v5.0 (Land Cover Database)

The Land Cover Database (LCDB) provides a record of land cover across New Zealand, derived from satellite imagery. The most recent version (LCDB v5.0) captured in 2018[6], is used as a crucial piece of evidence in the methodology to help refine the classification of land. It is used to identify areas that are currently in horticultural or cropping use, which helps to verify the suitability of land for horticulture (Orchard, Vineyard, or Other Perennial Crop' or 'Short-Rotation Cropland')[7].

3.4 IRRIGATED LAND

Irrigated Land Area - 2020

This dataset identifies areas with existing irrigation infrastructure and, while irrigation alone cannot overcome inherent soil limitations, its presence is a strong indicator of current or intended productive use.

The dataset is available from the MfE Data Service and serves as a strong indicator of current or intended productive land use, even though irrigation cannot overcome inherent soil limitations. The methodology for creating it involved a desktop study that integrated aerial and satellite imagery with a national water take consents dataset. For Northland, the dataset identified 12,337 hectares (ha) of irrigated land, a 47% increase from the 2017 data, attributed to new orchard and dairy farm developments.

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6 https://lris.scinfo.org.nz/layer/104400-lcdb-v50-land-cover-database-version-50-mainland-new-zealand/
7 https://lris.scinfo.org.nz/document/22491-lcdb-classes-at-version5/

The report notes that Northland is a ‘‘low NDVI-contrast region’,’ which can make distinguishing irrigated from non-irrigated land in imagery challenging. Other limitations for Northland include a high percentage of unidentifiable irrigation systems (36%) and the use of older aerial photos from 2014-2016 for some areas. While the dataset is not recommended for fine-scale, property-level planning without further validation, its role in identifying land with existing horticulture can help further confirm areas of land suitable for horticulture.

3.5 Ancillary data

DEM (Digital Elevation Model)

A DEM, or Digital Elevation Model, provides detailed topographic information. This data is used to verify slope classifications, particularly for identifying areas with slopes greater than 15 degrees that may not be accurately captured by the broad-scale NZLRI data.

Aerial Imagery (12 November 2023)

The most recent aerial imagery available on Google Earth is a vital tool for visual verification. It is used in the manual expert review stage to confirm classifications, assess land use, and identify any physical constraints that may contradict the automated classifications. It provides a visual confirmation of current horticultural activity, infrastructure, or other features that help to make a final determination.

Legacy soil map information

Legacy soil maps[8] were considered in this revised method. These maps provided a valuable reference for correlating soil series to the New Zealand Soil Classification (NZSC) and contextualising the current S-Map layer. They also served to supplement broad-scale NZLRI-LUC and Fundamental Soil Layers (FSL) data, addressing limitations for local planning and known inaccuracies. Due to the lack of a digitised map layer, the Legacy soil map information was utilised for manual, visual checking rather than for automated spatial analysis. Discussion with Manaaki Whenua – Landcare Research confirmed that the Legacy soil map information was considered during S-Map development for the Northland region.

4 Soil and land characteristics for horticultural suitability

4.1 Webb & Wilson 1994 soil and land characteristics for horticultural suitability

The Webb and Wilson (1994) classification provides a robust and widely recognised framework for assessing land versatility specifically for orchard crop production. This framework operates on the assumption of high capital and energy inputs, mechanised farming methods, and sufficient fertiliser

8 https://nrcgis.maps.arcgis.com/apps/webappviewer/index.html?id=fd6bac88893049e1beae97c3467408a9; Cox, J.E. et al. 1983: Northland Peninsula soil survey, scale 1:100 000.

application to meet crop nutrient requirements. It systematically categorises land qualities into three main groups: root zone qualities, management-related qualities, and environmental hazards.

Root Zone Qualities

Root penetrability (r or p): This refers to the volume of soil that roots can exploit and the ease with which they can grow through it. It is assessed by measuring the depth distribution of penetration resistance or density. For optimal versatility (O1), a minimum soil depth of 1 metre is ideal. Limitations include the presence of fragipans, compact horizons, underlying rock, gley horizons (indicating poor aeration), or excessively stony soils. This quality can be assessed using LUC and S-Map soil depth classes.

Profile aeration capacity (a): This indicates the likelihood of seasonal constraints on soil aeration. Inadequate aeration negatively impacts root function, and severe or prolonged anaerobic conditions can lead to crop failure. This quality can be assessed using LUC and S-Map soil drainage classes.

Risk of short-term waterlogging conditions (w): This complements the overall aeration assessment by quantifying the likelihood of brief (one day or more) anaerobic conditions occurring after rainfall or irrigation. It is assessed based on expected rainfall intensities and the soil's air-filled porosity and permeability profiles. This quality can be assessed using LUC and S-Map soil drainage classes.

Salinity (n): High salinity directly and negatively affects the growth of most crops. While less common in New Zealand, it is recognised in low-rainfall areas and estuarine sediments, with secondary salinisation possible from irrigation. Moderate to strong salinity indicates low versatility. This quality is not likely relevant for the soils of the notified Horticulture Zone area.

Soil water deficit (d): This represents the mean cumulative soil water deficit and is particularly crucial for non-irrigated production. High water stress significantly impacts crop yield and quality. Non-irrigated lands with deficits exceeding 300 mm typically exhibit very low or extremely low versatility. Irrigation is assumed to be available within the HZ as notified.

Management-Related Qualities

Topographic constraints to management (t): Topography significantly influences the feasibility of mechanisation in orchards. Slopes greater than 11 degrees are generally considered unsuitable for mechanised orchard production, as this approaches the practical limit for wheeled tractors operating with trailers. Optimal slopes are typically less than 10 degrees. Other factors such as the length, shape, and brokenness of the terrain also influence these ratings. This quality can be assessed using LUC slope classes and DEM derived slope.

Soil constraints to management (s): Factors such as excessive topsoil stoniness and shallow depth to underlying rock can impose constraints on orchard operations that require excavation, fencing, or trellising. While these factors primarily increase management costs, they typically do not reduce the orchard crop versatility class below moderate. This quality can be assessed using LUC and S-Map soil depth classes.

Soil constraints to trafficability (b): This refers to the soil's ability to support machine operations with minimal damage at critical times, which is vital for efficient orchard management. It is determined by the duration over which the soil surface-horizon penetration resistance is likely to exceed critical values. This quality cannot be assessed using LUC or S-Map data.

Environmental Hazards

Potential erosion risk (e): Soil erosion is a process of soil loss that can lead to reductions in crop production and pollution of water bodies. Land with a moderate erosion risk may retain moderate versatility for orchard crop production. However, severe erosion risk that directly threatens plants or structures renders the land unsuitable for orcharding. This quality can be assessed using LUC erosion classes.

Potential flood risk (f): Flooding, defined as the temporary covering of the soil surface by flowing water, poses a significant economic risk due to the substantial capital investment required for orchard development. A high probability of flooding therefore presents a high risk of economic losses. This quality can be inferred using LUC wetness limitations.

Potential leaching losses (l): This refers to the soil's inherent capacity to retain nutrients and contaminants (such as biocides) within the root zone, thereby minimising the risk of groundwater pollution. This capacity depends on the soil water surplus (the amount of water leaching through the soil) and its cation-exchange capacity. Moderate to very severe leaching losses are associated with moderate to low versatility, primarily due to their potential for environmental pollution. This quality is not assessed.

4.2 Soil and land characteristic considerations for horticulture in Northland

The soil criteria used in this methodology are primarily based on the requirements for kiwifruit. This is because kiwifruit cultivation demands highly specific soil attributes (e.g. excellent structure, deep fertile loam, precise pH range) that are more closely aligned with the characteristics of highly versatile and versatile soils (LUC Classes 1-3). Meeting these kiwifruit soil requirements generally ensures suitability for a wider range of other horticultural crops, including avocados, citrus and intensive vegetable production. Land characteristics, such as slope, are applied generally for mechanised orchard production, which encompasses the needs of kiwifruit, avocado and citrus, recognising that these all benefit from flatter terrain for efficient operations.

Kiwifruit soil and land requirements

Soil attributes: Optimal kiwifruit production occurs in deep, fertile loam soils that are well-drained and free-draining, possessing excellent soil structure.

Slope: Most kiwifruit orchards are established on flat to gently undulating land, ideally with a slope of less than 8 degrees, to facilitate the operation of machinery and pergola systems.

Avocado soil and land requirements

Soil attributes: Avocados grow best in free-draining, sandy or loamy soils that are well-aerated, as they are highly prone to Phytophthora root rot in waterlogged conditions.

Slope: Flat or gently sloped land is considered best for avocado cultivation, however, steeper slopes up to 15 degrees can support avocado orchards.

Citrus soil and land requirements

Soil attributes: Citrus trees perform best in deep, well-drained, and fertile loamy soils with good structure. They are highly sensitive to waterlogged conditions, which can lead to root rot. A good soil depth is required to support their extensive root systems.

Slope: Flat to gently sloping land is considered optimal for the use of machinery and general orchard management. However, citrus can be successfully cultivated on slopes up to 15 degrees, provided appropriate management strategies are employed to control soil erosion and ensure efficient access.

Intensive vegetable production soil and land requirements

Soil attributes: Intensive vegetable production requires deep, fertile, and well-drained soils with a high capacity for water and nutrient retention. The soil must possess excellent structure and be easily workable to facilitate repeated cultivation, planting, and harvesting cycles. Waterlogging is a significant constraint for the majority of vegetable crops.

Slope: Land for intensive vegetable production must be predominantly flat or gently undulating. This is crucial for enabling a high degree of mechanisation, implementing efficient irrigation systems, and mitigating the risk of soil erosion on land that is frequently exposed. Ideally, a slope of less than 8 degrees is required for most mechanised operations.

Additional comment on slope

A maximum slope of 15 degrees is generally considered acceptable for avocado, kiwifruit, and citrus orchards in New Zealand, provided that appropriate management strategies are implemented to address the challenges associated with sloped terrain.

Avocado cultivation in New Zealand is viable on slopes up to 15 degrees, with ‘Rolling’ land (8-15 degrees) being considered a suitable option. Although flat land is often preferred for operational ease, slopes up to 15 degrees are acceptable for various horticultural crops. A Plant & Food Research assessment for generic horticulture in Northland's Kaipara District uses a slope criterion of ‘less than 15°’ to ensure trafficability for orchards and vineyards.

Kiwifruit can also be successfully cultivated on slopes up to 15 degrees. The ‘Land Use Capability Classification of the Northland Region’ identifies LUC unit IIIe2 (3e2) as having ‘Gently rolling to rolling slopes’ (8-15 degrees) where kiwifruit is listed as a present and potential vegetation type. This unit is described as highly suited to cropping, including kiwifruit, despite slight physical limitations under intensive use. The general horticultural suitability assessment for Kaipara District also includes kiwifruit within its ‘less than 15°’ slope criterion.

