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LAND AND SOIL REPORT – SCOTT ROAD TE KAUWHATA

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CONTENTS

SUMMARY

A 194 ha site at Scott Road, Te Kauwhata was assessed for Land Use Capability (LUC) and soil characteristics to determine the extent of any High Quality Soil. The land is currently used for dairy farming and consists of rolling hills adjacent to Lake Waikare. Parts of the hills have flatter undulating tops and there are some strongly rolling to moderately steep hill sides. In the valley bottoms, and near Lake Waikare, the land is flat and subject to flooding.

The soils on the flatter hill tops are Te Kauwhata clay loams. These soils have clay loam topsoil and firm clay subsoils and are moderately well drained. Soils on the rolling slopes are Ruawaro clay loams. These are also moderately well drained soils with clay subsoil. On the hill sides are seepage and gully areas that have steeper slopes or are poorly drained. The flat land at the base of the hills is composed of wet poorly drained soil types.

The site had no LUC class 1 land. LUC class 2 occurred on the flatter hill slopes and LUC class 3 and 4 on the steeper slopes. Class 4 land also occurred on the wet lower flat land.

High quality soil as defined in the Waikato District Plan (LUC Class 1 and 2, and well and moderately well drained Class 3 land) covered 91 hectares (46%) of the site. The majority of the site (103 ha, 54%) was either too wet or too steep to qualify as High Quality Soil.

High Class Soils as defined in the Waikato Regional Policy Statement (LUC Classes 1 and 2 (excluding peat soils) and soils in LUC Class 3e1 and 3e5) covered 54 hectares (27 %). The remainder of the site (140 ha, 73 %) was not High Class Soil.

Waikato Regional Council data shows there is over 90,000 ha and 40,000 ha of High Quality Soil and High Class soil, respectively, within 30 km of Te Kauwhata township and those soils on the site represent a very small percentage of the total (Table 1).

Table 1. Areas of high quality and high class soil - at the site, within 30 km of Te Kauwhata township, district and region, and the soils on the site as a percentage of the total areas.

	Site	30km	District	Region
High quality soil				
Area (ha)	91	91,870	136,438	488,128
%	-	0.10	0.07	0.02
High class soil				
Area (ha)	54	42,581	70,091	296,457
%	-	0.13	0.08	0.02

INTRODUCTION

An onsite soil and land assessment was undertaken at the request of Mr Simon Ash of Lakeside Developments 2017 Limited, Auckland, to report on the extent of any High Quality Soil within the 194 ha Scott Road site at Te Kauwhata (Figures 1 & 2). The total property is 194 ha.

The site is located on the southern boundary of Te Kauwhata township and bounded by the main trunk railway to the west and Lake Waikare to the east. The site is in pasture and has been grazed for many years. It is currently used for dairy farming and calf rearing.

The land is mainly undulating to rolling hills with some steeper slopes and wet seepage areas. Flat land occurs at the base of the hills to the south and east. This flat land is wet and the majority is subject to flooding.

To help guide land use decisions, Waikato District Council requires a detailed land and soil assessment to determine the extent of any High Quality Soil on the site. This assessment requires both a LUC and soil assessment. LUC Class 1 land is the most versatile, multiple use land on flat to undulating slopes. Classes 2 and 3 are also very good agricultural and horticultural land with slight (Class 2) or moderate (Class 3) physical limitations for arable use. For the purposes of this investigation LUC Class 1 and 2, and well and moderately well drained Class 3 land, is defined as 'High quality soil' in accordance with the definition in the Waikato section of the operative Waikato District Plan (2016).

High quality soil

> *Means land classified as Land Use Capability Class 1, 2 or 3e, on the New Zealand Land Inventory Worksheets (as amended in the 1986 Second Edition) legend, provided land classified as Class IIIe is further described as containing well and moderately drained soil, in accordance with Milne, J. D. G.; Clayden, B.; Singleton, P. L.; Wilson, A. D. 1995 Soil description handbook (revised edition press). Manaaki Whenua Press, Lincoln, New Zealand.*

There is a definition for High Class Soil in the recent Waikato Regional Council's Regional Policy Statement. High Class Soil is defined in the Regional Policy Statement as:

High class soil

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

Natural Knowledge Ltd was commissioned to provide a LUC and soil assessment of the site and determine the area of any High Quality Soil. The area of any High Class Soil was also to be determined. The site was inspected and mapped in mid-October 2016 and early March 2017 by Dr Peter Singleton. Dr Singleton has over 35 years experience in mapping and assessing soils.

Figure 1. Location of the site.

Figure 2. Scott Road site, Te Kauwhata.

METHODS

Land Use Capability Assessment was carried out using methods based on the national land classification system used by soil conservators for farm planning since the 1950s. A detailed description of the system can be obtained from the Land Use Capability Survey Handbook, a 3rd edition (Lynn *et al*., 2009).

The soil survey and assessment was based on standard soil survey methods and the Soil Description Handbook (Milne *et al*., revised edition 1995).

Other resource information used included 1:250,000 geological map of Te Kauwhata (Kear & Schofield 1978) and Soils of Part Te Kauwhata Area (Singleton, 1982).

LAND USE CAPABILITY

Land Use Capability (LUC) assesses an area's capacity for sustained productive use, taking into account physical limitations, soil type, management requirements and soil conservation needs.

A Land Use Capability assessment is a systematic arrangement of the different types of land according to those properties that affect its capacity for long term and sustained production. It is a system that primarily assesses the land for arable (cropping) use.

The LUC assessment identifies areas with similar rock type, soil, slope, erosion types and degree and vegetation cover. Where any one of these factors changes significantly a boundary is drawn and a new map unit created. Based on this physical inventory, together with an understanding of climate an assessment is made of each unit's capacity for long term sustained use. Thus the property is completely covered by mapped units which identify areas having similar physical attributes.

THE LUC MAPPING UNIT

The LUC mapping unit is in three parts:

i. The LUC class
The LUC class is the broadest grouping in the classification, identifying the general **degree of limitation** to arable use. It comprises eight classes. Formerly represented as classes I to VIII and now superseded by a recent change in nomenclature to numerals 1 to 8. Classes 1 to 4 are classified on their suitability for cultivation for cropping, with class 1 being the most versatile with few limitations to use, through to LUC class 4 which has limitations so severe it is marginal for cultivation for cropping. Classes 5 to 7 are not suitable for cropping but are suitable for non-cropping uses such as pastoral farming, tree crops or forestry. Physical limitations increase from LUC class 5 to 7. LUC class 8 has such severe physical limitations it is not suited for any commercial farming system and is considered suitable only for retirement and protection use. Land use capability classes as recognised in the New Zealand Land Resource Inventory are listed below (Table 2).

ii. The LUC subclass

The LUC class is subdivided into one of four subclasses, depending on the **major physical limitation to use**. There are four limitations; **erodibility (e), wetness (w), soil (s), and climate (c).** They are denoted by the small letter e, w, s or c after the LUC class number. For example, an area of land suitable for pastoral farming but limited by moderate erosion is shown as Class 4e.

iii. The LUC unit

The third and most detailed level of classification is the LUC unit. The unit groups areas that require the same kind of management, the same kind and intensity of soil conservation treatment, and are suited to the same kinds of crops, pasture or forestry species which require specific conservation measures and management practices to achieve similar yields. For example, LUC class 6e becomes 6e1, or 6e2, and so on depending on the detailed management requirements needed.

