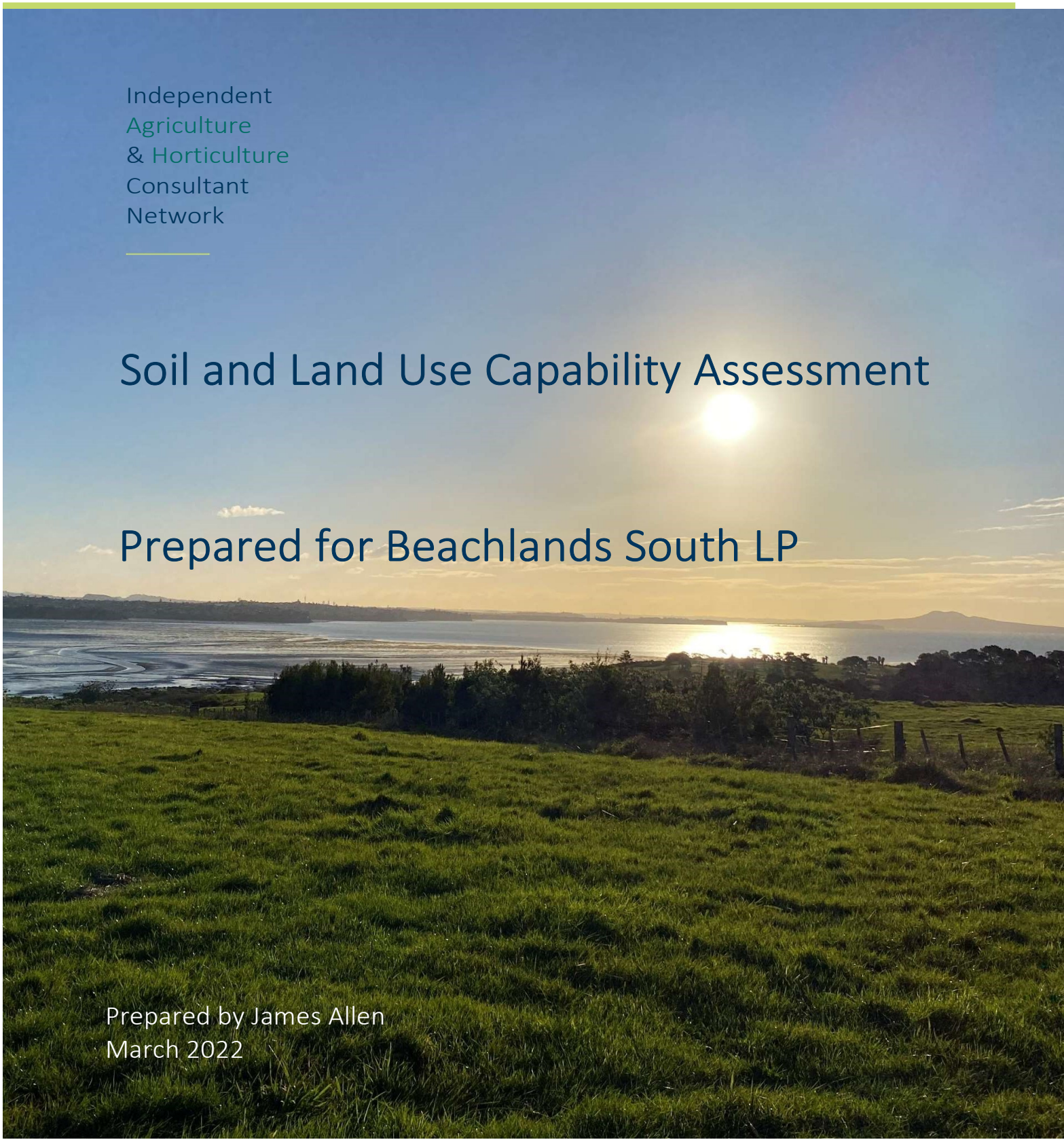
AGFIRST

Independent
Agriculture
& Horticulture
Consultant
Network

Soil and Land Use Capability Assessment

Prepared for Beachlands South LP



Prepared by James Allen
March 2022

TABLE OF CONTENTS

1.0 Background 2
2.0 Property Summary and Existing Land Use 2
3.0 Soil Types 5
4.0 Land Use Capability 10
4.1 Land Use Capability Table – Formosa Site and 620 Site 11
4.2 Land Use Capability Table – 712 Site 16
4.3 Land Use Capability Table – Collective Lifestyle Blocks 19
4.4 Prime Soils table 21
5.0 Soil Assessment 22
6.0 Land Use Potential 25
7.0 Land Use Summary 27
8.0 References 28
Appendix A – Soil VSA Photographs 29
Appendix B – Soil Test Results 33

1.0 BACKGROUND

Beachlands South LP (Beachlands South) have purchased three parcels of land within Auckland, incorporating the Formosa Golf Resort (170.5 ha) at 110 Jack Lachlan Drive, Beachlands; a rural-residential property (79.9 ha) at 620 Whitford-Maraetai Road, Beachlands; and a small lifestyle block has recently been purchased, at 712 Whitford-Maraetai Road, Beachlands (4.8 ha). In addition, the Plan Change area also includes 13 additional properties (Collective Lifestyle Blocks) along Whitford-Maraetai Road, Beachlands (51.8 ha). This combined Plan Change area is approximately 307 ha of coastal frontage property 20 km to the southeast of Auckland CBD.

The vision is to extend the growth of the thriving coastal community of Beachlands into a new area. Under the Auckland Unitary Plan, both sites are zoned Rural – Countryside Living. In order to develop this land for a variety of urban purposes, Beachlands South are proposing a private plan change to rezone the land.

The Auckland Unitary Plan (AUP) has a policy that protects land of high productive potential for farming. This includes elite land (LUC Class 1) and prime land (LUC Class 2 and 3).

AgFirst Waikato (2016) Ltd (AgFirst) have been engaged by Beachlands South to provide an assessment that that identifies the key soil attributes and Land Use Capability (LUC) classifications and summarise the productive potential of the proposed residential rezoning area.

2.0 PROPERTY SUMMARY AND EXISTING LAND USE

A field assessment of the Formosa Golf Resort (Formosa), a farm located at 620 Whitford-Maraetai Road (620 Site), and a lifestyle property located at 712 Whitford-Maraetai Road (712 Site) has been undertaken to identify the productive potential with regard to any elite and prime land. In addition to the site assessments for these properties, AgFirst has been asked to provide a desktop assessment for the 13 lifestyle properties along Whitford-Maraetai Road, Beachlands (Collective Lifestyle Blocks).

Formosa Site

Formosa is an 18-hole golf course and resort located on a picturesque clifftop site in Beachlands. Formosa is spread over 170.5 ha that overlooks the Hauraki Gulf with stunning panoramic views of Waiheke Island, Rangitoto Island, and the Coromandel Peninsula. Formosa, a once world-class international golf course, was designed by Sir Bob Charles and hosted the 1998 New Zealand Open. There is no economic return from this land with regard to agricultural production.

AgFirst has been provided an aerial photograph showing the construction of Formosa Golf Course (Figure 1). This photo shows a significant amount of development that was undertaken to contour the course, with the stripping of the topsoil exposing raw clay. This is evident in the soil assessment undertaken on site with shallow topsoil, poor drainage and heavy clays.