Citrus is also grown on sloped land within this range. The Northland Region's LUC classification includes LUC unit IIIe1 (3e1), which features 'Undulating to rolling slopes' (4-15 degrees) and lists 'subtropical fruit' as a present and potential land use. Citrus is specifically mentioned as one of the main subtropical crops cultivated in Northland. Similar to kiwifruit and avocados, the Kaipara District's generic horticulture assessment considers slopes less than 15 degrees suitable for these crops.

Climate

Note that climate is not considered a criterion in this revised method due to limited available data. The assumption has been made that the climate throughout the area is suitable given the presence of kiwifruit and other horticulture.

Soil pH nutrients and organic matter

Similarly, soil pH, nutrients and organic matter are not considered in this method due to limited data, inherent variability (organic matter), or that deficiencies can be managed by the addition of fertiliser (nutrients) or lime (soil pH).

4.3 Integration of Irrigation Infrastructure and Water Availability

Reliable water access from irrigation schemes, dams, or aquifers is critical for successful horticulture within the HZ. The Kerikeri Irrigation North and South Regions, servicing approximately 5,801 hectares, demonstrate this infrastructure's importance for the zone's productive potential. However, irrigation, while enhancing yields and mitigating moisture deficits, does not fundamentally alter a soil's inherent physical limitations. Irrigation generally cannot overcome major inherent limitations of most LUC 4 subclasses, particularly those with severe erosion risk under cultivation (4e) or persistent wetness (4w) and may even exacerbate existing issues like runoff on erodible slopes or waterlogging in poorly drained areas, leading to unsustainable production.[9] This highlights that irrigation facilitates, rather than fixes, inherent soil limitations. Therefore, while irrigation is necessary for high yields in Northland's variable climate, its presence alone is insufficient to reclassify unsuitable land as productive; underlying soil properties and their long-term response to intensive management remain the primary determinants of sustainable horticultural potential.

9 https://www.fndc.govt.nz/__data/assets/pdf_file/0032/34979/Audrey-Campbell-Frear,-S209,-FS172-I-Hanmore,-Soils-evidence.pdf.

5 Reclassification Framework

5.1 Overview

This methodology employs a two-step classification framework to delineate land suitability:

1. Initial classification

This step used NZLRI-LUC data or S-Map soil characteristic data, combined with LCDB vegetation data and Irrigated land data to identify areas to 'Include', 'Check', or 'Exclude'. An ‘initial status’ classification layer with attributes 'Include', 'Check', or 'Exclude' was assigned to polygons to inform the visual checking and classification review.

2. Visual checking and classification review

This step used ancillary data and visual checks by a soil expert to review and revise the classifications in question. The ancillary data was unable to be incorporated into the GIS for spatial analysis, so its use was by expert visual assessment. The soil expert conducted a visual review using aerial imagery for all ‘Check’ polygons. The soil expert's final determination was used to update the fields in the GIS.

5.2 Spatial analysis process

A series of spatial analysis steps were performed by the Property Group spatial analyst to review land included in within the notified HZ boundary. The spatial analysis steps followed guidance provided by the soil expert. The work was conducted in ArcGIS. The process began by intersecting all relevant data layers—NZLRI-LUC, S-Map data, LCDB v5.0, and Irrigated land data—with the notified Horticulture Zone boundary to create a primary analysis feature class.

An ‘initial status’ classification layer with attributes 'Include', 'Exclude' or 'Check', was then assigned to polygons based on NZLRI-LUC and S-Map criteria, with S-Map data taking precedence where available. Polygons were re-evaluated using data from the Land Cover Database (LCDB5) and Irrigated land datasets.

Using the initial status layer classifications, a manual expert review of the ‘Check’ polygons was conducted by the soil expert using ancillary data to check and revise the classifications ‘in question’. The soil expert's final determination was used to update the fields in the GIS. A ‘final status’ classification layer with attributes 'Include', ‘Possibly Include’, ‘Possibly Exclude’, and 'Exclude' was finalised for use by the policy expert.

Spatial cohesion adjustments were then made to the final polygons before a new feature class, representing the revised boundaries, was created. Metadata was created and version control was maintained throughout the process.

5.3 INITIAL CLASSIFICATION

The initial classification step uses NZLRI-LUC data or S-Map soil characteristic data combined with LCDB vegetation data and irrigated land data to identify areas to 'Include', 'Exclude', or 'Check'. The second step uses ancillary data and visual checking.

S-Map Soil properties

Where available, S-Map data is considered the most reliable and detailed source for local-scale soil information and takes precedence over NZLRI data. **Table 1** outlines the specific thresholds from S-Map's soil properties that were used to determine a polygon's initial classification status. The criteria focused on identifying fundamentally unsuitable soil characteristics, such as specific soil orders and poor drainage, which were grounds for the 'Exclude' classification.

Table 1. S-Map Soil property criteria for the initial classification.

S-Map soil property	Criteria	Initial Status	Rationale
Soil Classification (Soil Order)	Not 'Ultic', 'Podzol', 'Gley', or 'Organic'	'Include'	These soil orders are inherently unsuitable and explicitly classified as 'Exclude'. Other soil orders are considered favourable for 'Include'.
	'Ultic', 'Podzol', 'Gley', or 'Organic'	'Exclude'	These soil orders are inherently unsuitable for sustained intensive horticulture due to severe limitations.
Soil Drainage	'Well-drained' to 'Moderately Well-drained'	'Include'	Kiwifruit requires well-drained soils, ensuring adequate aeration for healthy root function.
	'Imperfectly drained'	'Check'	Soils in this category require further investigation.
	'Poorly drained' or 'Very Poorly drained'	'Exclude'	Kiwifruit and other sensitive crops do not tolerate wet or waterlogged conditions, which can lead to root diseases.
Soil Depth	≥ 0.40 metres (Moderately deep to deep)	'Include'	This depth is considered a favourable threshold for deep-rooted horticultural crops.
	< 0.40 metres	'Check'	A depth less than this threshold triggers a need for further assessment.

NZLRI-LUC Criteria

For areas where S-Map data was not available (the majority of the notified HZ area), the NZLRI-LUC database was used to provide the initial classification. **Table 2** outlines the default classification for various LUC classes and units, including strict 'Exclude' classifications for land with severe limitations such as wetness-prone ('w' units) and steep slopes (‘e’ units).

Table 2. NZLRI-LUC thresholds for the initial classification.

LUC Unit	Initial Status	Rationale
2s1	'Include'	LUC Classes 1, 2, 3 (excluding 'w' subclasses) are initially classified as 'Include'.
3e1	'Include'	LUC Classes 1, 2, 3 (excluding 'w' subclasses) are initially classified as 'Include'.
3s2	'Check'	This specific unit is explicitly tagged as 'Check' in the NZLRI-Based Initial Classifications.
3w2	'Check'	LUC Classes 1, 2, 3 with 'w' subclasses are tagged as 'Check'.
4e2	'Check'	LUC Class 4 (excluding 'w' subclasses) are initially tagged as 'Check'.
4e6	'Check'	LUC Class 4 (excluding 'w' subclasses) are initially tagged as 'Check'.
4e7	'Check'	LUC Class 4 (excluding 'w' subclasses) are initially tagged as 'Check'.
4s2	'Check'	LUC Class 4 (excluding 'w' subclasses) are initially tagged as 'Check'.
4s4	'Exclude'	This specific unit (Podzols on sedimentary rock) is explicitly classified as 'Exclude'.
4w1	'Exclude'	LUC Class 4 with 'w' subclasses are explicitly classified as 'Exclude'.
5c1	'Exclude'	LUC Classes 5, 6, 7, 8 are all classified as 'Exclude'.
5s1	'Exclude'	LUC Classes 5, 6, 7, 8 are all classified as 'Exclude'.
6e1	'Exclude'	LUC Classes 5, 6, 7, 8 are all classified as 'Exclude'.
6e4	'Exclude'	LUC Classes 5, 6, 7, 8 are all classified as 'Exclude'.
6e9	'Exclude'	LUC Classes 5, 6, 7, 8 are all classified as 'Exclude'.
6s2	'Exclude'	LUC Classes 5, 6, 7, 8 are all classified as 'Exclude'.
6s5	'Exclude'	LUC Classes 5, 6, 7, 8 are all classified as 'Exclude'.

LCDB v5.0 (Land Cover Database) Reclassification

Land use as of 2018, as captured by LCDB v5.0, provides verifiable evidence of a polygon's suitability for horticulture. Table 3 summarises how current or previous horticultural or cropping activity can trigger a reclassification. This is especially important for land that might have been initially classified as 'Check' or 'Exclude' based on other criteria, as it suggests the land is, in fact, capable of supporting horticulture and can over-ride the NZLRI-LUC based classification in the initial step.

Table 3. LCDB criteria for the initial classification.

Initial Status	Condition	Reclassified Initial Status	Rationale
'Check'	LCDB5 indicates 'Orchard, Vineyard, or Other Perennial Crop' or 'Short-Rotation Cropland'	'Include'	Current land use is strong evidence of productive use and can be used to reclassify a polygon to 'Include'.
'Exclude'	LCDB5 indicates 'Orchard, Vineyard, or Other Perennial Crop' or 'Short-Rotation Cropland'	'Check'	Existing horticultural or cropping activity on land initially classified as 'Exclude' triggers a reclassification to 'Check', prompting a manual review by an expert to verify suitability.

Irrigated land reclassification

The presence of existing irrigation infrastructure is a strong indicator of productive use and can be used to reclassify a polygon's initial status. **Table 4** details how the Irrigated Land data was used to upgrade a polygon's status from 'Check' to 'Include' or from 'Exclude' to 'Check' for further review, acknowledging that irrigation can mitigate moisture limitations but does not fundamentally alter a soil's inherent physical limitations.

Table 4. Irrigated land criteria for the initial classification.

Initial Status	Condition	Reclassified Initial Status	Rationale
'Check'	Irrigated land data indicates 'Irrigated Land'	'Include'	The presence of irrigation is strong evidence of productive use and can be used to reclassify a polygon to 'Include'.
'Exclude'	Irrigated land data indicates 'Irrigated Land'	'Check'	Irrigation on land initially classified as 'Exclude' triggers a reclassification to 'Check', prompting a manual review by an expert to verify suitability.

Based on the initial classification, a map was created and all the spatial data was made available through an ArcGIS viewer application. This was done to facilitate the second step of the process, which was the visual checking and classification review conducted by a soil expert. This approach allowed for the manual expert review of 'Check' polygons using ancillary data.

5.4 Final classification

To further improve accuracy, especially without extensive on-the-ground field checks, a combination of digitally available datasets was used to verify the initial classifications. The manual review was conducted by the soil expert to confirm 'Include' and 'Exclude' classifications and to definitively

determine the status of 'Check' areas. This visual review used all relevant ancillary data, including the 2023 aerial imagery layer, for all polygons initially flagged with a 'Check' status.

During this process, the soil expert:

- Checked for consistency between the classified status and the land use observed in aerial imagery.
- Used ancillary data to identify potential misclassifications.
- Used aerial imagery to verify the presence of horticultural activity, irrigation, or other relevant features.
- Checked for any obvious physical constraints that the automated classification might have missed.