Table 2. Land use capability classes as recognised in the New Zealand Land Resource Inventory.

LUC Class	Brief description
1	Class 1 land is the most versatile multi-use land with minimal physical limitations to arable use. It is nearly level, has deep easily worked soils and there is practically no risk of erosion. The soils are well drained and not seriously affected by drought. They are usually well supplied with plant nutrients and responsive to applied fertilisers. The climate is favourable for the growth of a wide range of cultivated crops, vineyards and berry fields, pasture, tree crops or production forestry.
2	This is good land with slight limitations to arable use which makes it more difficult to manage than Class 1. Management practices to overcome these limitations are easy to apply. Depending on the limitation, the land can be suitable for many cultivated crops, vineyards and berry fields, pasture, tree crops or production forestry. Limitations may be – a) slight to moderate susceptibility to erosion; b) gentle slopes; c) soils of only moderate depth; d) wetness existing permanently as a slight limitation after drainage; e)occasional damaging flooding; f)unfavourable structure and difficulty in working.
3	This class of land has moderate physical limitations to arable use. These limitations restrict the choice of crops and the intensity of cultivation, and/or make special conservation practices necessary. Depending on the limitation, Class 3 land can be suitable for cultivated crops, vineyards and berry fields, pasture, tree crops or production forestry. Limitations may be – a) moderate susceptibility to erosion under cultivation; b) rolling slopes; c) shallow or stony soils; d) wetness or water-logging after drainage; e) frequent damaging overflow; f)low moisture holding capacity; g) low natural fertility not easily corrected.
4	This land has severe physical limitations to arable use. These limitations substantially reduce the range of crops which can be grown, and/or make intensive soil conservation and careful management necessary. Because of these difficulties, Class 4 land is suitable only for occasional cropping but is suitable for pasture, tree crops or production forestry. Limitations may be – a) moderate to high susceptibility to erosion under cultivation; b) strongly rolling slopes; c) very shallow soils; d) excessive wetness with continued hazard of water-logging after drainage; e) frequent flooding; f) very low moisture holding capacity; g) low fertility very difficult to correct.
5	This is high-producing land with physical limitations that make it unsuitable for arable cropping, but only slight limitations or hazards to pastoral, vineyard, tree crop or production forestry use. Limitations may be – a) moderately steep slopes; b) erosion risk; c) stoniness and/or the presence of boulders or rock outcrops; d) excessive wetness after drainage; e) frequent flooding.
6	This class of land is unsuitable for arable use, and has slight to moderate physical limitations and hazards under pasture cover. Suitable uses include pastoral, tree crop or production forestry use. Erosion is commonly the dominant limitation and needs careful management. Other limitations may be a) steep and very steep slopes; b) very stony or very shallow soils; c) excessive wetness; d) frequent flooding; e) low moisture holding capacity.
7	This class of land is unsuitable for arable use, and has severe physical limitations or hazards under pasture. Consequently it is high-risk land requiring active management to achieve sustainable production. It can be suited to grazing provided intensive soil conservation measures and practices are in place. In many cases it is more suitable for forestry. It is often very steep land with a severe erosion or wetness hazard.
8	Class 8 land has very severe to extreme physical limitations or hazards which make it unsuitable for arable, pastoral, or commercial forestry use.

LUC MAPPING UNITS AT THE SITE

The Land Use Capability (LUC) units used for this site are primarily based on those in the New Zealand Land Resource Inventory (NZLRI), Waikato Region Land Use Capability Classification (Ministry of Works and Development 1970s). This national survey was undertaken to provide standards for LUC mapping. It was carried out at the 1:63360 scale with 10 regional classifications covering the North Island and one for the South Island. The Waikato Region extends from Pukekohe, south to the southern boundary of the Mokau River and from the west coast eastwards to where the Taupo ashes become significant. Descriptive bulletins were prepared for most regions, but not for the Waikato. The definitions for the regional LUC units can be found in the 'Waikato Region: Land Use Capability Extended Legend'.

For this property, the relevant LUC units (from the NZLRI) have been identified and used for the map of the site.

The site consists of hills with rolling and undulating slopes and some steeper sided gullies and wet seepage areas. At the foot of the hills are wet soils above the current flood levels and large areas of flat wet lower land subject to flooding.

No Class 1 land was identified at the site. Class 2 land occurred on the undulating land of the hills and on flatter tops of the rolling Class 3 hills. Steeper hill sides and gullies were Class 4 land, as was wet land subject to flooding.

The LUC Class 2 land was all subclass 2s. The soil in this subclass is the Te Kauwhata clay loam and Ruawaro clay loam. Class 3 land was divided into two based on drainage. Class 3e occurred on the rolling hills and was the moderately well drained Ruawaro clay loam. Class 3w were wet soils in seepage areas or at the base of hills where they received water from upslope. Class 3e was divided into 3e3 where the soil was Te Kauwhata clay loam from old volcanic ash, and 3e4 when it was Ruawaro clay loam from ancient alluvium.

Class 4 land was also divided into two based on erosion risk or wetness. LUC subclass 4e land occurred on the strongly rolling hill sides and 4w land was wet flat land subject to flooding.

Figure 2. Example of the various LUC subclasses of land on the site.

Figure 3 shows the LUC classes and subclasses for the site and Figure 4 shows the position of the LUC units in the landscape. Table 3 gives the areas of the LUC units at the site.