Figure 1: Photograph of Golf Course Development

620 Site

Directly south of the Formosa Golf Course is a 79.9 ha farm. For the majority of the year the farm operates as a cut and carry system, where pasture silage and hay are cut on the farm and exported to other farms. Very occasionally there are times during the year when the farm is grazed by beef cattle.

Based on the AgFirst 2020 financial survey, the 2019/20 Earnings before Interest and Tax (EBIT) for a low intensive sheep and beef farm in central north island hill country was $374 per ha. For a 79 ha farm, this would equate to an EBIT of approximately $29,800. This sum of money is then required to meet a range of further expenses:

- Interest on debt
- Living costs for the farmer (drawings)
- Tax
- Any capital &/or development costs
- Principal debt repayments

The EBIT noted above represents a 1.8% return on assets, based on the financial survey average land value of $7,800 per ha. Considering the fact that this particular block of land will be worth significantly more than this average value, the likely return on asset from this land will be very low if run as a sheep and beef property. The farm is unlikely to show any real profit, and therefore alternative land use options would need to be explored to maintain this land as a productive operation.

712 Site

Adjacent to the Formosa Golf Course is a 4.84 ha lifestyle property, located at 712 Whitford-Maraetai road, and referred in this report as the 712 Site. The site is long and narrow running east to west from the Whitford-Maraetai Road. The front of the property is used for a residence including gardens, lawns and an orchard and associated residential buildings. The balance of the property is in pasture and native bush. Apart from the residential area, the property has rolling to steep topography with the steepest areas having been fenced off and planted in native trees. Some retaining walls have been constructed through a narrow gully system that dissects the property to prevent erosion. A pond has been constructed at the head of the gully system next to the house. Soils on the property are part of the Torehape complex and Rangiora clay loam and silt loam hill soils. There were no stock present on the property at the time of the site visit with pastural areas having been mowed.

Collective Lifestyle Blocks

Surrounding the 712 Site, are an additional 13 individual lifestyle properties. Most of these are similar in physical attributes to the 712 Site, with sizes ranging from 1.3 ha to 7.2 ha and accessed from Whitford-Maraetai Road. These sites are typically long and narrow running east to west with the front or east of the properties developed into residence including gardens, lawns and orchards and associated residential buildings. To the west, the balance of the properties are pastoral, with some ineffective area consisting of wetlands, native bush and waterways and gullies. It is unknown if the pastoral areas are used for grazing stock, and what farming infrastructure in available, such as reticulated stock water, power supply for fences or ineffective areas retired and fenced off. It is likely that most of the blocks will be managed in a similar way to that of the neighbouring 712 Site, which was no stock and mowed pasture.

3.0 SOIL TYPES

Soils identified on the property are described in the table below. Soil identification has been made using the General Survey of the Soils of the North Island, New Zealand (Soil Bureau Bulletin (n.s.) 5) as a reference rather than the more recent S-Map data. This approach has been taken as the former system is used in the Waikato Land Use Capability Extended Legend and enables a direct identification of LUC units, and therefore prime and elite soils. The Auckland Council also uses soils from the General Survey of the North Island when identifying elite soils. A soil map is also included which shows the location and distribution of these soils.

Soil Profile	Description
	**Soil Name:** Torehape complex **Soil classification:** Yellow-brown loams **Parent material:** Water sorted ash, sandstone, greywacke **Soil description:** » 0-250mm: Friable, strongly developed, 4-10mm nut, slight sticky, plastic, dark grey (10YR 4/1), clay to clay loam. » 250-460mm: Firm, strongly developed, blocky, sticky, plastic, olive yellow (2.5Y 6/6-6/8) clay with light olive brown mottling (2.5Y 5/3). Iron/manganese nodules present. **Overall drainage:** Imperfectly drained **Location of Sample:** Formosa Site and 620 Site
	**Soil Name:** Torehape complex **Soil classification:** Yellow-brown loams **Parent material:** Water sorted ash, sandstone, greywacke **Soil description:** » 0-250mm: Friable, strongly developed, 4-10mm nut, slight sticky, plastic, very dark grey (2.5Y 3/1), clay to clay loam. » 250-460mm: Firm, strongly developed, blocky, sticky, plastic, light brownish grey (2.5Y 6/2) clay with yellow mottling (2.5Y 7/8). Iron/manganese nodules present. **Overall drainage:** Poorly drained **Location of Sample:** Formosa Site and 620 Site

	**Soil Name:** Torehape complex **Soil classification:** Yellow-brown loams **Parent material:** Water sorted ash, sandstone, greywacke **Soil description:** » 0-260mm: Very friable, strongly developed, 2-5mm crumb, sticky, plastic, very dark greyish brown (2.5y 3/2) clay to clay loam. » 260-420mm: Friable, strongly developed, 2-10mm crumb, sticky, plastic, olive yellow (2.5Y 6/8) clay **Overall drainage:** Moderately well drained **Location of Sample:** Formosa Site and 620 Site
	**Soil Name:** Torehape complex **Soil classification:** Yellow-brown loams **Parent material:** Water sorted ash, sandstone, greywacke **Soil description:** » 0-230mm: Very friable, strongly developed, 1-5mm crumb, sticky, plastic, dark brown (10yr 3/3) clay loam » 230-400mm: Very friable, strongly developed, 2mm crumb, sticky, plastic yellowish brown (10yr 5/8) clay loam. **Overall Drainage:** Well drained **Location of Sample:** Formosa Site and 620 Site
	**Soil Name:** Rangiora clay and silty clay loam hill soil **Soil classification:** Podzolic soils from sedimentary rocks **Parent material:** Greywacke **Soil description:** » 0-75mm: Friable, strongly developed, grey brown silty clay loam » 75mm +: Firm, strongly developed, sticky, plastic, yellow clay **Overall Drainage**: Imperfectly drained **Location of Sample:** Formosa Site and 620 Site

Soil Name: Modified Torehape complex

Soil classification:

Parent material: Water sorted ash, sandstone, greywacke.

Soil description: The soil profile has undergone significant modification with the topsoil being striped off, the subsoil shaped then topsoil re-laid as well as various mounds and features shaped from various soil material sourced from both onsite and brought in.

Topsoil varies in depth, texture and development. In places, friable, strongly developed clay loam in others a mix of sand, gravel and soil.

Subsoil is firm to very firm, strongly developed, sticky, plastic, clay.