Following discussions with the Council reporting officer who is considering the spatial extent of the revised Horticulture Precinct, the polygons were ultimately reclassified into four final categories: 'Include', 'Possibly Include', 'Possibly Exclude', and 'Exclude'. These classes were chosen to provide a more detailed and useful delineation based on soil and land characteristics, to best inform the reporting officer's recommendations. The specific checks performed during this stage are summarised in Table 5.

Table 5. The combination of digitally available datasets (ancillary data) and criteria used to verify the validity of 'Include', 'Possibly Include', 'Possibly Exclude' and 'Exclude' areas during manual expert review.

Data Layer	Action/Use	Rationale
DEM slope class (Digital Elevation Model derived slope classes)	Used to verify slope classifications, particularly for identifying slopes > 15 degrees.	This data is used to confirm exclusions for areas that may not have been accurately captured by NZLRI data. The main changes are where: LUC 4e land is reclassified to 'Possibly Include' if slopes are predominantly <15 degrees, and LUC 3 land is reclassified to 'Possibly Exclude' if slopes are predominantly >15 degrees.
2025 Aerial Imagery	Used for thorough visual review by the soil expert for all 'Check' polygons.	Provides visual confirmation of land cover/use and the presence of horticulture. Essentially this is providing a revision of the dated (2018) LCDB data). The main changes are where: LUC 3 land is reclassified to 'Possibly Include' if horticulture is present and LUC 4 land is reclassified to 'Possibly Exclude' if horticulture is present.
Legacy Soil Maps	Used for manual, visual correlation and context.	Provides valuable reference for checking soil series suitability for horticulture. The main changes are where: LUC 3 and 4 land is reclassified to 'Possibly Exclude' if soil series included suffix 'b' (indicating bouldery) was dominant and was reclassified to 'Possibly Exclude'.

Based on the manual expert review, the final classification for polygons was directly updated in the GIS to reflect the results. This revised classification was then used to update the preceding layer, ensuring

the GIS accurately reflected the final 'Include', 'Possibly Include', 'Possibly Exclude', or 'Exclude' determinations. The purpose of these additional categories was to provide specific guidance to the reporting officer. For example, land that was generally more favourable based on its inherent soil and land characteristics was classified as 'Possibly Include'. Conversely, if land was generally less favourable, it was classified as 'Possibly Exclude'.

5.5 Final Output

The final output of the methodology is a revised, Soil and LUC base layer intended to be used by the Council reporting officer to make recommendations on the spatial extent of the revised Horticulture Precinct. This is represented as new feature classes containing areas confirmed as:

- 'Include' areas of land considered fundamentally suitable for horticulture.
- 'Possibly Include' slightly more favourable areas requiring further consideration.
- 'Possibly Exclude' slightly less favourable areas requiring further consideration.
- 'Exclude' areas of land considered fundamentally unsuitable for horticulture.

6 Revised classification outputs

6.1 Initial classification

This subsection presents the outputs of the automated spatial analysis, which assigned polygons within the notified Horticulture Zone to one of three categories: ‘Include’, ‘Check’, or ‘Exclude’. Results are visualised spatially in **Figure 2**. The classification used NZLRI data and, where available, S-Map data in combination with the LCDB and Irrigated land data to inform decisions.

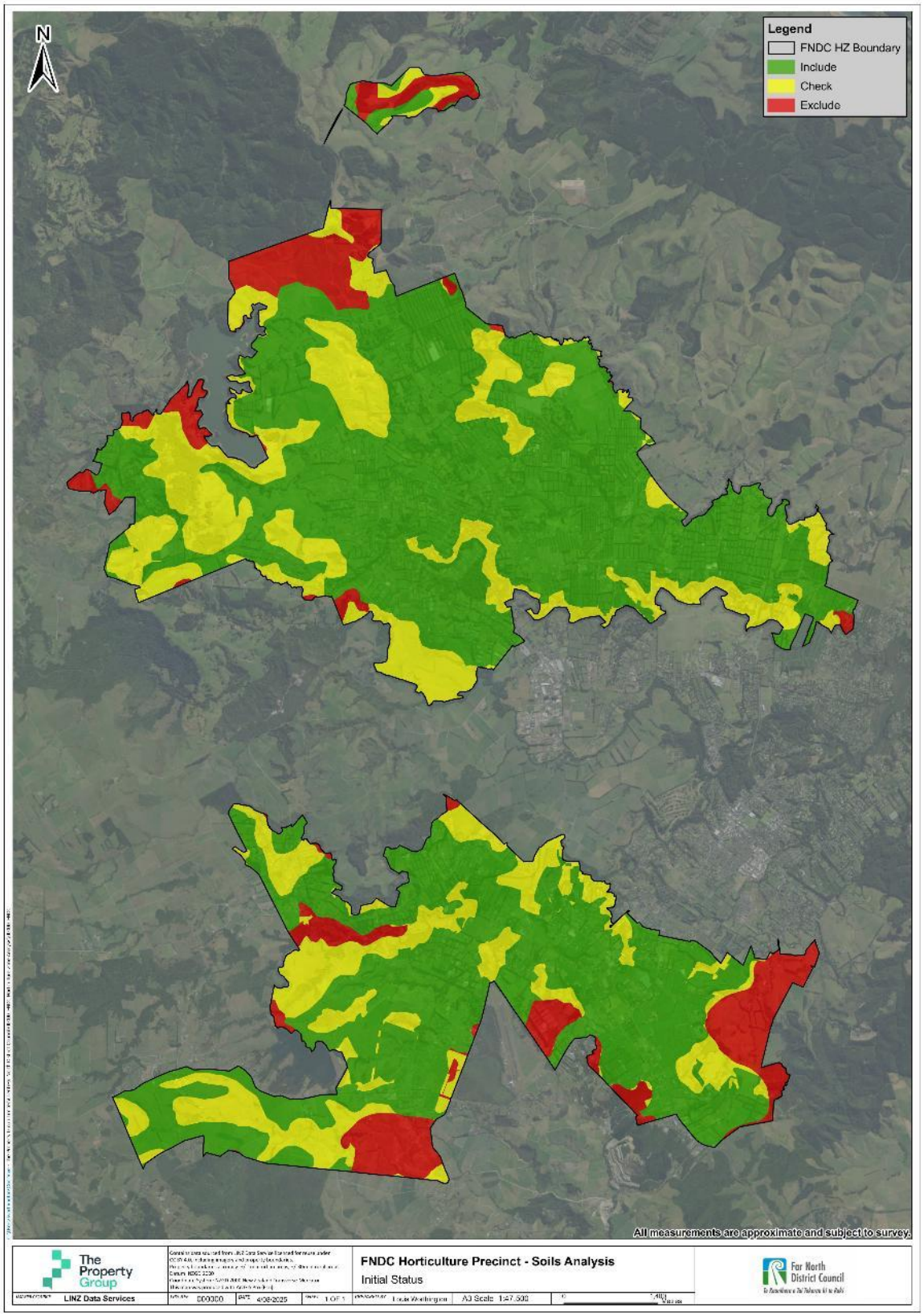

Figure 2: Map for the initial classification areas (Include, Check and Exclude).

As shown in Figure 2, the initial classification resulted in a broad spatial distribution across the three categories. Land areas classified as Include are widely distributed throughout the core of the Horticulture Precinct. Conversely, land classified as 'Exclude' is typically found on the periphery of the precinct, often corresponding to steeper terrain and river margins. The Check areas, which require further expert review, are scattered between the other two categories, indicating zones where automated analysis alone could not definitively determine suitability.

The detailed area distribution of each LUC unit is provided in Table 6. The table ranks LUC units from most versatile to least versatile land.

Table 6. Initial classification by LUC Unit from most versatile to least versatile land for the notified Horticulture Zone area.

LUC unit	'Include' (%)*	'Check' (%)*	'Exclude' (%)*	% by LUC unit*
2s1	15.4%	0.1%	5.9%	10.5%
3e1	8.5%	0.0%	0.0%	5.5%
3s2	72.5%	0.0%	0.2%	46.6%
3w2	0.0%	11.0%	0.0%	2.8%
4e2	3.6%	75.6%	13.7%	22.9%
4e6	0.0%	1.8%	0.0%	0.5%
4e7	0.0%	7.6%	7.0%	2.7%
4s2	0.0%	2.2%	0.0%	0.6%
4s4	0.0%	0.4%	12.8%	1.4%
4w1	0.0%	0.8%	11.2%	1.4%
5c1	0.0%	0.0%	0.2%	0.0%
5s1	0.0%	0.3%	9.9%	1.1%
6e1	0.0%	0.0%	0.0%	0.0%
6e4	0.0%	0.1%	20.4%	2.1%
6e9	0.0%	0.1%	3.2%	0.3%
6s2	0.0%	0.0%	0.3%	0.0%
6s5	0.0%	0.0%	15.2%	1.6%

*Minimum reported value is 0.1%.

Based on the data presented in Table 6, there is a clear and predictable distribution of LUC units, reflecting their versatility. For the most versatile land (LUC 1-3), the vast majority of the area was assigned to the 'Include' class, making up 96.4% of that category's total. Only a minimal portion of this versatile land was classified as 'Exclude' (6.1% of that category's total).

In contrast, land with lower versatility (LUC 4-6) showed a fundamentally different distribution. Only a small fraction of this land was categorised as 'Include' (3.6% of that category's total), with the majority falling into the 'Check' (96.0%) and 'Exclude' (93.9%) classes. This distribution indicates the initial classifications effectiveness for identifying the most suitable land for horticulture.

These findings are consistent with the methodological hypothesis, confirming that land with higher versatility (LUC 1-3) is more likely to be included in the Horticulture Precinct, whereas land with lower versatility is subject to a more thorough review or direct exclusion from the outset.

The initial classification serves a crucial purpose in addressing known limitations of the underlying data, such as potential misclassification issues identified in the report. The deliberate use of the 'Check' and 'Exclude' categories, particularly for certain LUC units like 3w2 (wetness limitation), 3s2 (soil limitation), and all LUC Class 4 land, is a core feature of the methodology. This approach is designed to flag areas that, while potentially appearing productive at a broad scale, possess inherent physical limitations that necessitate a more detailed, expert review before a final classification can be determined.

Final classification

This subsection provides the final output, which follows a manual expert review of all Check polygons using ancillary data and visual aerial imagery checks. The outputs are first visualised in **Figure 3**, a map of the final classification areas. The final classification replaces the initial three classes with a more detailed, four-tiered system: 'Include', 'Possibly Include', 'Possibly Exclude', and 'Exclude'.