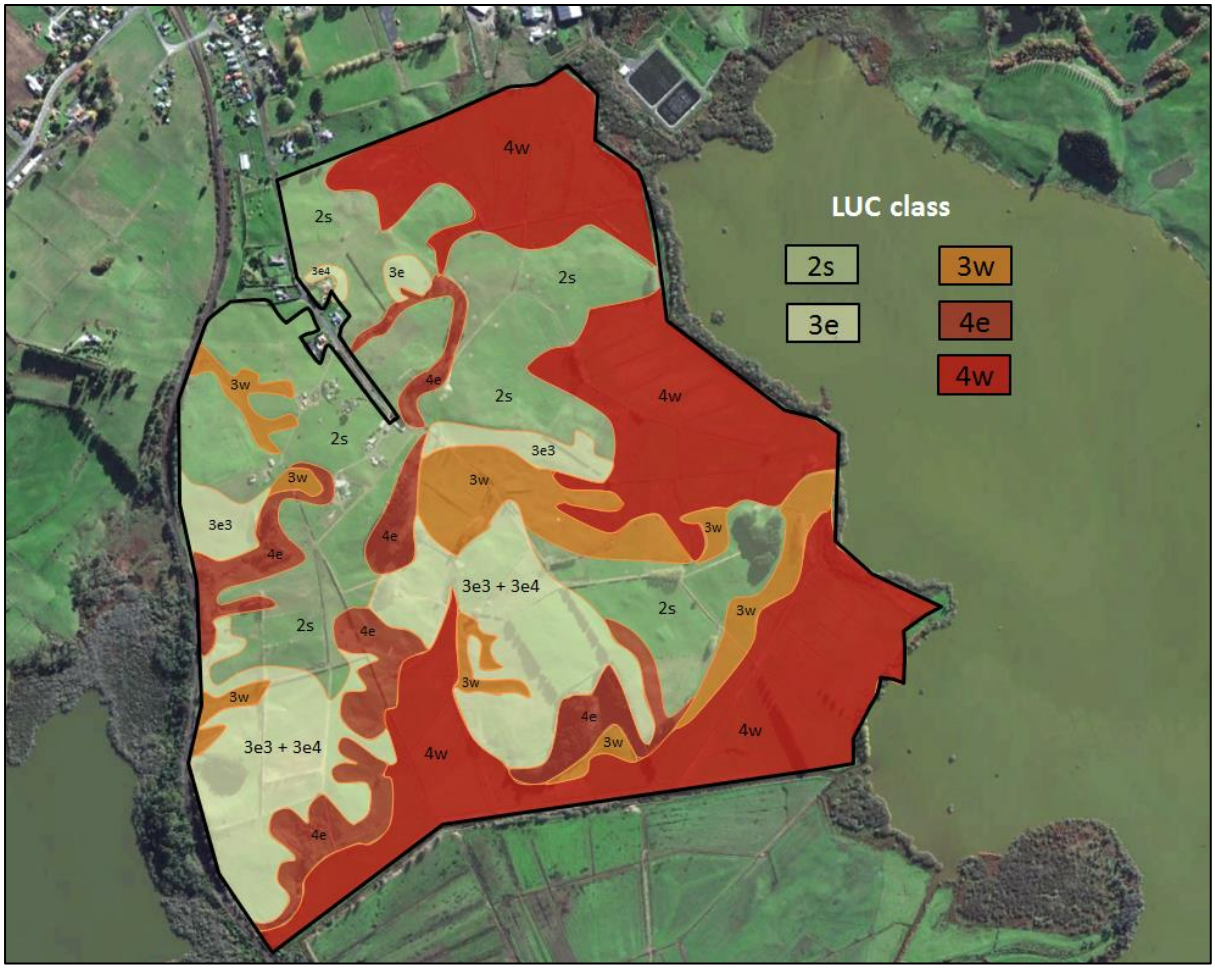

Figure 3. LUC units for the site.

Table 3. Areas and percentage of LUC units at the site.

LUC class	Area (ha)	Percent of total area
2s	54	27
3e3, 3e4	37	19
3w	19	10
4e	19	10
4w	65	34
Total	**194**	**100**

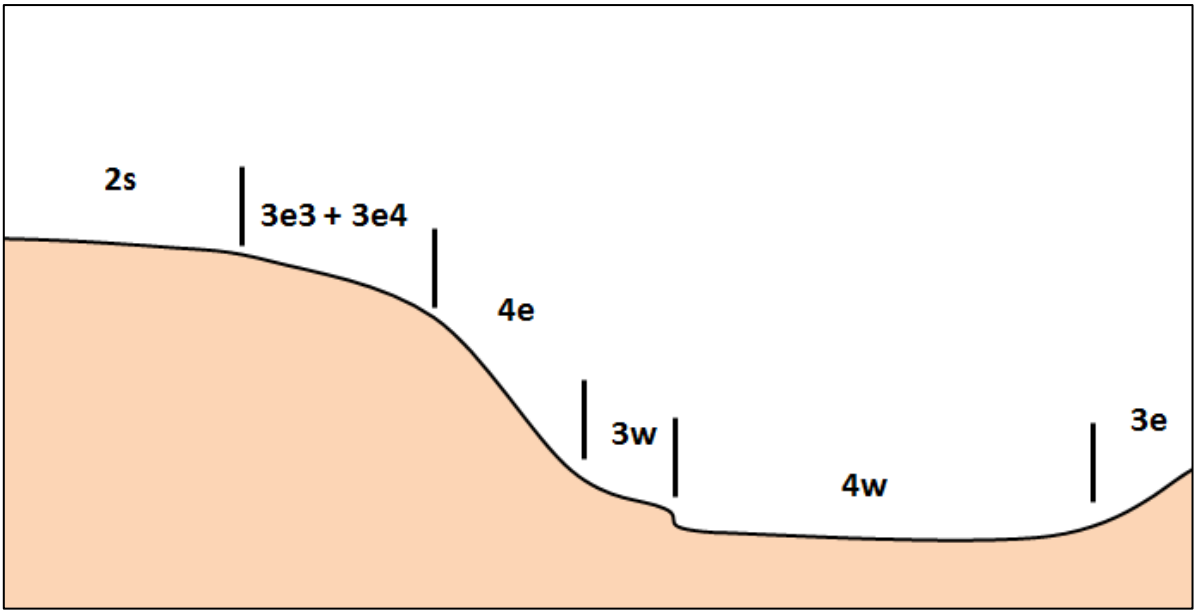

Figure 4. Diagrammatic cross-section showing the position of the LUC units in the landscape.

SOILS AT THE SITE

A soil survey of the site was carried out using standard methods. Field investigations indicate that soil on the hills is mainly the Te Kauwhata clay loam and Ruawaro clay loam (Figure 5).

The Te Kauwhata soil has formed in weathered volcanic ash of the Hamilton Ash Formation and several metres of this clayey brown material sits on ancient weathered pumiceous alluvium. The Te Kauwhata soil occurs on the undulating hill tops where the volcanic ash has been preserved from erosion. The soil has clay loam topsoil over firm clay subsoil. They are moderately well drained and classified as Granular soils.

On the rolling to moderately steep slopes of the hills the original layers of volcanic ash have been eroded away and the underlying ancient pumiceous alluvium of the Puketoka Formation form the soils. These are the Ruawaro clay loams and are classified as Brown soils. The soil has clay loam topsoil over firm clay subsoil. Drainage in these soils ranges from moderately well to imperfectly drained.

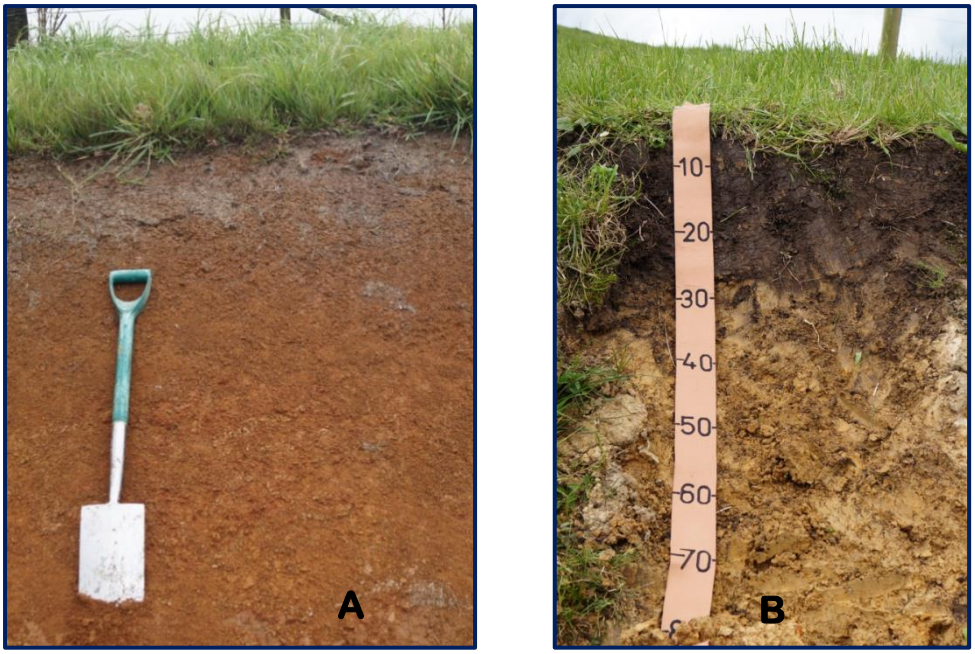

Figure 5. Te Kauwhata clay loam (A) and Ruawaro clay loam (B).