Overall Drainage: Variable

Location of Sample: Formosa Site

Soil Name: Torehape complex

Soil classification: Yellow-brown loams

Parent material: Water sorted ash, sandstone, greywacke

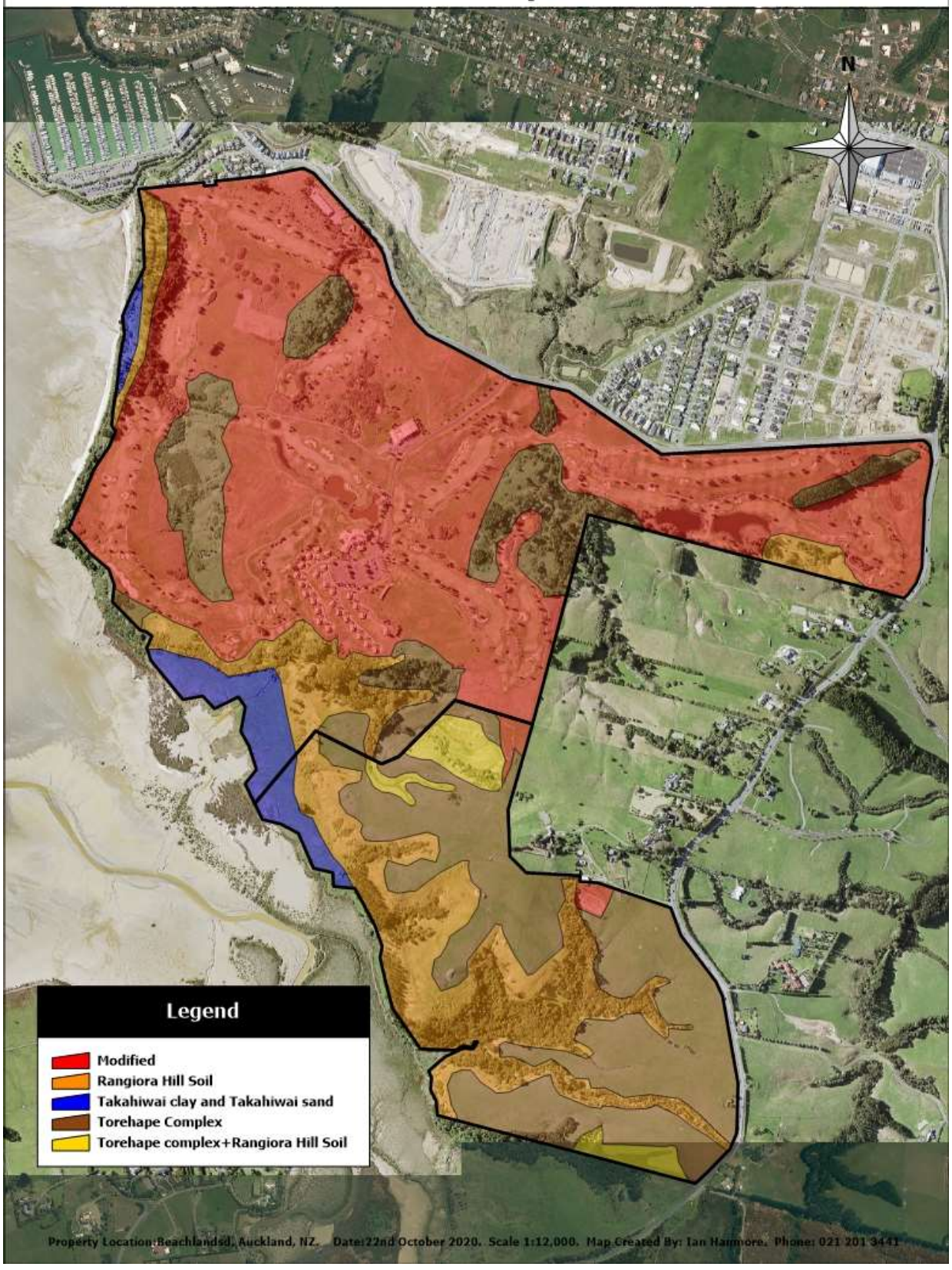
Soil description:

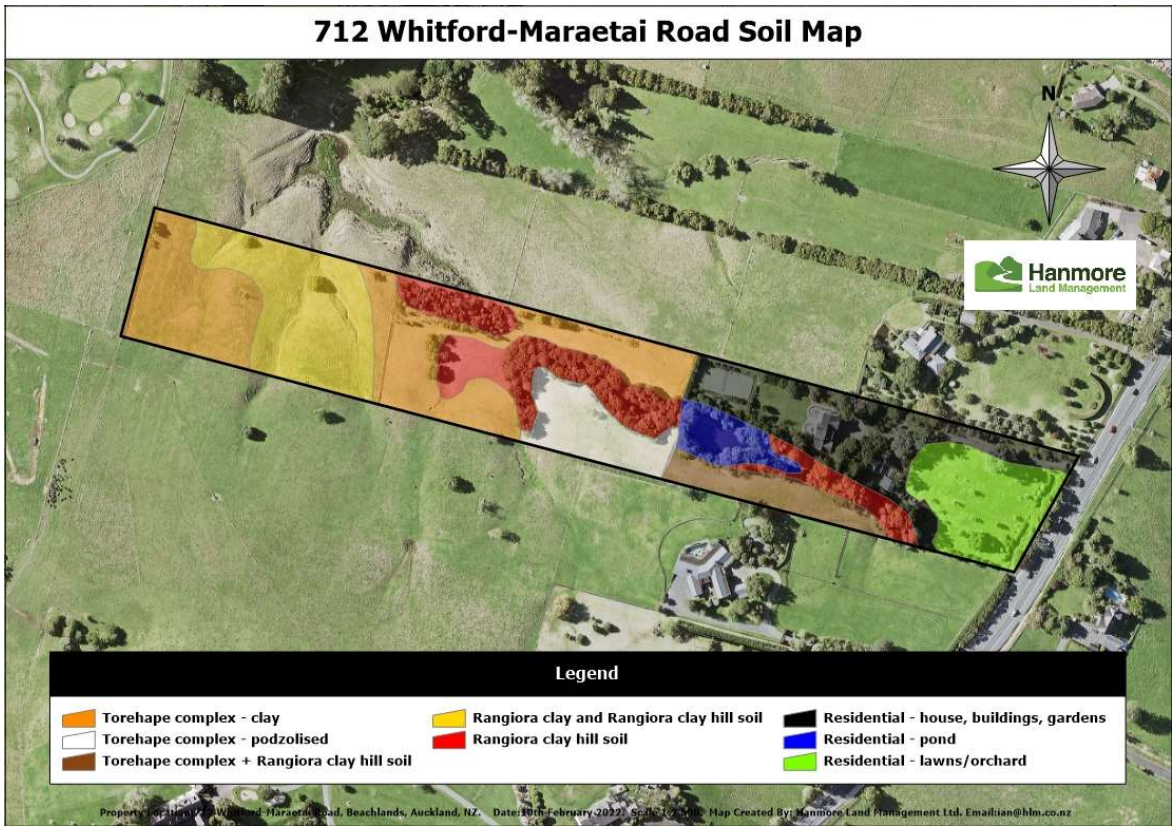
- 0-15cm Strongly developed, fine to medium nut, friable, slightly sticky, plastic, very dark grey (10YR 3/1) clay loam.
- 15-21cm Strongly developed, fine to medium nut, friable, slightly sticky, plastic, grey (10YR 6/1) clay loam.
- 21-31cm Strongly developed, medium blocky, firm, sticky, plastic, brownish yellow (10YR 6/8) clay with 50% white (10YR 8/1) mottles.

Overall drainage: Imperfectly to poorly drained.

Location of Sample: 712 Site

Formosa Golf Resort and 620 Whitford-Maraetai Road Soil Map




712 Whitford-Maraetai Road Soil Map
N
Hanmore
Land Management
Legend
Torehape complex - clay
Torehape complex - podzolised
Torehape complex + Rangiora clay hill soil
Rangiora clay and Rangiora clay hill soil
Rangiora clay hill soil
Residential - house, buildings, gardens
Residential - pond
Residential - lawns/orchard

4.0 LAND USE CAPABILITY

LUC classifications categorise land into eight classes according to its long-term capability to sustain one or more productive uses. Classes one to four have arable potential with limitations to this land use moving from class one being the most versatile, multi-use land with minimal physical limitations for arable use and increasing to severe limitations under class four land. These classes are also suitable to viticulture, berry production, pastoralism, tree crops and production forestry. Classes five to seven are suitable for pastoral farming and production forestry with class eight land having no productive use and is rather managed for catchment protection and conservation purposes.