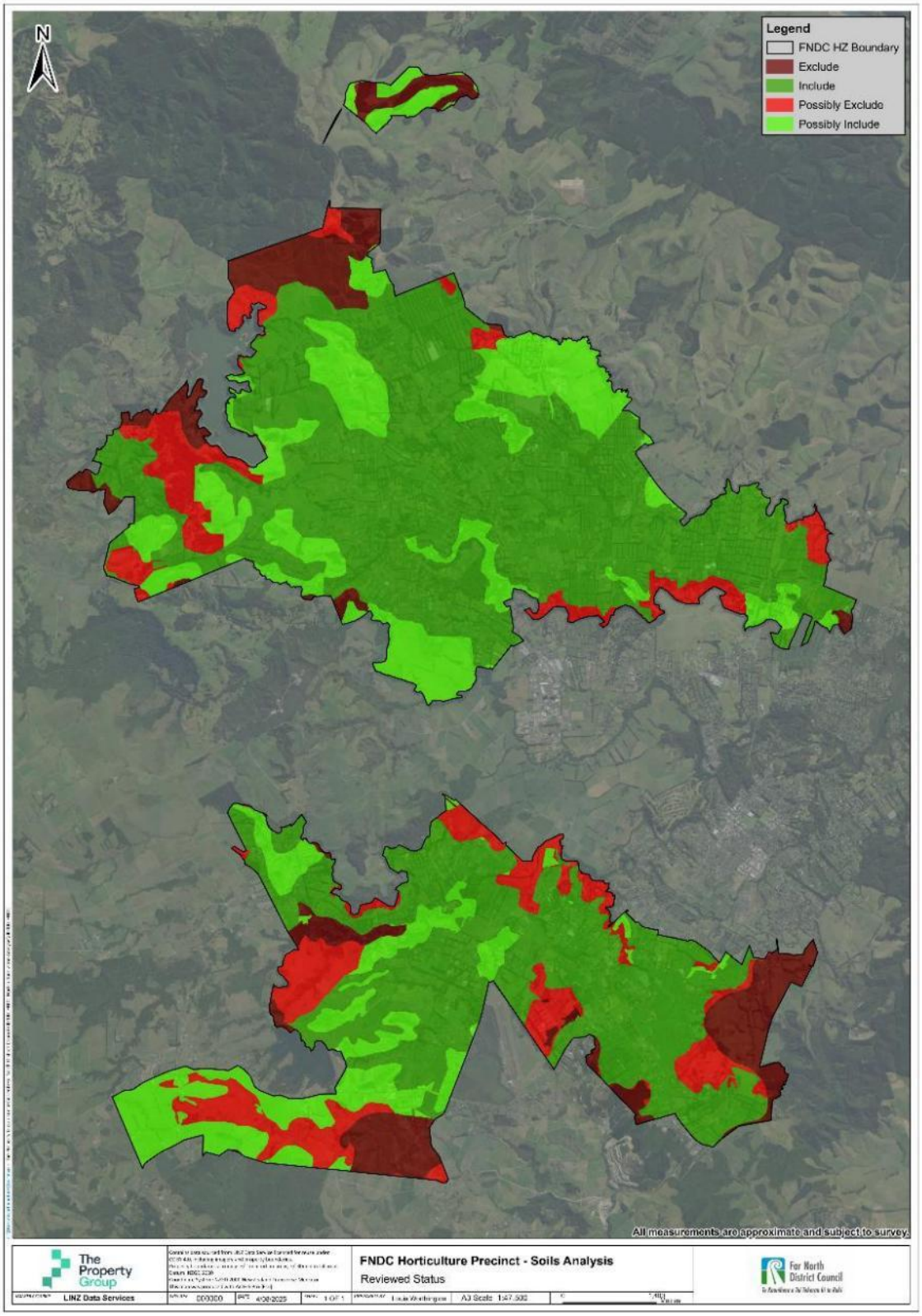

Figure 3: Map for the Final classification areas ('Include', 'Possibly Include', 'Possibly Exclude' and 'Exclude').

As shown in Figure 3, the manual review and final classification have refined the initial spatial distribution. Areas that were previously classified as 'Check' have now been assigned a more definitive status, with the new 'Possibly Include' and 'Possibly Exclude' categories often as areas between the core 'Include' and peripheral 'Exclude' areas. This reflects the expert judgement applied to areas with mixed characteristics, ensuring availability of more precise information to inform the location of the proposed Horticulture Precinct boundary.

The detailed area distribution of each LUC unit is provided in Table 7. The table ranks LUC units from most versatile to least versatile land.

Table 7. Final classification by LUC Unit from most versatile to least versatile land for the notified Horticulture Zone area.

LUC unit	'Include' (%)*	'Possibly Include' (%)*	'Possibly Exclude' (%)*	'Exclude' (%)*	% by LUC unit*
2s1	17.1%	0.6%	0.2%	6.3%	10.5%
3e1	9.6%	0.0%	0.0%	0.0%	5.5%
3s2	70.3%	29.5%	1.4%	0.2%	46.6%
3w2	0.0%	8.4%	8.3%	0.0%	2.8%
4e2	3.0%	47.9%	81.0%	14.5%	22.9%
4e6	0.0%	0.0%	3.8%	0.0%	0.4%
4e7	0.0%	8.8%	0.2%	7.5%	2.7%
4s2	0.0%	2.7%	0.0%	0.0%	0.6%
4s4	0.0%	0.2%	0.8%	13.3%	1.4%
4w1	0.0%	1.4%	4.1%	6.0%	1.4%
5c1	0.0%	0.0%	0.0%	0.2%	0.0%
5s1	0.0%	0.4%	0.0%	10.5%	1.1%
6e1	0.0%	0.0%	0.0%	0.0%	0.0%
6e4	0.0%	0.1%	0.0%	21.7%	2.1%
6e9	0.0%	0.0%	0.1%	3.4%	0.3%
6s2	0.0%	0.0%	0.0%	0.4%	0.0%
6s5	0.0%	0.0%	0.0%	16.1%	1.6%

*Minimum reported value is 0.1%.

Based on Table 7, a greater proportion of LUC classes 2 and 3 (most versatile land) was classified as 'Include'. For the versatile land, the majority of the 3,801.2 ha classified as 'Include' was dominated by LUC unit 3s2 (2,754.3 ha). However, some of LUC 3s2 (439.0 ha) was also classified as 'Possibly Include' along with a lesser area of LUC 3w2 (125.4 ha). The 'Possibly Exclude' category was predominantly from unit 3w2, while the final 43.0 ha classified as 'Exclude' was almost entirely from LUC unit 2s1.

In contrast, least versatile land showed a different distribution. The largest category for this land was 'Possibly Include' at 913.9 ha, with most of this coming from LUC unit 4e2 (711.9 ha). Similarly, the next

largest category, ‘Possibly Exclude’ (725.6 ha), was also primarily composed of unit 4e2 (652.7 ha), with only a small portion of this unit (116.3 ha) being classified as ‘Include’.

Table 8 provides a more granular comparison of the Initial and Final classifications. On this occasion, a separate breakdown is included for LUC 4, as this class, while technically considered arable, possesses severe physical limitations that required a more rigorous, evidence-based assessment to determine its suitability for the proposed Horticulture Precinct.

Table 8. Table 8. Comparison of Initial and Final classification areas by versatile and least versatile land.

Initial classification	‘Include’ (%)*	‘Check’ (%)*		‘Exclude’ (%)*	LUC totals (%)*
LUC 1-3	94.7%	4.3%		1.0%	65.4%
LUC4	8.0%	76.4%		15.6%	29.4%
LUC 5-6	0.0%	2.3%		97.7%	5.2%
Final classification	‘Include’ (ha)*	‘Possibly Include’ (ha)*	‘Possibly Exclude’ (ha)*	‘Exclude’ (ha)*	Totals (ha)*
LUC 1-3	84.5%	12.7%	1.8%	1.0%	65.4%
LUC 4	5.8%	44.8%	35.8%	13.6%	29.4%
LUC 5-6	0.0%	2.2%	0.2%	97.6%	5.2%

*Minimum reported value is 0.1%.

The data in Table 8 consistently shows a clear distribution based on land versatility, from the initial to the final classification. For the most versatile land (LUC 1-3), the majority (94.7%) was initially classified as 'Include'. A substantial amount of this land, however, has been re-evaluated in the final classification, with the 'Include' portion decreasing to 84.5%. This shift moved a significant 12.7% of LUC 1-3 land into the 'Possibly Include' category.

Land with moderate to severe limitations (LUC 4) showed a different pattern. Initially, the largest portion (76.4%) was placed in the 'Check' category. In the final classification, this group was distributed primarily into the 'Possibly Include' (44.8%) and 'Possibly Exclude' (35.8%) categories, with only 5.8% remaining in the 'Include' category.

For the least versatile land (LUC 5-6), the classification remained largely consistent across both analyses. An overwhelming majority of this land (97.7% initially, and 97.6% finally) was categorized as 'Exclude', with minimal portions in the other classes. This highlights a strong correlation between low land versatility and unsuitability for the Horticulture Zone.

The shift from the initial to the final classification highlights the critical role of expert review in assessing land with moderate or mixed limitations, thereby mitigating the risk of misclassification inherent in broader-scale datasets. This was made possible through visual assessment and ancillary data, which allowed for a finer-scale assessment in the absence of on-ground surveys. Specifically, data such as DEM

slope classes and aerial photography were incorporated to provide a more detailed and robust basis for final decisions.

The refinement directly addressed misclassification issues, which are known to exist in the national NZLRI-LUC database. For example, the national database incorrectly recorded the Voigt property as having highly productive volcanic soils, when a field survey confirmed it has unsuitable 'gumland soils'. Similarly, LUC unit 3w2 (with a wetness limitation) was initially flagged as 'Check' and was subsequently split into 'Possibly Include' and 'Possibly Exclude,' demonstrating the value of a more detailed assessment. By moving beyond the broad assumptions of national datasets, this approach provides a more robust and scientifically based final output for informing the location of the proposed Horticulture Precinct boundary, ensuring that land suitability is based on a hierarchy of evidence and targeted scrutiny.

Analysis of S-Map data

An analysis of the area informed by S-Map data was conducted to provide a more detailed understanding of the value of using S-Map data criteria given that S-Map data is considered spatially and contextually superior to the NZLRI data. The tables presented include a breakdown of the total area, with the classifications based on S-Map data explicitly identified by soil properties, while the remaining areas are classified based on the default NZLRI-LUC data. The Initial classification of the combined S-Map and NZLRI-LUC area is shown in Table 9.

Table 9. Initial classification by S-Map criteria for the notified Horticulture Zone area, with NZLRI-LUC area classifications for the balance of the area.