Soils on the alluvial flats and in valley bottoms are poorly drained Gley soils and cover a range in soil types, some with humic topsoils and they can have clay to fine sand subsoils. There was alsop a pocket of decomposed peat in the NW corner of the property. An example of a sandy clay is shown in Figure 6.

Figure 6. Poorly drained soil in the valley bottom.

LUC Class 1 and 2, and well and moderately well drained Class 3 land, is defined as 'High quality soil' in accordance with the definition in the Waikato section of the operative Waikato District Plan (2016).

High quality soil

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The area of High Quality Soil at the site corresponded to LUC class 2 and LUC subclass 3e. There was no LUC class 1 at the site. The area of High Quality Soil covered 91 hectares (46%) of the site (Figure 7). The majority of the site (103ha, 54 %) was either too wet or too steep to qualify as High Quality Soil.

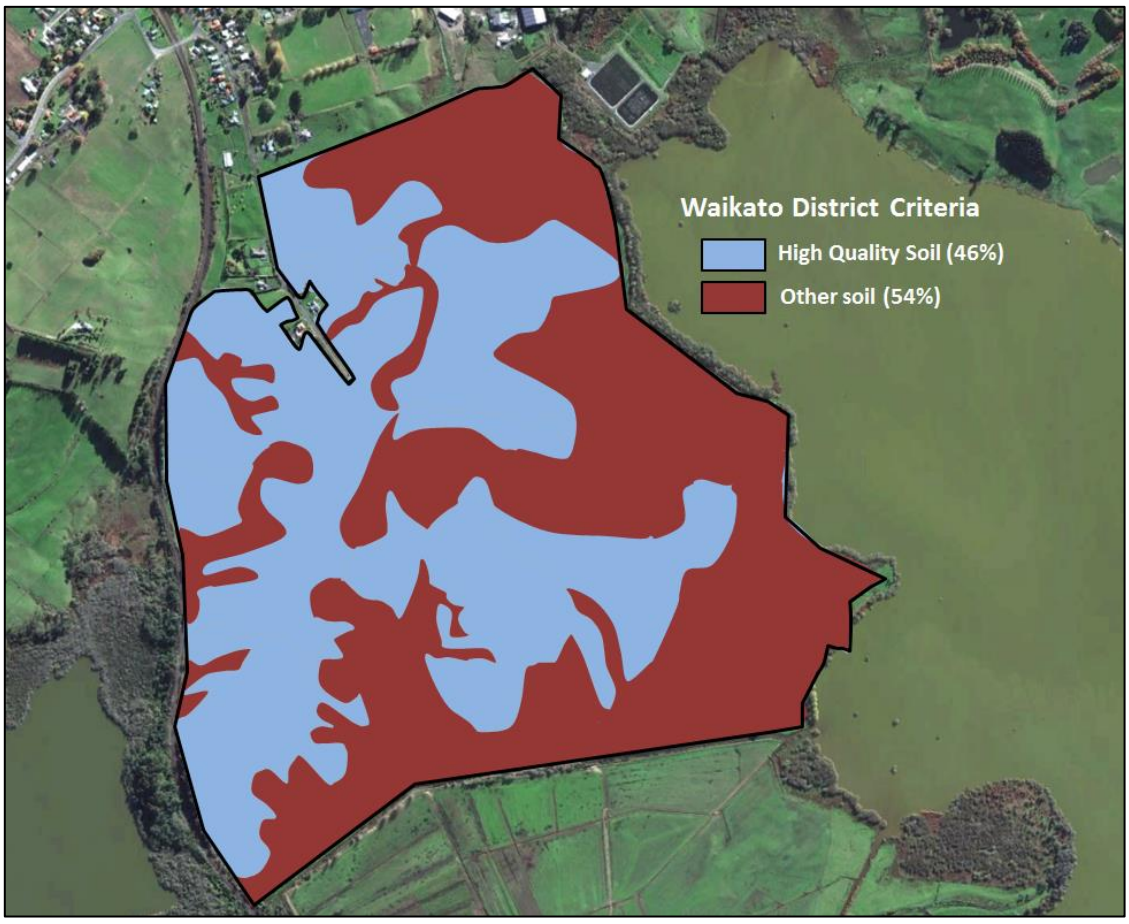


Figure 7. Area of High Quality Soil (shown in blue).

Appendix 1 shows the distribution of High Quality Soil within a 30 km radius of Te Kauwhata, for the Waikato District and for the Waikato Region. The areas are given in Table 4.

Table 4. Areas of High Quality Soil – Waikato District Plan definition*

	LUC class 1 & 2 (ha)	LUC class 3 ** (ha)	Total (ha)
Te Kauwhata (30 km radius)	62,232	29,638	91,870
Waikato District	97,600	38,838	136,438
Waikato Region	298,755	189,373	488,128

* Waikato Regional Council data **Well drained or moderately well drained.

HIGH CLASS SOIL

LUC Class 1 and 2 (excluding peat), and Class 3e1 and 3e5 land is defined as 'High class soil' in Waikato Regional Council Regional Policy Statement (2016).

High class soil

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

The area of High Class Soil covered 54 hectares (27%) of the site (Figure 8). The majority of the site (140 ha, 73%) was either too clayey, wet or steep to qualify as High Class Soil.

Appendix 2 shows the distribution of High Class Soil within a 30 km radius of Te Kauwhata, for the Waikato District and for the Waikato Region. The areas are given in Table 5.