After reviewing all the initial information, it was decided that it was necessary to prepare an updated and more detailed LUC map. This is due to:

- Increased resolution (1:5,000 scale compared to 1:50,000 scale from NZLRI maps).
- NZLRI maps are several decades old and do not account for subsequent land use modifications.
- Significant land and soil modifications have occurred at this site which is not represented within the NZLRI classification.

This updated classification forms the basis of our recommendations. The LUC mapping work was undertaken by Ian Hanmore, a recognised expert in this field.

Mapping Method

FORMOSA SITE AND 620 SITE

A site visit was carried out on the 30th of September 2020 to the Formosa site and the 620 site to evaluate and describe the soil types and the LUC units present. Both properties were mapped with site mapping carried out at a scale of 1:5,000. Soil profiles were dug and described on each landform present with supporting holes dug or profiles observed on bank/drain cuttings to establishing soil boundaries. In total over 30 profiles were observed in the soil mapping process. LUC mapping was carried out in accordance with the methods described in the 3rd Edition of the Land Use Capability Survey Handbook. Activities included gathering field data, including soil mapping (as described above), measuring slopes with a clinometer, and gathering any other data that may be of assistance in assessing the suitability of the land for primary production such as erosion, susceptibility of the land to flooding, winter wetness and/or cold, high temperatures, exposure to salt winds, aspect, and accessibility.

712 SITE

A site visit was carried out on the 27th of January 2022 to evaluate and describe the soil types and the LUC units present. The site was mapped at a scale of less than 1:4,000. LUC mapping was carried out in accordance with the methods described in the 3rd Edition of the Land Use Capability Survey Handbook (Lynn et al 2009). This process involves making a land resource inventory (LRI) of the property in which soil types, soil parent materials, land slopes, erosion type and severity and land cover of the area are recorded. Whenever any of these land features change a new unit is made. Specific field work activities include digging and describing soil profiles on each landform with supporting holes dug or profiles observed on bank/drain cuttings to establishing soil boundaries, measuring slopes with a clinometer, and gathering any other data that may be of assistance in assessing the suitability of the land for primary production such as erosion,

susceptibility of the land to flooding, winter wetness and/or cold, high temperatures, exposure to salt winds, aspect, and accessibility. This information is then used to determine the specific LUC units, as described in the New Zealand Land Use Inventory Worksheets for the Waikato Region (National Water and Soil Conservation Organisation) for the area.

Collective Lifestyle Blocks

As the lifestyle blocks are not owned by Beachlands South, AgFirst has been asked to undertake desktop analysis on these sites. AgFirst has used the Landcare Research soils portal, S-Maps. This data is represented as a 1:50,000 scale digital map. These maps are useful for understanding regional soil variations, although they are not designed to be interpreted at a farm or paddock scale. To demonstrate the LUC classification, AgFirst has used the New Zealand Land Resource Inventory (NZLRI) national database of physical land resource information. Within this database is a regional scale LUC rating of the ability of each polygon to sustain agricultural production. This is based on an assessment of the physical factors (rock type, soil, slope, present type and severity of erosion, and vegetation), climate, the effects of past land use, and the potential for erosion. As with the S-Maps, these have been produced at a 1:50,000 scale and are suitable for guidance, but are not specifically designed to be interpreted at a farm or paddock scale. To help understand the farm or paddock scale soils and LUC classification, a comparison can be made to the 712 Site that is surrounded to the north and south by the Collective Lifestyle Blocks.

4.1 Land Use Capability Table – Formosa Site and 620 Site

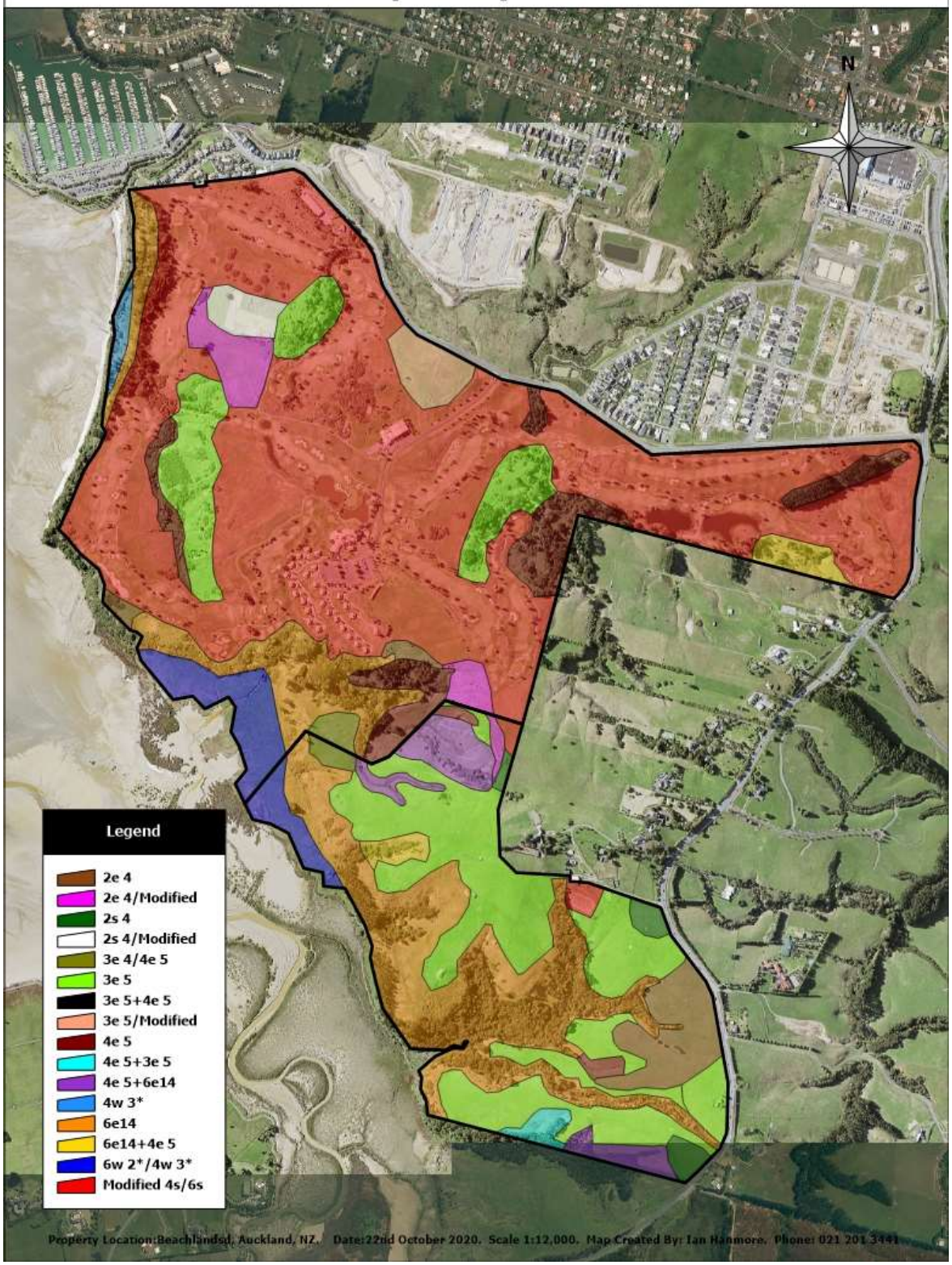
The table below describes each of the LUC units present on the properties, the area they cover and if they are classified as prime or elite soils according to the Auckland Council definition. Note that two of the units described 4w3* and 6w2* are taken from the LUC descriptions for the Northern Region and correspond to 4w2 and 6w2 respectively in that publication. These units have been used as there are no units within the Waikato LUC extended legend to describe the landforms identified while equivalent units have been described in the Northern Region by Harmsworth. This table is accompanied by an LUC map and a prime/elite soils map.