Soil order	Sum of area (ha)	Soil drainage	Sum of area (ha)	Soil depth	Sum of area (ha)
'Include'	4,420	'Include'	4,420	'Include'	4,420
NZLRI-LUC data area only	4,420	NZLRI-LUC data area only	4,420	NZLRI-LUC data area only	4,420
'Check'	1,750	'Check'	1,750	'Check'	1,750
Oxidic	6	Imperfectly drained	3	Deep	6
Ultic	3	Poorly drained	2	Shallow	3
NZLRI-LUC data	1,741	Well drained	4	NZLRI-LUC data	1,741
'Exclude'	712	'Exclude'	712	'Exclude'	712
Gley	28	Imperfectly drained	265	Deep	223
Ultic	265	Poorly drained	28	Shallow	71
NZLRI-LUC data area	419	NZLRI-LUC data	419	NZLRI-LUC data	419
Grand Total	6,882	Grand Total	6,882	Grand Total	6,882

As shown in Table 9, the initial classification relied heavily on the available NZLRI-LUC data. However, where available, more detailed S-Map data was crucial in flagging specific areas for exclusion or further review. For instance, the presence of Gley soils (28 ha) and a substantial amount of Ultic soils (265 ha) led to a direct 'Exclude' classification, validating the use of S-Map to identify inherently unsuitable soil types. Similarly, the 'Check' category was informed by S-Map data that identified areas with Imperfectly drained soils and limited soil depth, which required expert review to determine final suitability.

The final classification of the combined S-Map and NZLRI-LUC area, following an expert review, is presented in Table 10. The initial classification classes have been replaced by the more detailed, four-class system. For comparison, the NZLRI-LUC area classifications for the balance of the notified Horticulture Zone area have also been included.

Table 10. Final classification by S-Map criteria for the notified Horticulture Zone area, with NZLRI-LUC area classifications for the balance of the area.

Soil Order	Sum of Area (ha)	Soil Drainage	Sum of Area (ha)	Soil Depth	Sum of Area (ha)
'Include'	3,919	'Include'	3,919	'Include'	3,919
NZLRI-LUC data area only	3,919	NZLRI-LUC data area only	3,919	NZLRI-LUC data area only	3,919
'Possibly Include'	1,487	'Possibly Include'	1,487	'Possibly Include'	1,487
NZLRI-LUC data Only	1,487	NZLRI-LUC data area only	1,487	NZLRI-LUC data area only	1,487
'Possibly Exclude'	810	'Possibly Exclude'	810	'Possibly Exclude'	810
Oxidic	6	Imperfectly drained	3	Deep	6
Ultic	3	Poorly drained	2	Shallow	3
NZLRI-LUC data area	801	Well drained	4	NZLRI-LUC data	801
'Exclude'	666	'Exclude'	666	'Exclude'	666
Gley	28	Imperfectly drained	265	Deep	223
Ultic	265	Poorly drained	28	Shallow	71
NZLRI-LUC data area	373	NZLRI-LUC data	373	NZLRI-LUC data	373
Grand Total	6,882	Grand Total	6,882	Grand Total	6,882

The final classification, presented in Table 10, shows the outcome of the expert review process. A comparison of the two tables highlights the refinement achieved. The initial 'Check' areas identified by S-Map data, which were flagged due to various soil properties, were reclassified into the 'Possibly Exclude' category. Notably, none of the initial S-Map 'Check' areas were reclassified as 'Possibly Include', which is a key finding. The S-Map data analysis confirms that a significant proportion of the land covered

by S-Map was excluded based on specific S-Map criteria. The final classification revealed that out of the 302 ha covered by S-Map data, 268 ha were excluded due to the identification of Ultic and Gley soils. This aligns with the detailed soil mapping provided by Mr. Cathcart for the Voigt property, which identified unsuitable 'gumland soil' in an area previously thought to be highly productive, adding validity to the inclusion of S-Map data in the methodology.

The analysis highlights that while S-Map data, where available, provided a more granular and improved soil classification for that specific area, it is important to acknowledge that this may not necessarily hold true for the remainder of the notified Horticulture Zone. Once S-Map data becomes available for the entire area, further verification would be required to confirm the classifications. For now, the findings demonstrate that the use of S-Map is a demonstrable improvement and aligns with the outcomes of on-ground, finer-scale mapping undertaken for the Voigt property.

7 Delineation of the proposed Horticulture Precinct boundary

Following the completion of the Final classification layer, a workshop involving the Council reporting officer, the soil expert and a spatial analyst was held to delineate a revised/proposed Horticulture Precinct boundary.

The delineation was a collaborative effort that considered polygons classified as 'Exclude', 'Possibly Exclude', and 'Possibly Include' in conjunction with parcel boundaries, rivers, roads, and other ‘hard’ or ‘natural’ boundaries. The inclusion or exclusion of land parcels was considered as a whole (i.e. there was not delineation within land parcels).

Figure 4 provides a visual representation of the proposed Horticulture Precinct boundary and the areas to be removed from the notified Horticulture Zone.

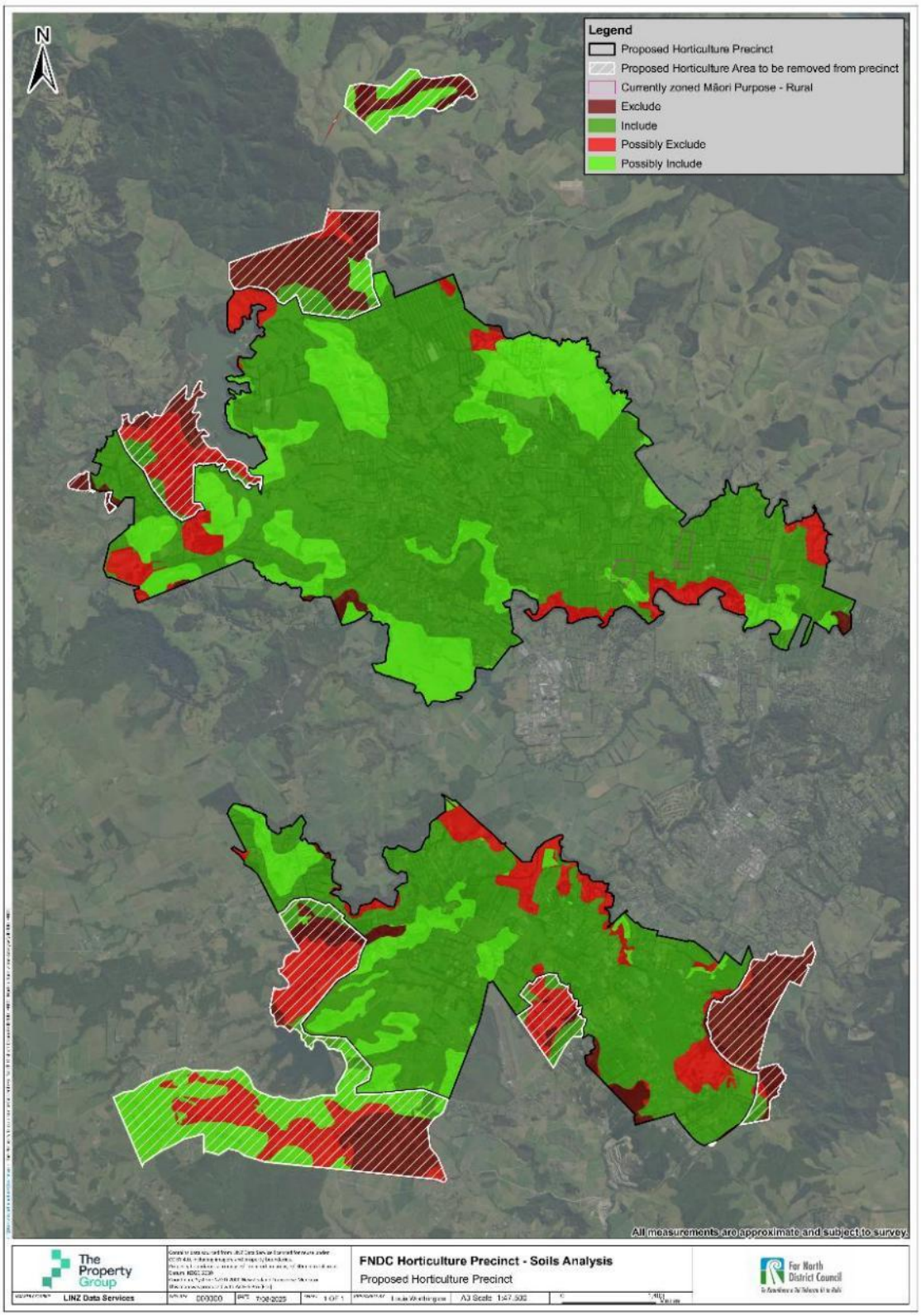

Figure 4: Proposed areas to be removed from the notified Horticulture Zone, and the resulting proposed Horticulture Precinct boundary.

Table 11 shows the LUC unit areas for the whole removed area and areas where there is S-Map data.

Table 11. LUC unit areas for the whole removed area and areas where there is S-Map data.

Entire area removed (including S-Map data area)	LUC unit	Area removed (ha)
	3s 2	421
	4e 2	568.4
	4s 4	94
	4w 1	76.8
	5s 1	63.3
	6e 4	122
	6s 5	101.8
	2s 1	52.2
	3e 1	2.2
	4e 6	0.5
	4e 7	51.9
Total area removed		**1555.6**
Total area remaining		**5,326.4**
S-Map area only*	Soil order	Area removed (ha)
	Gley	27.9
	Oxidic	6.3
	Ultic	239.2
Total area removed		**273.4**
Total area remaining		**29.2**

* Part of full area removed.

The proposed revision would remove 1,555.6 hectares from an original notified Horticulture Zone area of 6,882.1 hectares, leaving a revised area of 5,326.4 hectares.

For the S-Map area, 273.4 ha of Gley, Oxidic, and Ultic soils would be removed, with 29.2 ha remaining in the proposed Horticulture Precinct.

Figure 5 provides a visual representation of the proposed area changes for the entire[10] notified Horticulture Zone, showing the original land area of each LUC unit and the proportion of each unit's area that is proposed to be removed and retained to create the proposed Horticulture Precinct. The red portion of each bar represents the land proposed for removal, and the blue portion represents the land that would be retained.