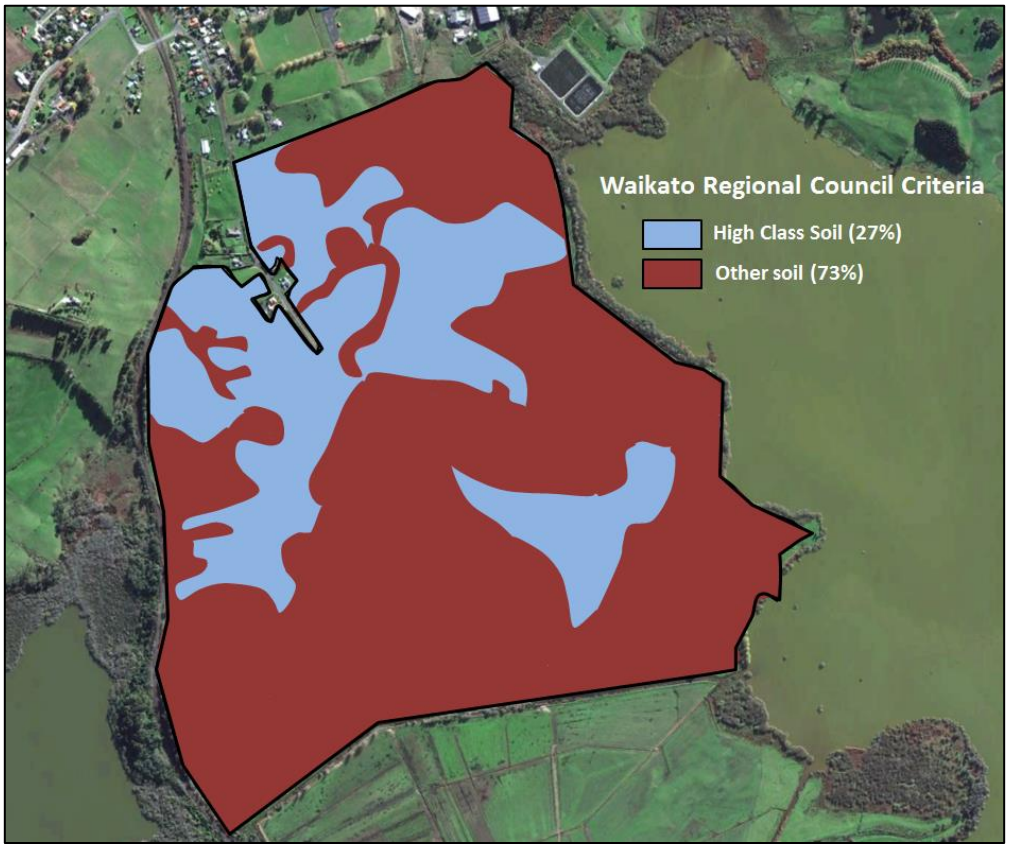


Figure 8. Area of High Class Soil (shown in blue).

Table 5. High Class Soil – Waikato Regional Policy Statement*

	LUC class 1 & 2 (ha)**	LUC class 3e1 & 3e5 (ha)	Total (ha)
Te Kauwhata (30 km radius)	39,473	3,108	42,581
Waikato District	63,612	6,479	70,091
Waikato Region	227,559	68,898	296,457

* Waikato Regional Council data, **Excluding peat

CONCLUSIONS

- The property is undulating and rolling hill land with flat valley bottoms and alluvial areas. It is currently used for dairy farming and calf raising.
- The LUC assessment shows the site comprises of LUC class 2, 3 and 4.
- There are no LUC class 1 soils on the site.
- The soils are predominantly moderately well drained Te Kauwhata and Ruawaro clay loams with a variety of poorly drained soils in the valley bottoms and alluvial flats.
- High quality soil as defined by Waikato District covers 91 hectares (46%) of the site. High class soil as defined by Waikato Regional Council covers 54 hectares (27%) of the site.
- The majority of the site is too clayey, wet or steep to qualify as High Quality or High Class soil.
- High Quality and High Class soil is common in the vicinity of the site and wider district.

REFERENCES

Lynn, I., Manderson, A., Page, M., Harmsworth, G., Eyles, G., Douglas, G., Mackay, A. & Newsome, P. 2009. Land Use Capability Survey Handbook. A New Zealand handbook for the classification of land- 3rd edition, 163p; AgResearch Ltd, Hamilton; Landcare Research New Zealand Ltd, Lincoln; Institute of Geological and Nuclear Sciences Ltd, Lower Hutt.

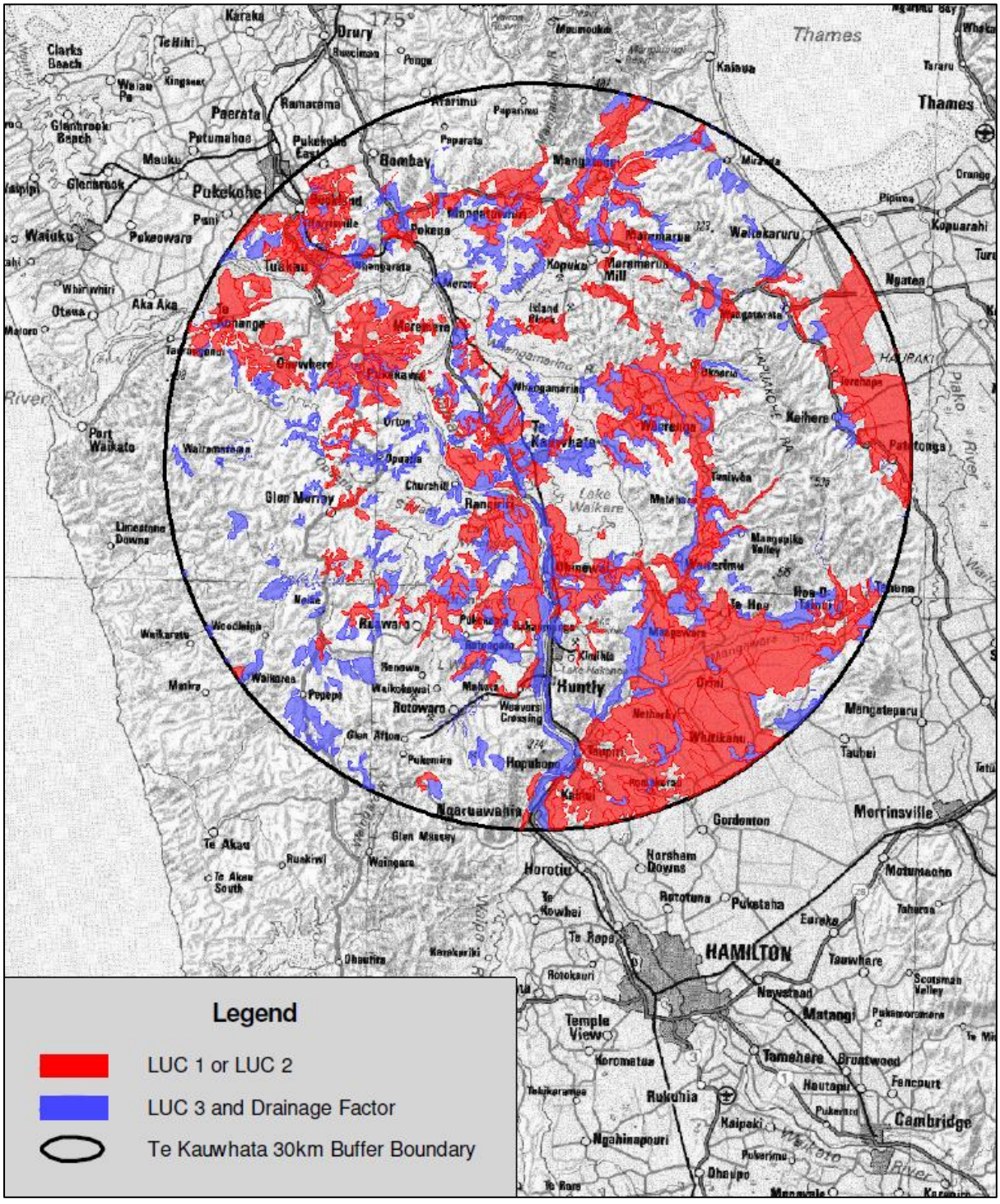
Milne J D G., Clayden B., Singleton PL., & Wilson AD. 1995. Soil Description Handbook - Revised Edition. 157 p; Manaki Whenua Press, Lincoln, Canterbury, NZ.