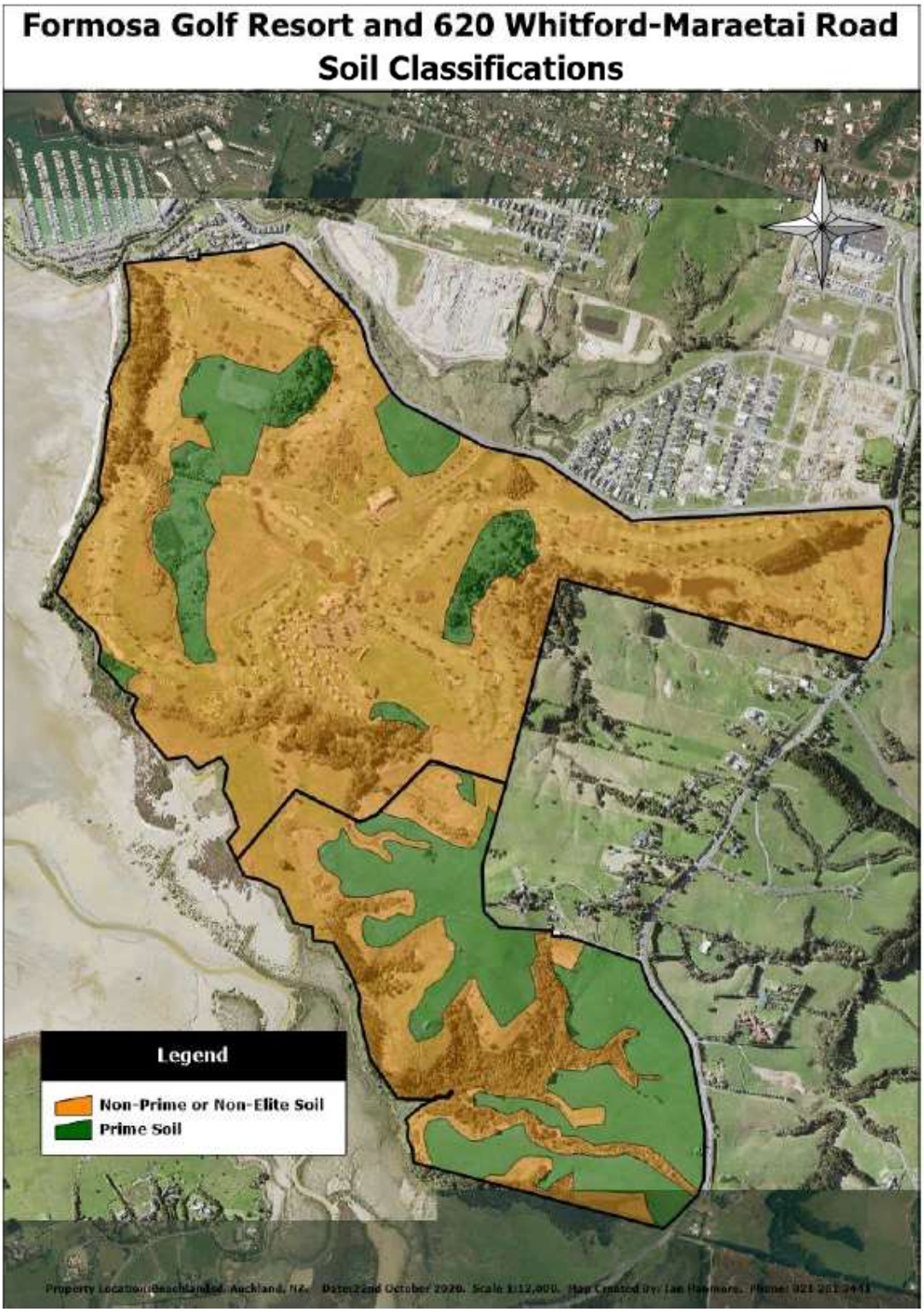
Resource information	LUC unit	Total area (ha)	Parent material	Dominant soil type	Slope degree	Land Cover	Erosion degree & severity		Land use suitability	Soil Classification
							Actual	Potential		
2e 4 Undulating to rolling slopes on yellow-brown loams formed on water sorted tephra with a slight erosion hazard when cultivated.		9.5	Water sorted ash, sandstone, greywacke	Torehape complex	4-15^0 (B, B/C)	Pasture	Nil	Slight sheet and rill when cultivated	Intensive cropping Intensive grazing Forestry	Prime
2s 4 Flat to undulating slopes on yellow-brown loams formed on water sorted tephra.		2.9	Water sorted ash, sandstone, greywacke	Torehape complex	0-8^0 (A, B)	Pasture	Nil	Nil	Intensive cropping Intensive grazing Forestry	Prime
3e 5 Undulating to rolling slopes on yellow-brown loams formed on water sorted tephra with a slight to moderate erosion hazard when cultivated.		45.3	Water sorted ash, sandstone, greywacke	Torehape complex	4-15^0 (C, C/B)	Pasture Native and exotic trees	Nil	Slight to moderate rill and sheet when cultivated	Cropping Intensive grazing Forestry	Prime
4e 5 Rolling to strong rolling slopes on yellow-brown loams formed on water sorted tephra with a moderate to severe erosion hazard when cultivated.		18.1	Water sorted ash, sandstone, greywacke	Torehape complex	15-20º	Pasture, Exotic trees	Nil	Moderate to severe sheet and rill when cultivated.	Occasional cropping Intensive grazing Production forestry	Non-prime or elite
4w 3* Flat reclaimed tidal mudflats, estuarine plains with slightly saline gley soils on alluvium.		4.7	Fine alluvium. Undifferentiated alluvium, fluvial and estuarine deposits	Takahiwai sand, Takahiwai clay	0-3^0 (A)	Pasture	Nil	Slight wind and sheet when cultivated	Greed fodder crops Intensive grazing	Non-prime or elite
6w 2* Flat, recently (<10 years) reclaimed tidal mudflats, estuarine plains with slightly saline gley soils on alluvium.		3.8	Fine alluvium. Undifferentiated alluvium, fluvial and estuarine deposits	Takahiwai sand, Takahiwai clay	0-3^0 (A)	Pasture	Slight deposition	Slight to moderate deposition	Grazing	Non-prime or elite

Resource information	LUC unit	Total area (ha)	Parent material	Dominant soil type	Slope degree	Land Cover	Erosion degree & severity		Land use suitability	Soil Classification
							Actual	Potential		
6e14 Moderately steep to steep slopes on deeply weathered greywacke.		43.8	Deeply weathered greywacke	Rangiora hill soil	20-35º (E,F)	Pasture, native and exotic trees	Nil	Moderate to severe earth slip and soil slip. Moderate sheet and gully	Semi-intensive grazing Production forestry	Non-prime or elite
4s Modified Flat to undulating slopes on significantly modified landscape. Topsoil has been striped, subsoil modified, and mixed topsoil returned. Topsoil depth varies from 200-300mm over firm to very firm clay		61.1	Water sorted ash, sandstone, greywacke	Modified Torehape complex and Rangiora clay	$0\text{-}8^0$ (A, B)	Pasture	Nil	Nil	Grazing Production forestry	Non-prime or elite
6s Modified Flat to short strong rolling slopes on significantly modified landscape. Topsoil has been striped, subsoil modified, and mixed topsoil returned. Topsoil depth less than 200mm over firm to very firm clay.		61.1	Water sorted ash, sandstone, greywacke	Modified Torehape complex and Rangiora clay	$0\text{-}20^0$ (A-D)	Pasture	Nil	Nil	Grazing Production forestry	Non-prime or elite

*LUC data marked with * are taken from field work and LUC Classifications for the Northland Region, Harmsworth (1996).*
Where two LUC units are mapped together areas of each individual unit are allocated as half of the total area mapped.