10 Includes the area with S-Map coverage.

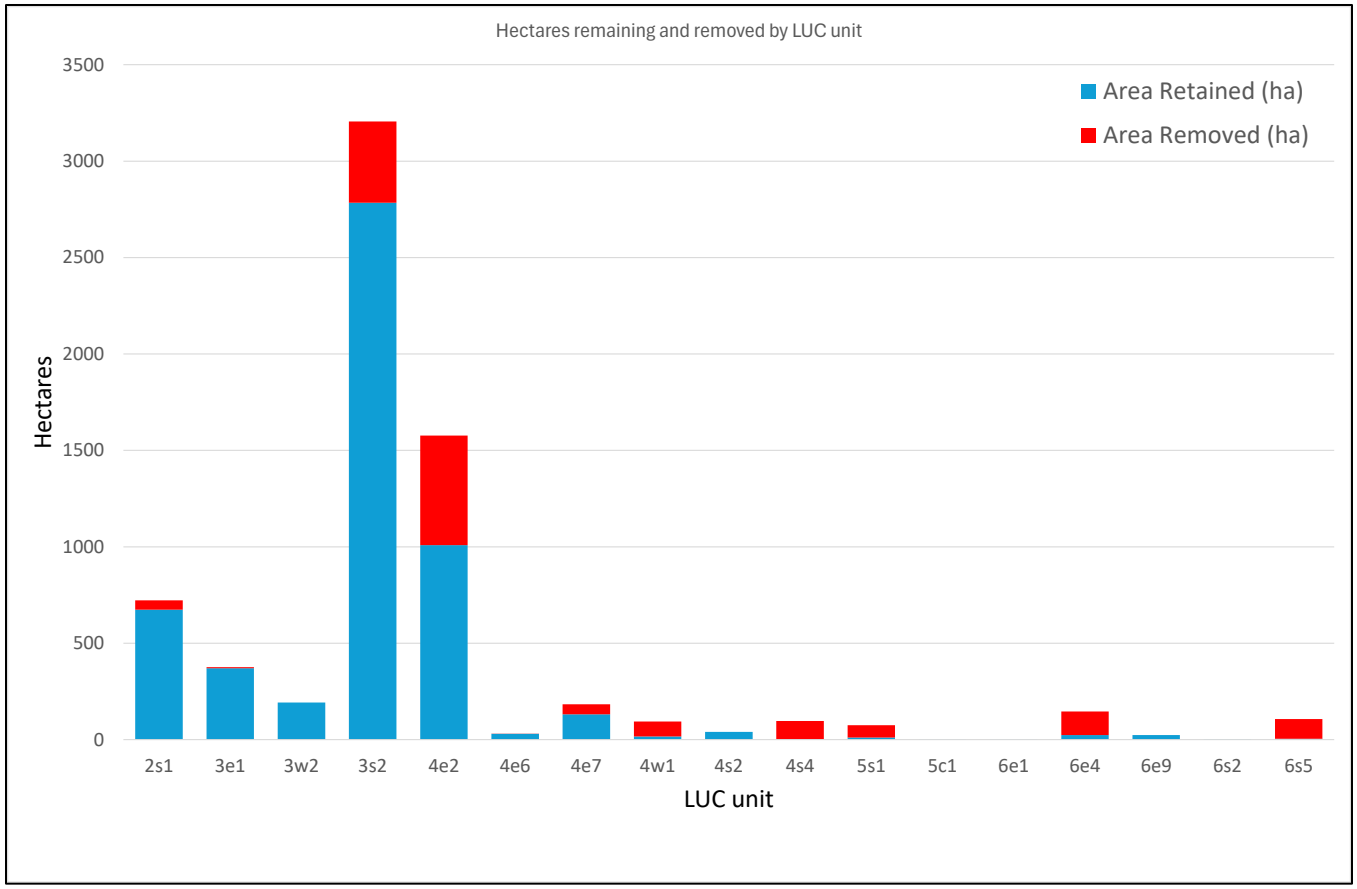

Figure 5: Hectares remaining and removed by LUC Unit for the notified Horticulture Zone area.

The data in **Figure 5** indicates that the two largest LUC unit areas that are proposed for removal from the notified Horticulture Zone area are LUC 4e2 (568.4 ha) and LUC 3s2 (421.0 ha). While a significant area of LUC 3s2 is included in the proposed removal, the data suggests that as a proportion of the original area, a much greater area of the least versatile land would be removed as part of the proposal.

The proposed revisions to the notified Horticulture Zone area show a clear and direct relationship with land versatility. While a total of 475.4 ha of the most versatile land (approximately 10.6% of its original area) is proposed for removal, a significantly larger area of the least versatile land is also proposed to be removed, totalling approximately 1,078.8 ha (roughly 46.2% of its original area). A key part of this removal is the land from LUC class 4, which accounts for 791.7 ha of the area proposed for removal from LUC classes 4, 5, and 6.

8 Addressing Misclassification, Methodological Limitations, and Future Approach

8.1 Addressing Misclassification as Identified by Cathcart and Hanmore

The methodology explicitly confronts the issue of misclassification in broad-scale NZLRI data, a concern consistently raised by soil experts like Mr Cathcart and Mr Hanmore. Their evidence highlights that NZLRI, designed for regional (1:50,000) scale, is often inaccurate for local property-level planning, frequently overestimating productive potential or omitting critical finer-scale variations. An example such as the Voigt property (misclassified as highly productive volcanic soils but found to be unsuitable gumland soil upon field inspection) underscores this limitation.

The revised method directly addresses these misclassification issues by:

- Defaulting most LUC 4 to 'Possibly Include' or 'Exclude': Instead of assuming suitability, the method initially places all LUC 4 (excluding 'w' and 4s4) into 'Possibly Include', and strictly 'Excludes' all 'w' units and 4s4, reflecting their inherent unsuitability as per expert opinion and technical data.
- For any LUC 4 land to be reclassified as ‘Include,’ the method demands compelling, multi-faceted evidence that acts as a proxy for fine-scale ground-truthing to identify actual misclassified areas. This evidence includes:
    - Current horticultural or cropping use (LCDB data).
    - Presence of existing irrigation infrastructure and active use.
    - Favourable S-Map soil properties (classification, depth, drainage) for horticulture.
    - All such evidence must be supported by aerial imagery checking.
- The method introduces a crucial safeguard by reclassifying even initially ‘Include’ (LUC 1-3) areas to ‘Possibly Include’ if expert evidence or aerial imagery suggests a potential misclassification or unsuitability at a finer scale. This ensures that even traditionally prime land is subject to scrutiny if concerns are raised.
- For any areas classified initially as ‘Check’, the method mandates targeted verification to better confirm suitability.

This approach ensures that the revised boundaries are not solely reliant on potentially inaccurate broad-scale data but are instead informed by a hierarchy of evidence, prioritising verifiable current use and detailed soil properties where misclassification is suspected.

8.2 Consideration of Legacy Soil Map Information

Legacy soil map information was explicitly considered in the revised method. These maps provided a valuable reference for correlating Soil Series to the New Zealand Soil Classification (NZSC) and

contextualising the current S-Map layer. They also served to supplement broad-scale NZLRI-LUC and Fundamental Soil Layers (FSL) data.

However, only non-spatial digital versions were available to view and the map units were not digitised into a GIS-compatible format. Consequently, it was not possible to generate a spatial layer for automated overlay or direct spatial analysis. Instead, the Legacy soil map information was utilised for manual, visual checking only.

Discussions with Manaaki Whenua – Landcare Research (MWLR) confirmed the Legacy soil map information was considered during S-Map development for the region (E. McKay, personal communication, June 2025).

Therefore, while the Legacy soil maps were a crucial reference for identifying and checking relevant soil types, their application was limited to visual interpretation due to the lack of digitised map units. The transition to S-Map will provide a more accurate, detailed, and spatially robust foundation for future soil and LUC assessments within the Horticulture Precinct.

8.3 Limitations of the Method

While the revised method significantly enhances robustness, it operates within the practical constraint that the revised Horticulture Precinct, once adopted, will essentially be a 'static' planning layer. This presents certain limitations.

No Opportunity for Full Fine-Scale Remapping

A comprehensive, fine-scale soil mapping and ground-truthing exercise across the entire notified Horticulture Zone area to verify every parcel's soil and LUC classification is not feasible at this stage of the District Plan review. The cost and time involved was considered to be prohibitive.

Reliance on Proxies for Misclassification

While the method uses strong proxies (making use of landcover data, irrigated land data and aerial imagery) to identify areas of likely misclassification, these are not a perfect substitute for direct, on-the-ground soil surveys. Therefore, some level of residual uncertainty or undetected misclassification remains.

9 Conclusions

The revised methodology provides a more robust, data-based spatial approach to inform the delineation of the Horticulture Precinct area, ensuring it contains predominantly current or potentially suitable horticultural production land.

The methodology addresses the limitations of broad-scale datasets like the NZLRI-LUC by integrating more current and verifiable information from a hierarchy of evidence. This hierarchy includes land-use data from the Land Cover Database, existing irrigation infrastructure data, and recent aerial imagery.

The methodology focuses on the requirements of key Northland crops such as kiwifruit, avocado, and citrus, as well as intensive vegetable production. It incorporates the more detailed S-Map data where available, which is considered a superior source for local-scale planning.

A key aspect of the framework is the initial exclusion of all LUC units with inherent wetness limitations ('w' subclasses) and specific problematic soil orders (e.g., Ultic Soils).

A thorough, evidence-based assessment is applied to LUC Class 4 land, with reclassification as 'Include' only occurring when there is compelling evidence of current horticultural use, existing irrigation, favourable S-Map soil properties, or DEM slope data that suggests misclassification.

The use of a multi-tiered final classification—'Include', 'Possibly Include', 'Possibly Exclude', and 'Exclude'—provides a more detailed and scientifically based delineation to support policy assessment.

The final framework balances the need to protect versatile land around Kerikeri and Waipapa, which supports existing horticulture, and land with potential for horticulture.

The proposed revision would remove 1,555.6 hectares from the original notified Horticulture Zone area of 6,882.1 hectares, resulting in a revised proposed Horticulture Precinct of 5,326.4 hectares.

Approximately 45.3% of the original LUC classes 4, 5, and 6 would be removed, compared to roughly 10.6% of the original LUC classes 2 and 3.

The resulting proposed Horticulture Precinct is composed of approximately 75.5% versatile land and 24.5% of less versatile land.

The refinement, guided by expert review and a hierarchy of evidence, directly addresses misclassification issues and provides a more robust and scientifically based final output for informing the extent of the proposed Horticulture Precinct boundary.

10 References

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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 3rd ed*. Hamilton, AgResearch; Lincoln, Landcare Research; Lower Hutt, GNS Science. 163p.

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APPENDIX 1: LINKS FOR DATA USED IN THE REVISED HORTICULTURE PRECINCT METHODOLOGY

Dataset	Source/link
Current HZ Boundary (existing polygon feature class)	https://opendata-fndc.hub.arcgis.com/datasets/FNDC::proposed-district-plan-zones-fndc/explore?layer=0
NZLRI Land Use Capability (LUC) - 2021	https://lris.scinfo.org.nz/layer/48076-nzlri-land-use-capability-2021/
NZLRI Slope - 2021	https://lris.scinfo.org.nz/layer/48064-nzlri-slope/
S-Map Soil Classification (Soil Order) - Aug 2024	https://lris.scinfo.org.nz/layer/119585-s-map-soil-classification-soilorder-aug-2024/
S-Map Soil Drainage - Aug 2024	https://lris.scinfo.org.nz/layer/119599-s-map-soil-drainage-aug-2024/
S-Map Soil Depth - Aug 2024	https://lris.scinfo.org.nz/layer/119593-s-map-soil-depth-aug-2024/
LCDB v5.0	https://lris.scinfo.org.nz/layer/104400-lcdb-v50-land-cover-database-version-50-mainland-new-zealand/
Irrigated land area - 2020	https://data.mfe.govt.nz/layer/105407-irrigated-land-area-raw-2020-update/
DEM derived <15 degrees and >15 degrees slope classes (for visual interpretation only)	Sourced from LINZ data service and Northland LiDAR 1m DEM (2018-2020) | LINZ Data Service. Slope class breaks aligned with the upper slope for NZLRI Slope class 'C' from NZLRI Slope | LRIS Portal
Google Earth Aerial Imagery (for visual interpretation only)	Google Earth Pro - Imagery date: 12/11/2023
Legacy soil maps (for visual reference only)	https://nrcgis.maps.arcgis.com/apps/webappviewer/index.html?id=fd6bac88893049e1beae97c3467408a9 Cox, J.E. *et al.* 1983: Northland Peninsula soil survey, scale 1:100,000.