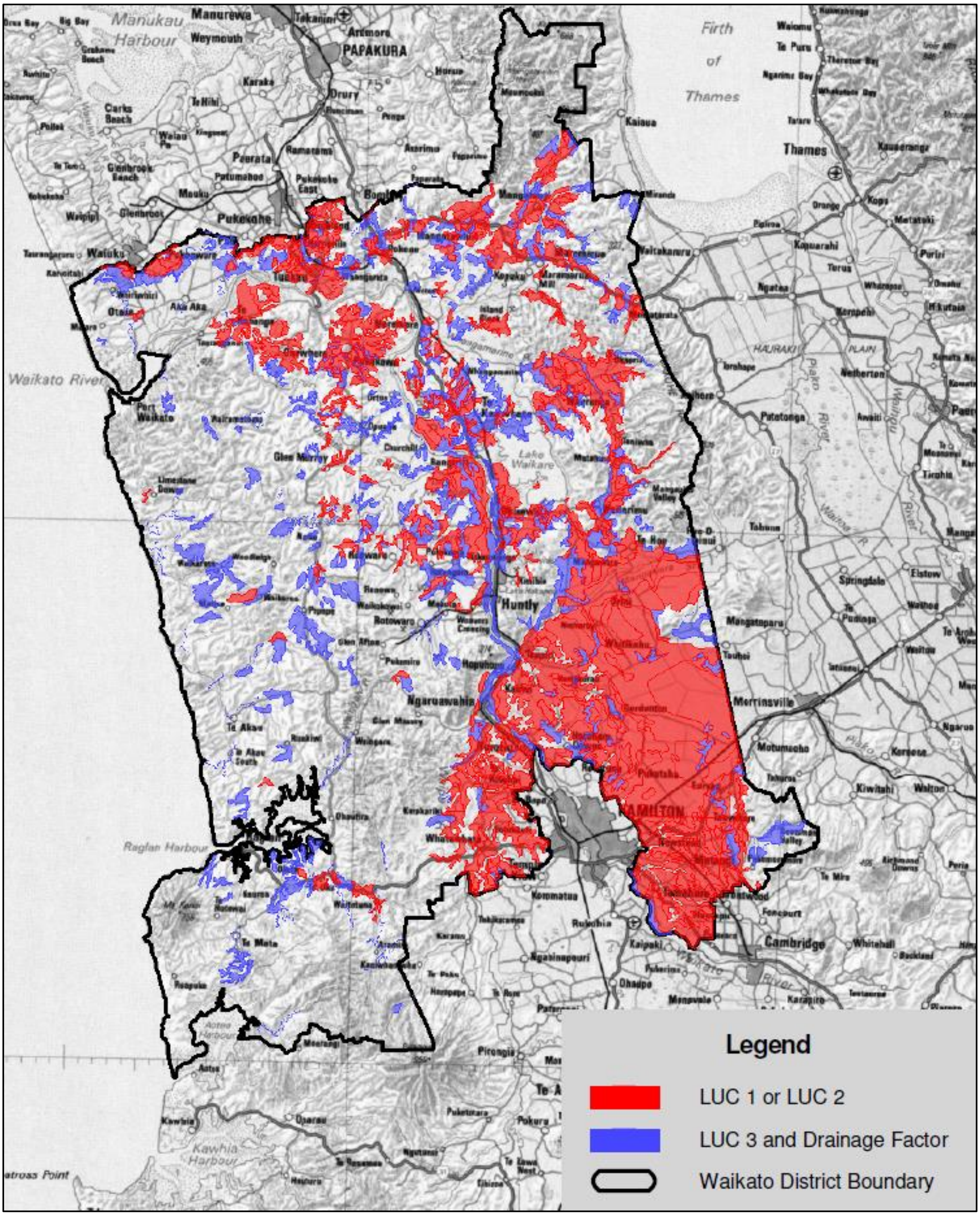
Kear, D. & Schofield, J.C. 1978. Geological Map of New Zealand. Sheet N52 – Te Kauwhata.

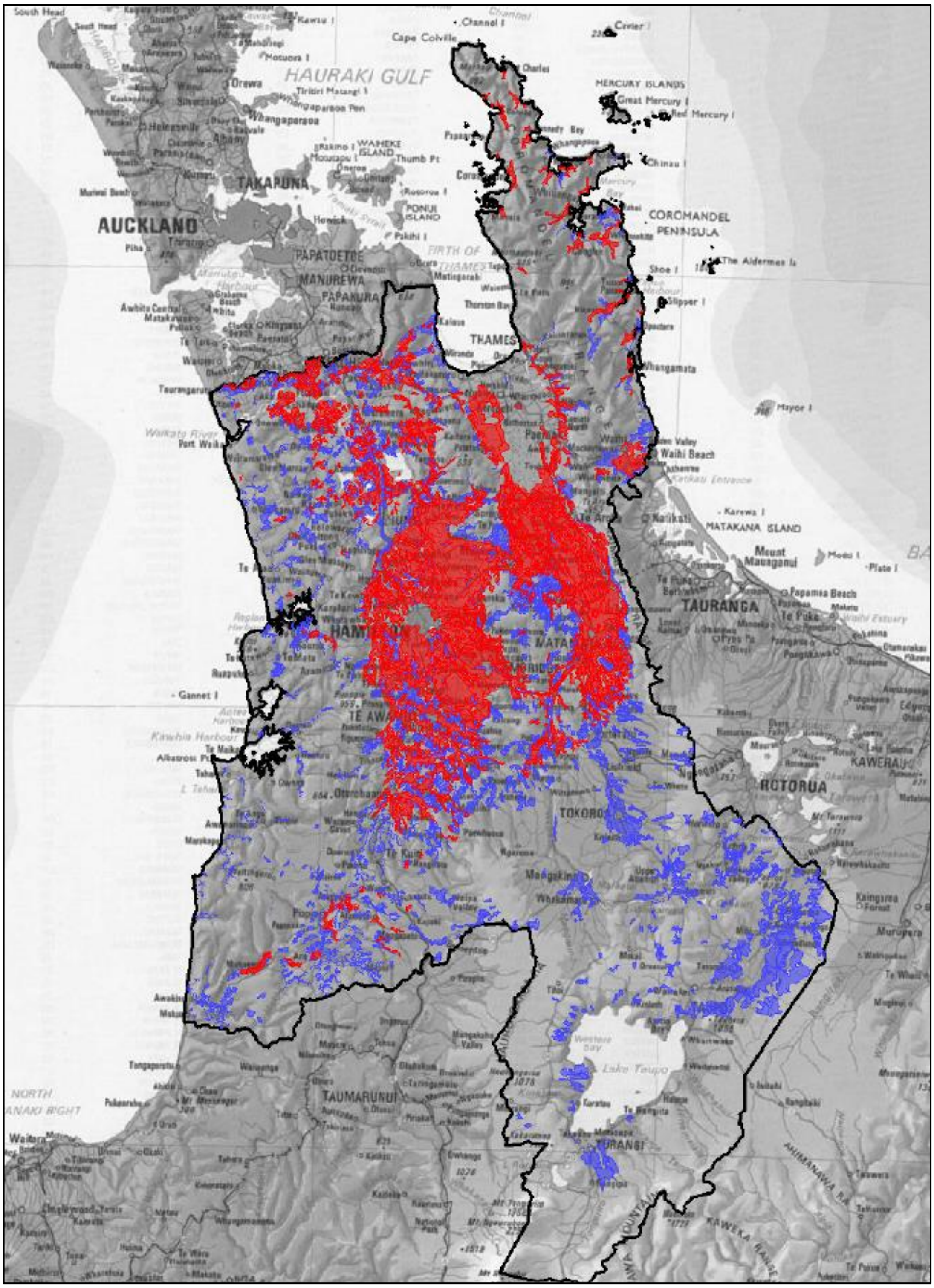
Singleton, P.L. 1982: Soils of Part Te Kauwhata Area, North Island, New Zealand. DSIR Soil Bureau District Office Report HN 6. 60pp.