Formosa Golf Resort and 620 Whitford-Maraetai Road
Land Use Capability Classifications

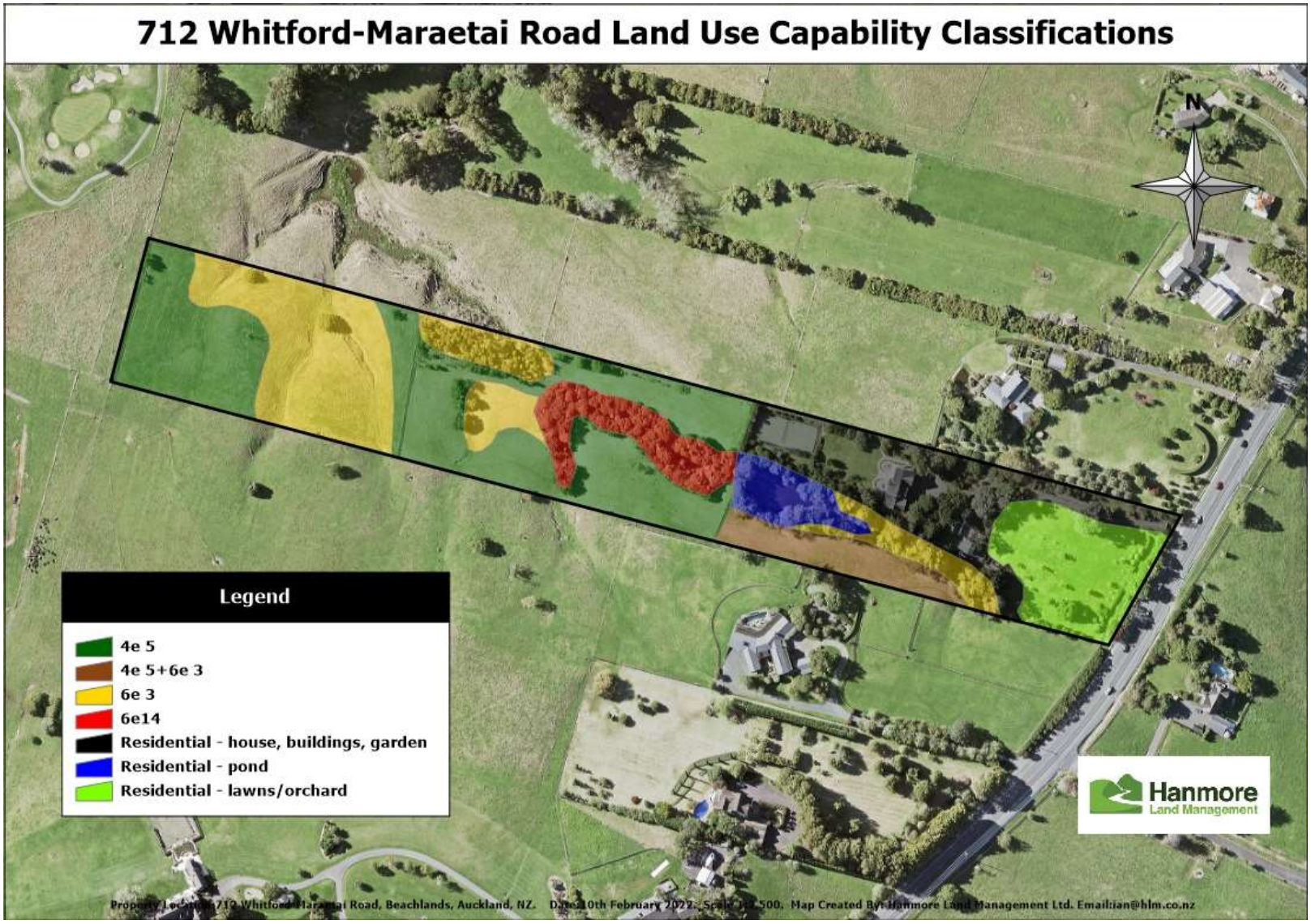


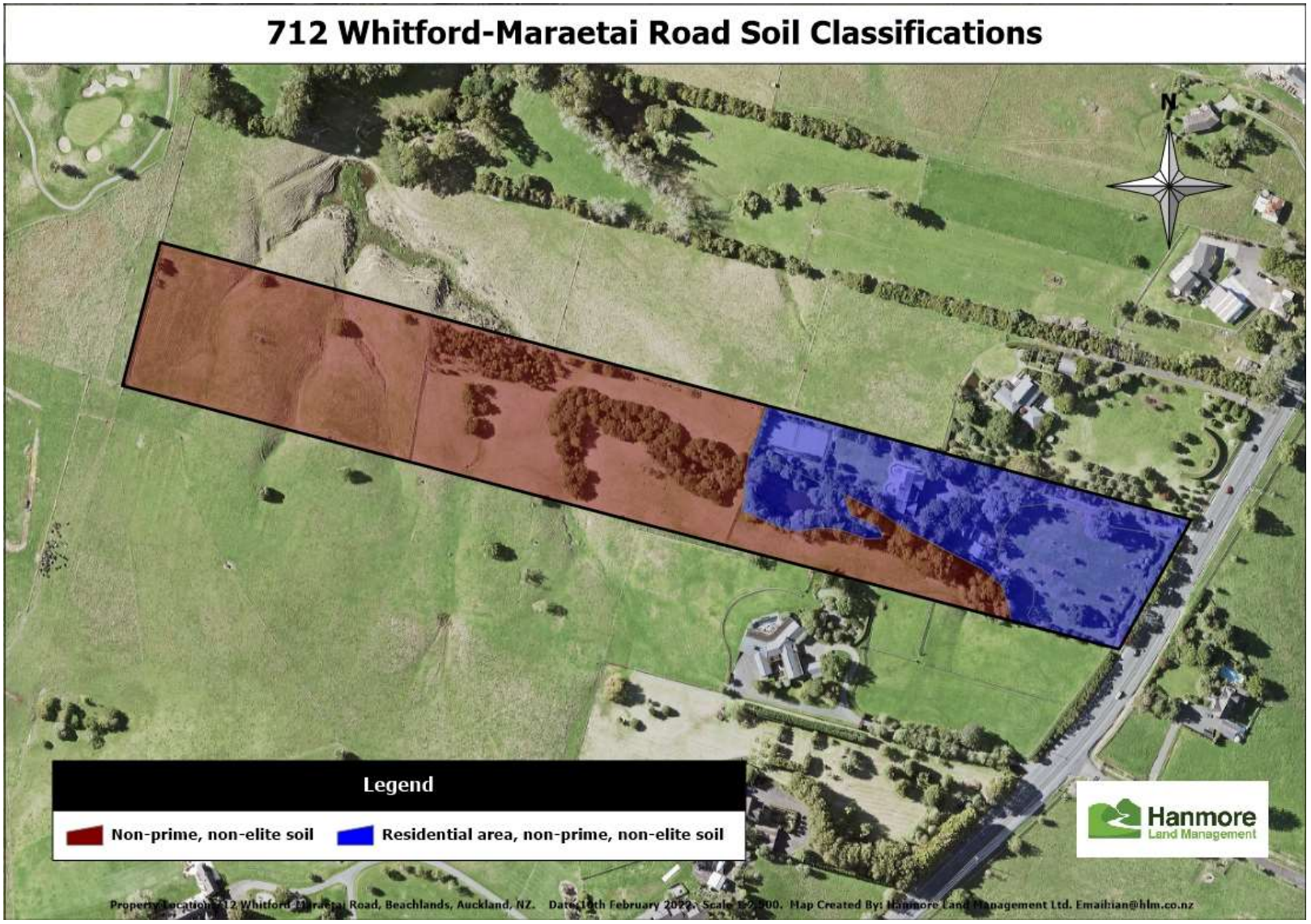

Formosa Golf Resort and 620 Whitford-Maraetai Road
Soil Classifications
N
Legend
Non-Prime or Non-Elite Soil
Prime Soil

4.2 Land Use Capability Table – 712 Site

The table below presents the LUC units mapped on the areas in this survey.
The table below describes each of the LUC units present on the property, the area they cover and if they are classified as prime or elite soils according to the Auckland Council definition. This table is accompanied by an LUC map and a prime/elite soils map.

Resource information	LUC unit	Total area (ha)	Parent material	Dominant soil type	Slope (degree)	Land Cover	Erosion degree & severity		Land use suitability	Soil Classification
							Actual	Potential		
4e 5 Rolling to strong rolling slopes on yellow-brown loams formed on water sorted tephra with a moderate to severe erosion hazard when cultivated		1.9 ha	Water sorted ash, sandstone, greywacke	Torehape complex	15-20º	Pasture	Nil	Moderate to severe sheet and rill when cultivated.	Occasional cropping Intensive grazing Production forestry	Non-prime Non-elite
6e 3 Moderately steep to strong rolling slopes on sedimentary lithologies		1.1	Terrace alluvium, siltstone, sandstone, mudstone and greywacke	Rangiora hill soil	16-25º	Pasture, native trees	Nil	Slight gully, soil slip and sheet.	Intensive grazing Production forestry	Non-prime Non-elite