Appendix 2: New Zealand Land Use Capability (LUC) Unit Classifications for the notified Horticulture Zone (from Harmsworth, 1996).

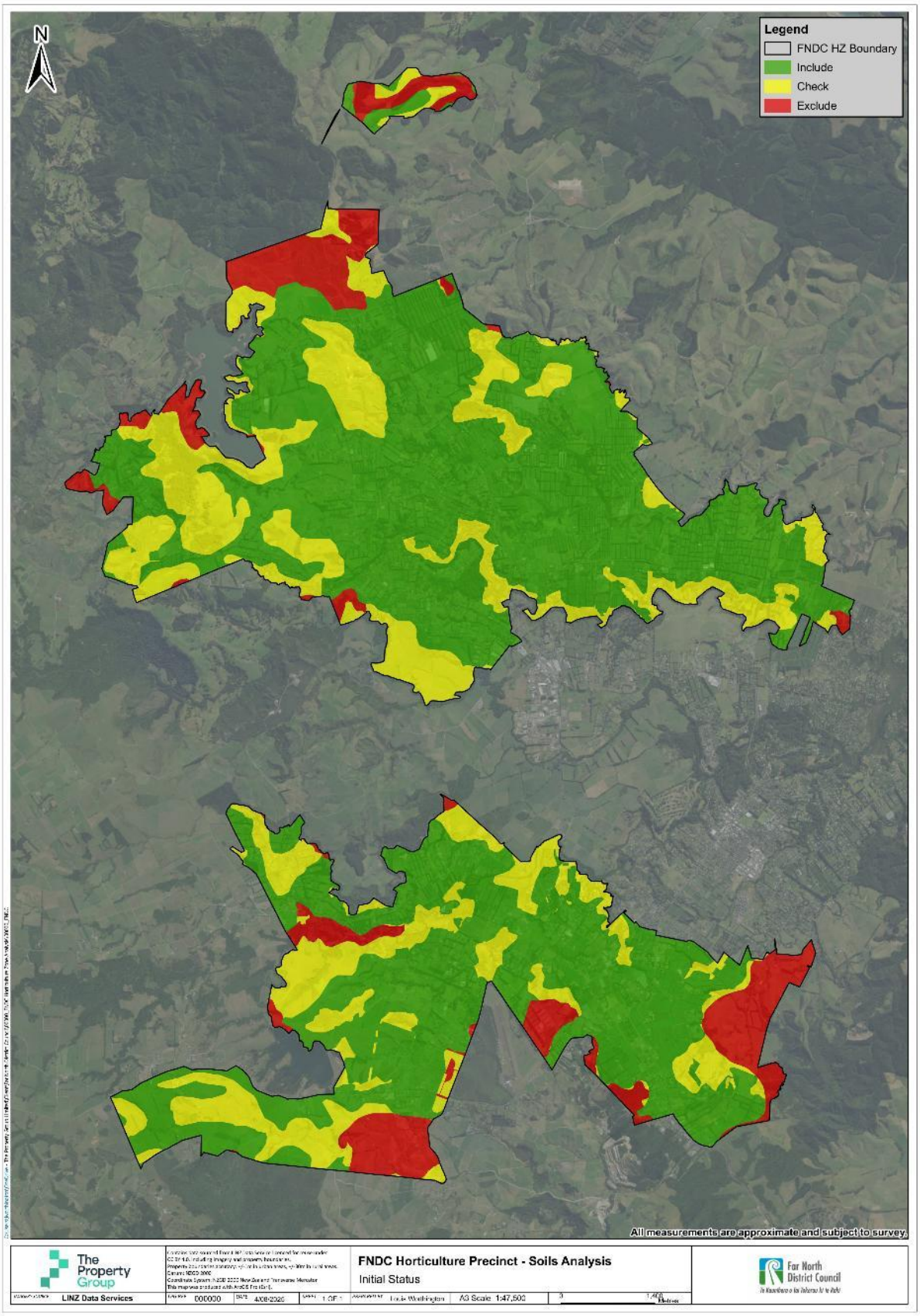
LUC Unit	Main Limitations	Geology	Soil Type	Soil Drainage	Soil Depth	Slope	Land use: Potential	Initial Status
2s1	Slight soil limitation due to soil depth and stoniness.	Lavas (Vo), Scoria (Sc). Older ashes or tephras (Mo).	Brown and red loams of Kiripaka suite (KB, KBH, KBe, KBeb, OW, OWb, YOb, MCb, KEb, RTb, MUb). Red loams of Papakauri suite (MUH, MU, ATH, AT).	Not specified, but generally free-draining.	Not specified, but soil depths are often shallow.	Flat to gently undulating (A, A+B, B), 0-7°.	**Cropping: Horticulture;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 30.	'Include'
3e1	Moderate limitations for arable use, largely due to potential for slight to moderate sheet and rill erosion when cultivated.	Basaltic lavas (Vo), Basaltic scoria (Sc). Older ashes or tephras (Mo).	Kiripaka suite (WG, WP, WPe, YO, MC, TG, KE, RT, PG), Papakauri suite (AT), Kohumaru suite (KM).	Not specified but implies free-draining from soil types.	Not specified.	Undulating to rolling (B+C, C+B), 4-15°.	**Cropping: Horticulture;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 30.	'Include'
3w2	Moderate wetness limitation for arable use but can be effectively drained.	Fine alluvium (Af).	Kaipara suite (KP, KPy, KA, KAy, TZ, TZy), Waipu suite (YUa, YUay, YU, YUy, YA), Waipapa suite (KO, KOr, KOi, KOy, YF).	Poorly drained.	Not specified.	Flat (A), 0-3°.	**Cropping: Root and green fodder crops. Cereals. Vegetables. Horticulture;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 24.	'Check'
3s2	Moderate soil limitation exists for cropping due to lower fertility, poorer drainage, and seasonal soil moisture deficiencies.	Lavas (Vo), Scoria (Sc). Older ashes or tephras (Mo).	Kiripaka suite (KE, RT, PG, TA, OKu, OK).	Not specified, but internal drainage may be impeded.	Not specified.	Flat to undulating (A, B), 0-7°.	**Cropping: Horticulture, root and green fodder crops;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 18.	'Check'
4e2	Potential for moderate to severe sheet, rill, wind, and gully erosion when cultivated.	Lava (Vo). Basaltic lava.	Kiripaka suite (PG, RT, RTb, KE, KEb).	Not specified.	Not specified.	Rolling to strongly rolling (C, C+D), 8-20°.	**Cropping: Root and green fodder crops, horticulture;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 24.	'Check'
4e6	Potential for moderate to severe sheet, rill, and gully erosion when cultivated.	Argillite (Ar) and massive (Sm) which has been shattered. Argillite (Ar) complexed with massive sandstone (Sm), crushed argillite (Ac), jointed mudstone (Mj), and/or ancient volcanics (In).	Omanaia, Purua, Waiotira suites.	Imperfectly drained to poorly drained.	Not specified.	Rolling to strongly rolling (C, D), 8-20°.	**Cropping: Root and green fodder crops;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 18.	'Check'
4e7	Potential for moderate to severe sheet, rill, wind and gully when cultivated.	Greywacke association of rocks (Gw).	Marua suite (MRr, MR, MRu, RA, RAI).	Not specified.	Not specified.	Rolling to strongly rolling (C, D), 8-20°.	**Cropping: Root and green fodder crops;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 18.	'Check'