APPENDIX 1- HIGH QUALITY SOIL – WAIKATO DISTRICT PLAN

The red areas on the following maps are LUC Class 1 & 2 land. The blue area is LUC Class 3 land that is well or moderately well drained. All these areas qualify as High Quality Soil.



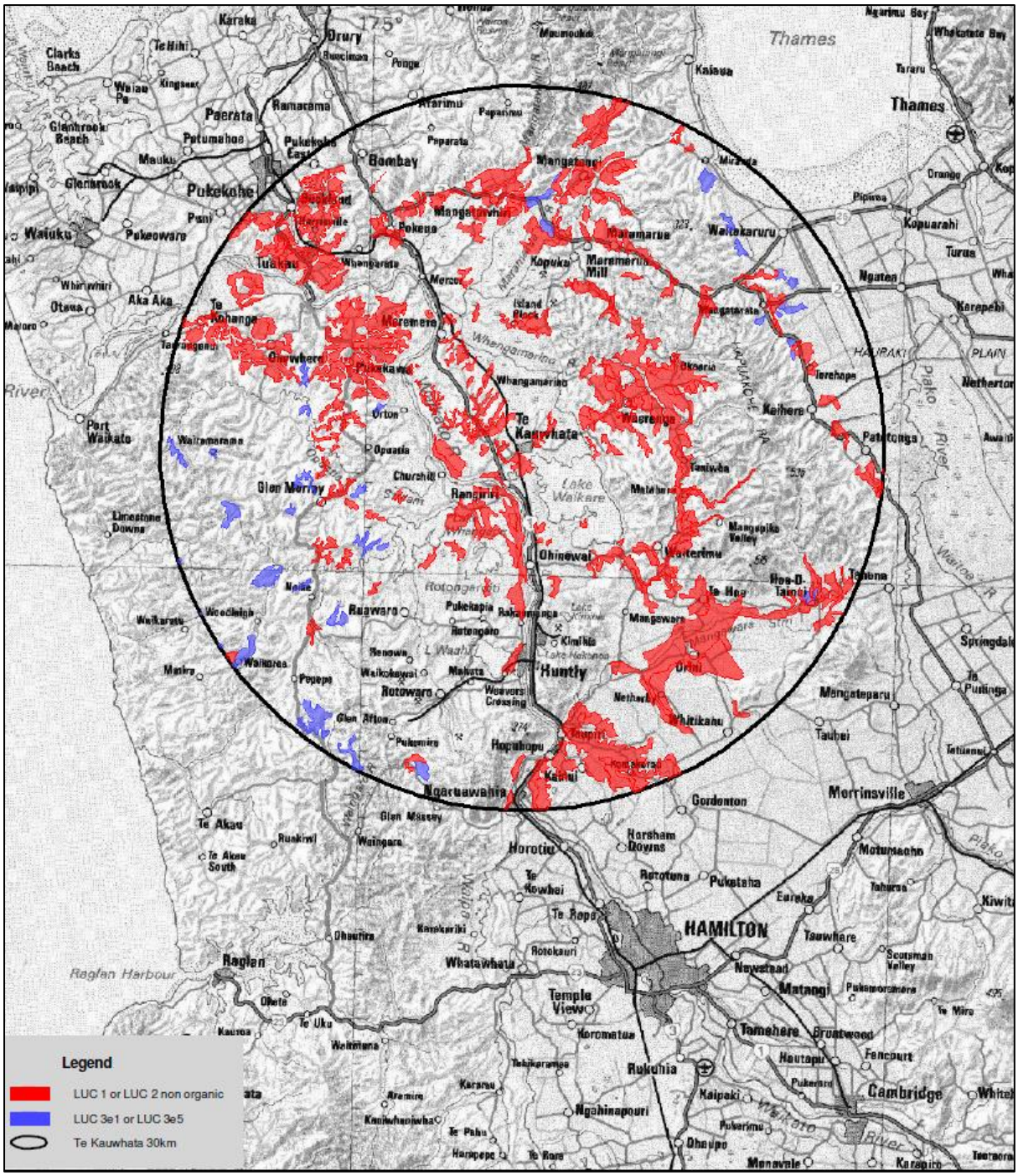

Legend
LUC 1 or LUC 2
LUC 3 and Drainage Factor
Waikato District Boundary

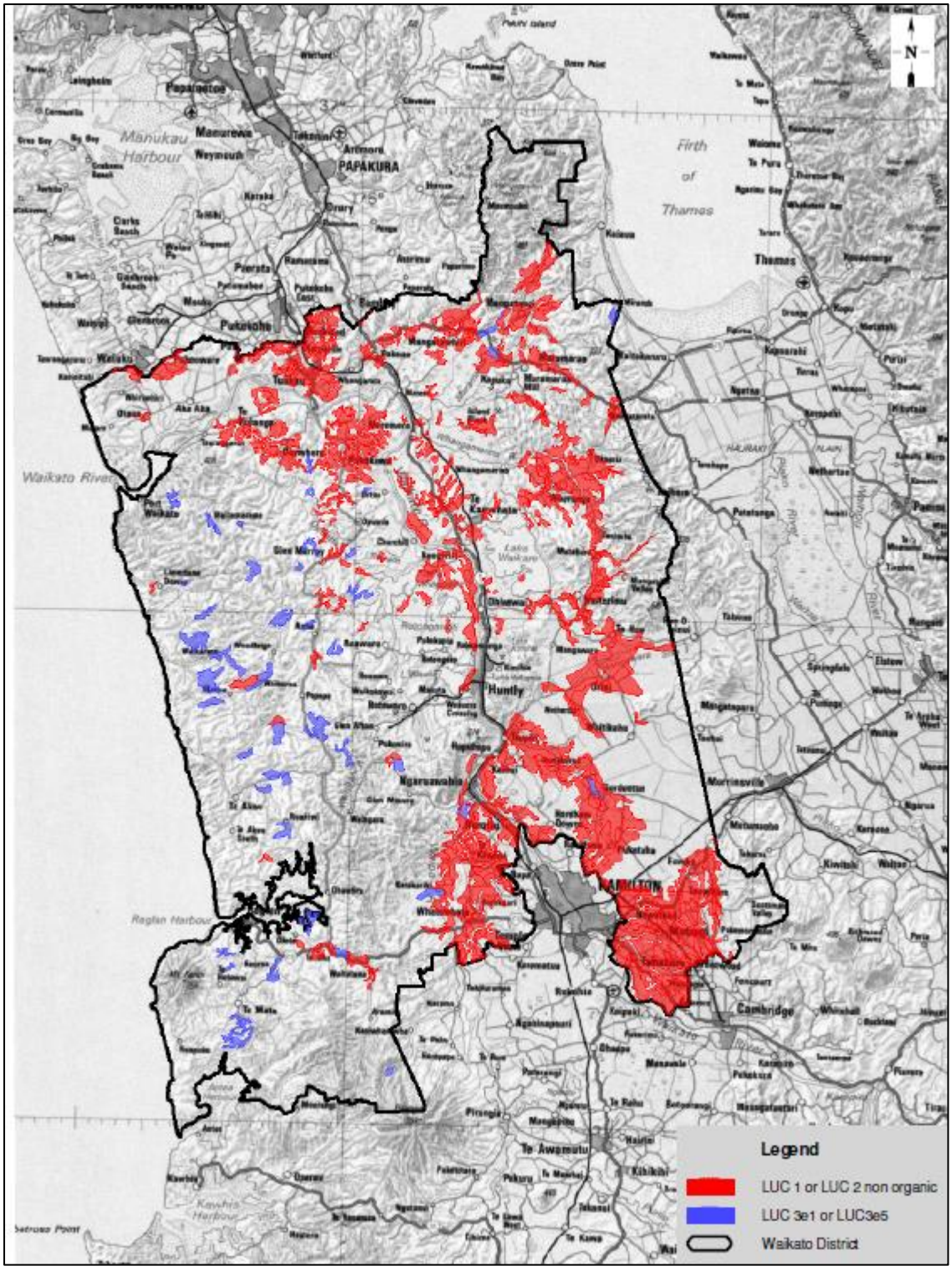


HAURAKI GULF
AUCKLAND
TAKAPUNA
COROMANDEL
PENINSULA
THAMES
TAURANGA
ROTORUA
TAUMARUNUI
Lake Taupo

APPENDIX 2- HIGH CLASS SOIL – WAIKATO REGIONAL POLICY STATEMENT