6e14 Moderately steep to steep slopes on deeply weathered greywacke.		1.5	Deeply weathered greywacke	Rangiora hill soil	20-35º	Pasture, native trees	Nil	Moderate to severe earth slip and soil slip. Moderate sheet and gully	Semi-intensive grazing Production forestry	Non-prime Non-elite


712 Whitford-Maraetai Road Land Use Capability Classifications
N
Legend
4e 5
4e 5+6e 3
6e 3
6e14
Residential - house, buildings, garden
Residential - pond
Residential - lawns/orchard
Hanmore
Land Management
Property Location: 712 Whitford-Maraetai Road, Beachlands, Auckland, NZ. Dated: 10th February 2022. Scale: 1:1,500. Map Created By: Hanmore Land Management Ltd. Email:ian@hlm.co.nz

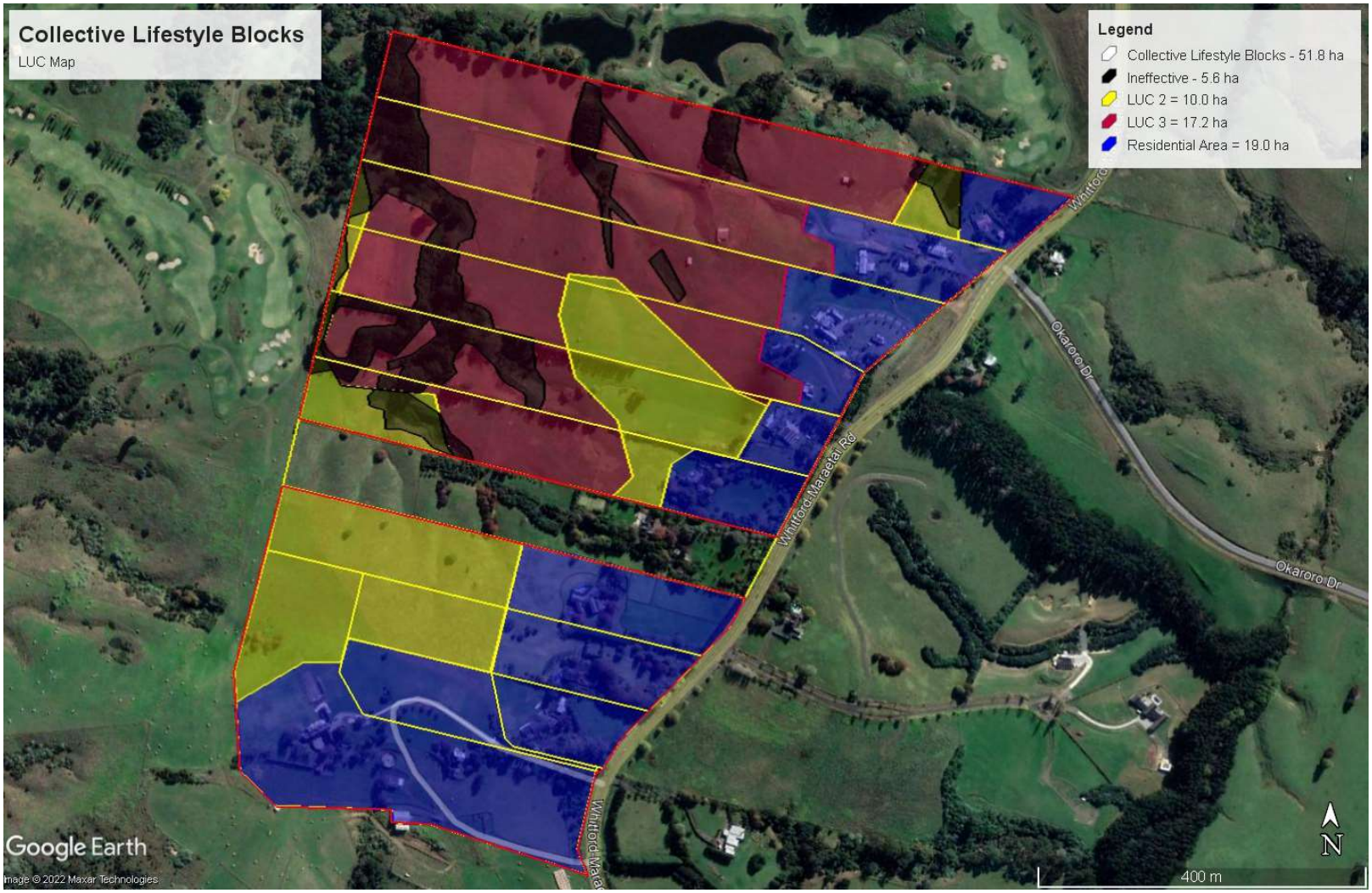

712 Whitford-Maraetai Road Soil Classifications
N
Legend
Non-prime, non-elite soil
Residential area, non-prime, non-elite soil
Hanmore
Land Management
Property Location: 712 Whitford-Maraetai Road, Beachlands, Auckland, NZ. Date: 10th February 2022. Scale 1:2,500. Map Created By: Hanmore Land Management Ltd. Email:ian@hlm.co.nz

There are no prime or elite soils present on the property at 712 Whitford-Maraetai Road. The LUC units mapped on the property are outside of the Auckland Council's prime or elite soils as they are all in classes four or six. The residential area has been classified as non-prime and non-elite as it is occupied by structures and spaces directly related to and utilised as part of the residence. The majority of this area will have also undergone significant modification and disruption of the soil profile during building construction and landscape development.