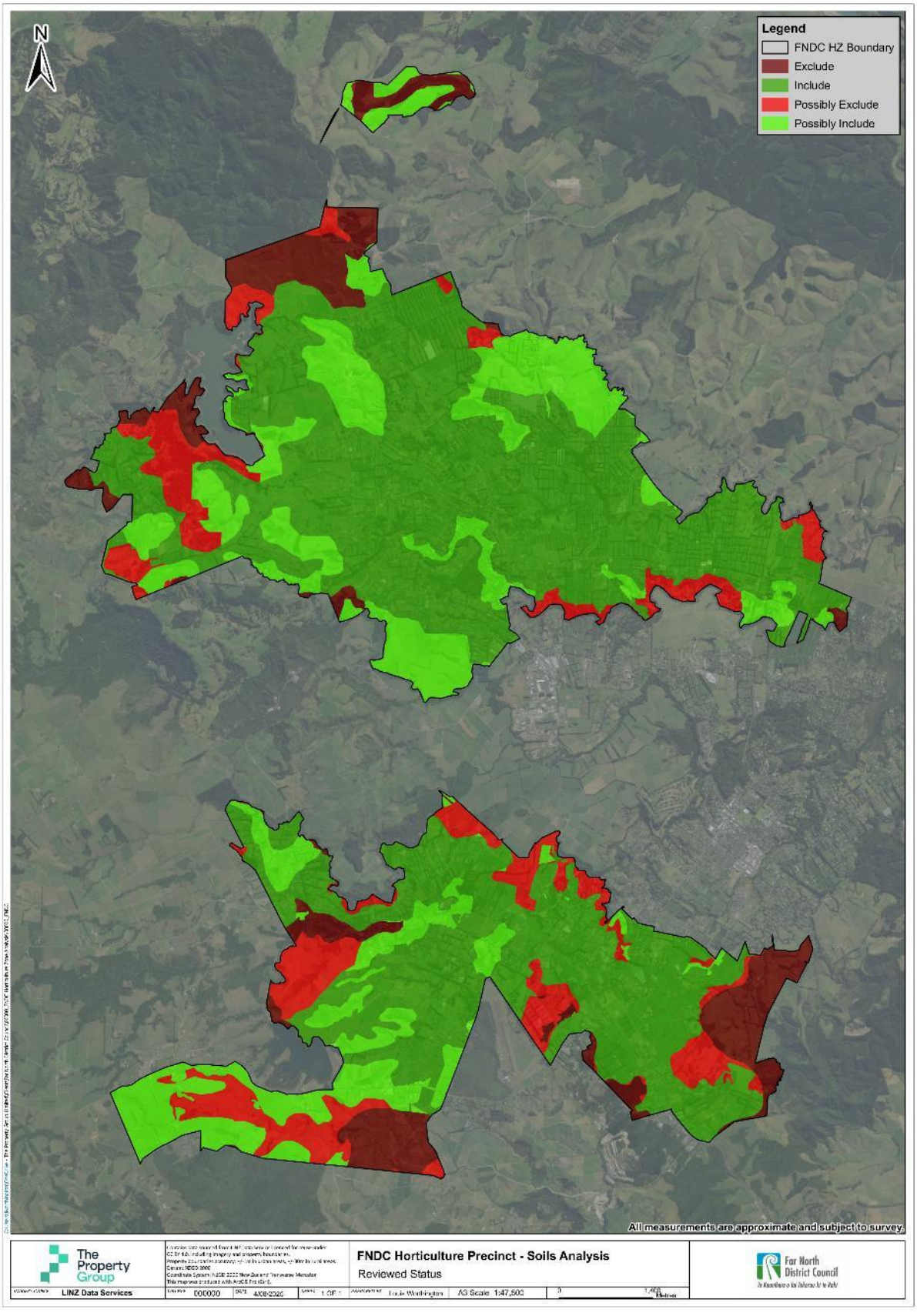
4w1	Continuing severe wetness or flooding limitation to arable use.	Fine alluvium (Af). Undifferentiated fine-grained alluvium, floodplain alluvium (Af), and fine alluvium intercalated with organic-peat deposits (Af + Pt).	Whareora and Kohumaru suites. Gley soils of Kaipara, Waipapa and Waipu suites are also included.	Not specified but has 'continuing severe wetness'.	Not specified.	Flat to undulating (A, B), 0-7°.	**Cropping: Root and green fodder crops;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 24.	'Exclude'
4s2	Moderate soil limitation exists for cropping due to lower fertility, poorer drainage, and seasonal soil moisture deficiencies.	Lavas (Vo), Scoria (Sc). Older ashes or tephras (Mo).	Kiripaka suite (KE, RT, PG, TA, OKu, OK).	Not specified, but internal drainage may be impeded.	Not specified.	Flat to undulating (A, B), 0-7°.	**Cropping: Horticulture, root and green fodder crops;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 18.	'Check'
4s4	Extreme limitations for arable use.	Fine alluvium (Af) or unconsolidated clays and silts (Uf). Sheared mixed lithologies (Mx). Argillite (Ar).	Whareora, Puhoi, Waiotira, Omu, Marua, Omanaia suites.	Not specified but implied as poorly drained.	Not specified.	Flat to rolling (A-C), 0-15°.	**Cropping: Root and green fodder crops;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 18.	'Exclude'
5c1	Slopes considered too steep for arable use but under pastoral use erosion remains negligible to slight.	Limestone (Li). Crystalline and fine-grained muddy limestone.	Rendzinas and associated soils of Arapohue suite (AU, AUd, MT, AUH, MTH) and Maungaturoto suite (MO, DF).	Not specified.	Not specified.	Strongly rolling to moderately steep (D, E), 16-25°.	**Cropping: Unsuitable;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 18.	'Exclude'
5s1	Stoniness and shallow soil depth regarded as dominant limitations precluding arable use.	Lavas (Vo), scoria (Sc).	Brown and red loams containing stones and boulders of Kiripaka suite (KB, KBb, KBe, KBeb, OWb) and Kiripaka suite (YOb, MCb, KEb, RTb).	Drainage may be impeded by underlying basalt.	Not specified, but soil depths may be less than 20-30 cm in some areas.	Undulating to rolling (A-C), 0-15°.	**Cropping: Unsuitable;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 24.	'Exclude'
6e1	Potential for moderate soil slip, sheet and tunnel gully erosion.	Bedded sandstones (Sb), mudstones (Mb), massive sandstone (Sm), massive mudstone (Mm).	Yellow-brown earth hill soils on stratified sandstones and mudstones of Puhoi suite (PBH, PBuH, TMH, WRH, WReH, OFH, MXH, WAH, AYH, AYfH) and Waiotira suite (WCS, YCgH, YCH, YCrH, RPH, RPaH, PVH).	Not specified.	Not specified.	Strongly rolling to moderately steep (D, E), 16-25°.	**Cropping: Unsuitable;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 12.	'Exclude'

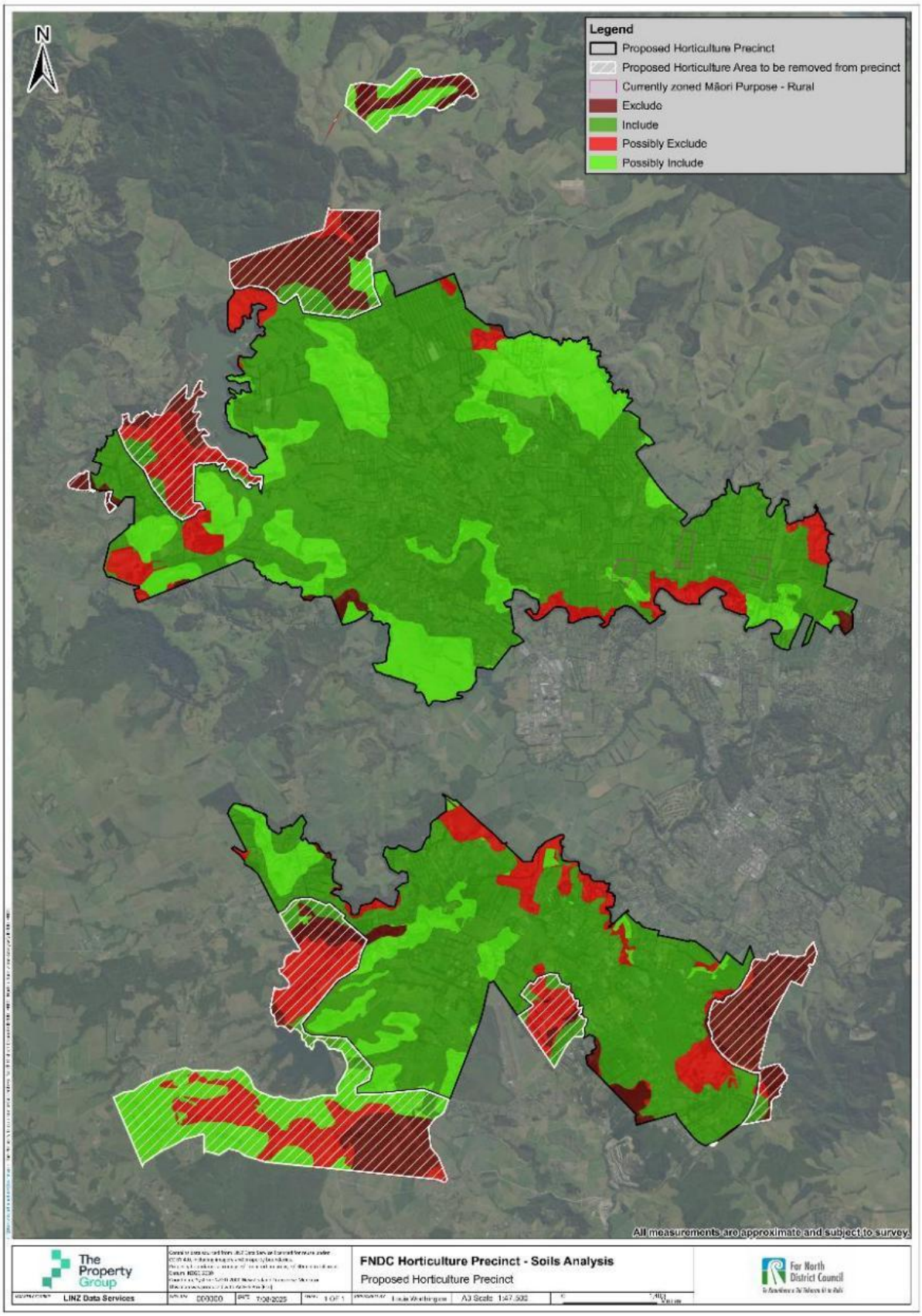
6e4	Potential for moderate soil slip and sheet erosion.	Lava (Vo), scoria (Sc).	Brown and red loam hill soils on basalt scoria and flows. Brown loams of Kiripaka suite (KBH, YOH, MCH). Red loams of Papakauri suite (PKH, RKeH, MUH, ATH).	Not specified.	Not specified.	Strongly rolling to moderately steep (D, D+E, E, F), 16-25°, occasional 26-35°.	**Cropping: Unsuitable;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 18.	'Exclude'
6e9	Potential for moderate soil slip, earthslip and sheet erosion.	Greywacke association of rocks (Gw).	Yellow-brown earth hill soils on greywacke and argillite of Marua suite (MRrH, MRH, MRuH, RAH, RAIH).	Not specified.	Not specified.	Strongly rolling to moderately steep (D+E), 16-25°.	**Cropping: Unsuitable;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 12.	'Exclude'
6s2	Stoniness or shallow soil depth preclude arable use.	Ancient volcanics (In), lavas and welded ignimbrites (Vo), indurated volcanic brreccias (Vb), complexed with various sedimentary lithologies (Ar, Mj, Sm).	Complex or association of brown granular loams and clays and yellow brown earths. Rendzinas may also be included. Maungarei suite (PF, PM, PMH, PR) may be included.	Not specified.	Not specified, but soil depths are often shallow.	Undulating to rolling (B, B+C, C), 4-15°.	**Cropping: Unsuitable;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 18.	'Exclude'
6s5	Podzolisation precludes sustainable arable use.	Range of sedimentary lithologies veneered by colluvium and/or alluvium: jointed mudstone (Mj), argillite (Ar), sandstone (Sm, Sb), fine alluvium (Af), unconsolidated clays and silts (Uf).	Podzols on various sedimentary lithologies. Podzols of Puhoi suite (Wkfp, WKf), Waiotira suite (WKap, WKa), Omu suite (Wkp, WKr). Podzols on alluvium of Whareora suite (KRp, KRap) and podzols on dacite, rhyolite and granodiorite of Maungarei suite (PRp) can be included.	Not specified but implies poorly drained from the description of 'waterlogged soils'.	Not specified.	Flat to gently rolling (B, B+A, B+C), 4-15°.	**Cropping: Unsuitable;** Grazing: Attainable physical potential carrying capacity (s.u./ha) = 18.	'Exclude'

APPENDIX 3: MAP OUTPUTS

- Initial Status map
- Reviewed (Final) Status map
- Proposed Horticulture Precinct map with removal areas for consideration.


N
Legend
FNDC HZ Boundary
Include
Check
Exclude
All measurements are approximate and subject to survey.
The Property Group
LINZ Data Services
FNDC Horticulture Precinct - Soils Analysis
Initial Status
A3 Scale 1:47,500
Far North District Council


N
Legend
FNDC HZ Boundary
Exclude
Include
Possibly Exclude
Possibly Include
All measurements are approximate and subject to survey.
The Property Group
LINZ Data Services
FNDC Horticulture Precinct - Soils Analysis
Reviewed Status
A3 Scale 1:47,500
Far North District Council


N
Legend
Proposed Horticulture Precinct
Proposed Horticulture Area to be removed from precinct
Currently zoned Māori Purpose - Rural
Exclude
Include
Possibly Exclude
Possibly Include
All measurements are approximate and subject to survey.
The Property Group
LINZ Data Services
FNDC Horticulture Precinct - Soils Analysis
Proposed Horticulture Precinct
Far North District Council