The red areas on the following maps are LUC Class 1 & 2 land excluding peat soils (organic soils). The blue area is LUC Class 3e2 or 3e5 land. All these areas qualify as High Class Soil.

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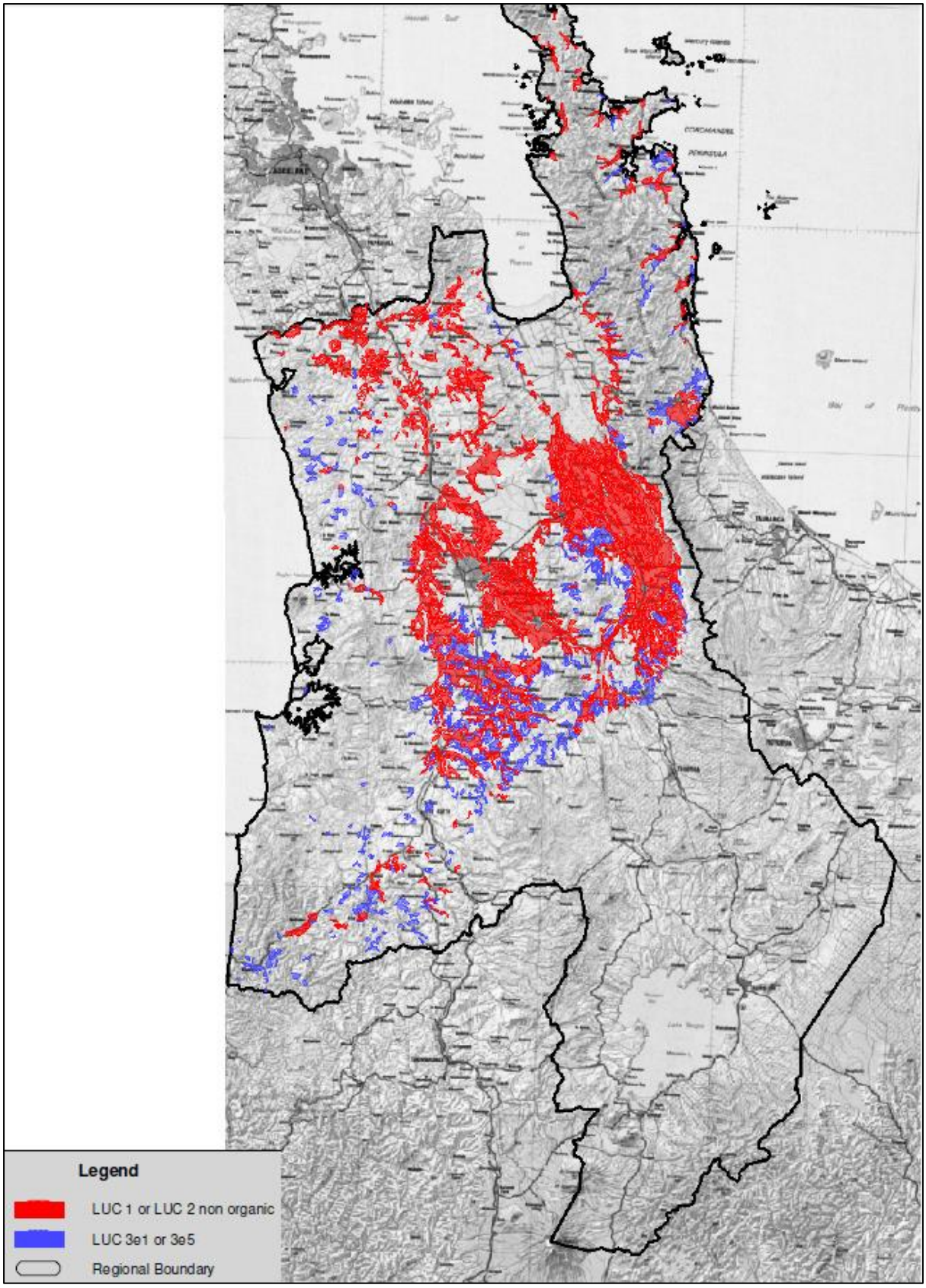
Manukau Harbour
Firth of Thames
Waikato River
Raglan Harbour
Kawhia Harbour
Papakura
Pukekohe
Huntly
Ngaruawahia
Hamilton
Cambridge
Thames
Te Awamutu
Legend
LUC 1 or LUC 2 non organic
LUC 3e1 or LUC3e5
Waikato District


Legend
LUC 1 or LUC 2 non organic
LUC 3e1 or 3e5
Regional Boundary