4.3 Land Use Capability Table – Collective Lifestyle Blocks

As discussed, as the collective lifestyle blocks are not owned by Beachlands South, AgFirst has undertaken a desktop assessment on this land. The table below describes each of the LUC units present on the property, the area they cover and if they are classified as prime or elite soils according to the Auckland Council definition. This table is accompanied by an LUC map and a prime/elite soils map. The residential areas have been classified as non-prime and non-elite as it is occupied by structures and spaces directly related to and utilised as part of the residence. The majority of these area will have also undergone significant modification and disruption of the soil profile during building construction and landscape development. As the assessment is at a scale of 1:50,000, the non-effective areas, such as wetlands, native bush, waterways and gullies have been given a classification that of LUC 2 and LUC 3, where ultimately these areas have no productive versatility. Based on the reclassification of the 712 Site from LUC 2 and LUC 3 (under the NZLRI database) into LUC 4 and LUC 6 with a 1:4,000 scale, it is likely that a large proportion the Collective Lifestyle Blocks would also be re-classified as non-prime soils.

LUC unit	Total area (ha)	Dominant soil type	Slope (degree)	Land Cover	Soil Classification
LUC 2e 5	10.0	Brown Soil – Imperfectly Drained	4-7º	Pasture	Prime
LUC 3e 4	17.2	Brown Soil – Imperfectly Drained	8-15º	Pasture	Prime
Ineffective & Residential	5.6 + 19.0 (24.6)	N/A	N/A	Wetlands, native bush, gullies and residential	Non-prime & Non-elite


Collective Lifestyle Blocks
LUC Map
Legend
Collective Lifestyle Blocks - 51.8 ha
Ineffective - 5.8 ha
LUC 2 = 10.0 ha
LUC 3 = 17.2 ha
Residential Area = 19.0 ha
Okaroro Dr
Okaroro Dr
Whitford-Maraetai Rd
Google Earth
Image © 2022 Maxar Technologies
400 m
N

4.4 Prime Soils table

Land Parcel	Total Area	Area of Prime Soil (ha)	Area of Non-Prime Soil (ha)	Percentage of Prime Soil
Formosa Golf Resort	170.5	22.0	148.5	12.9%
620 Site	79.9	38.6	41.4	48.3%
712 Site	4.8	0.0	4.8	0%
Collective LS Blocks	51.8	27.2	24.6	52.5%
Total	**307.0**	**87.8**	**219.3**	**28.6%**
Percentage		28.6%	71.4%	

There is no land within the properties that has been classified as land containing elite soil. The properties do currently have several areas with LUC ratings that indicate they would be classed as land containing prime soil under the AUP.

5.0 SOIL ASSESSMENT

AgFirst visited the properties on 9 July 2020 to understand the current land use and to verify and assess the presence of elite and prime soils. This was assessed by undertaking a visual soil analysis (VSA) across the properties and by taking some soil samples for a mixed soil analysis.

Visual Soil Analysis

AgFirst followed the procedures outlined in the Visual Soil Assessment Field Guide[1]. Many soil properties can be identified by their visual characteristics, which involves digging out and assessing a 20 cm cube of topsoil. The quality of soil is subject to the current and previous land use and management. Once soils have been degraded, it can take a long time (sometimes decades) to recover.

The soil indicators used in the VSA are: Soil structure and consistence; Soil porosity; Soil colour; Number and colour of soil mottles; Earthworm counts and Surface relief. Using the VSA scorecard, soil quality is ranked as poor (< 9), moderate (10 – 20) or good (> 20).

AgFirst undertook eight VSA samples across Formosa and the 620 Site and completed the scorecard to identify the suitability of the soil for agricultural production.

The results from the VSA indicate that the soils across Formosa and the 620 Site range from poor (<10) to moderate (10 – 20). The soil indicators across the properties summarised as:

- Soil structure and consistence – Most samples had moderate structure, with proportions of both coarse firm clods and friable fine aggregates.
  - » Soil structure is vital for growing good pastures as it regulates soil aeration and gaseous exchange rates, the movement and storage of water, soil temperature, root penetration and development, nutrient cycling and resistance to degradation.
- Soil Porosity – The Formosa samples showed moderate porosity with the 620 Site having good porosity.
  - » The macroporosity controls the movement of air and water in the soil. Low porosity will restrict air and water movement, which reduces root activity and pasture growth.
- Soil Colour – The soil samples had a poor to moderate visual scoring, with the paler soils indicating gleying and persistent pugging or waterlogging.
  - » Grey subsoil colours in loamy, silty or clayey soils suggest the soil is poorly drained, with frequent waterlogging and are deficient of oxygen.
- Number and colour of soil mottles – The majority of the samples scored poorly due to the soils containing abundant orange and grey mottles within the topsoil layer. The topsoil depth across most of the sites was very shallow, with a raw orange clay pan often less than 15 cm below the surface.

[1] Shepherd,T.G. 2000: Visual Soil Assessment. Volume 1. Field guide for cropping and pastoral grazing on flat to rolling country. Horizons.mw & Landcare Research, New Zealand

» Mottles are also an indication of aeration and drainage and a warning sign that the soil is becoming or is currently damaged.

- **Earthworm counts –** There were very few/if any earth worms counted in any of the soil assessments, with all the sites scoring poorly in this category.
  - » Earthworms play an important role in decomposing and cycling organic matter, and in supplying nutrients to the plants. Earthworm numbers can decline if soils are waterlogged or if severe pugging occurs, which can result in long-term effects.

- **Surface relief –** All of the locations scored well in this category, due to smooth, unbroken and cultivated/contoured surfaces on the golf course and lack of animals on the 620 Site.
  - » Although there was no pugging identified, this indicator is not providing an accurate indication of soil health. There is likely to be compaction issues from heavy machinery associated with the initial development, ongoing maintenance and frequent mowing of the golf course, which was evident from the waterlogged and heavily gleyed soils.

Photographs of the VSA are provided in Appendix A and the results are presented in Table 1.

Table 1: Visual soil analysis

Sample #	VSA#1	VSA#2	VSA#3	VSA#4	VSA#5	VSA#6	VSA#7	VSA#8
Site Location	Hole 8 South	Hole 9 South	Hole 3 North	Hole 14 Green	Hole 16 North	Hole 12 North	North Farm	South Farm
Soil Type	Silt loam over clay	Silt loam over clay	Silt loam over clay	Silt loam over clay	Silt loam over clay	Silt loam over clay	Silt loam over clay	Silt loam over clay
Textural Qualifier	Loamy	Loamy	Loamy	Loamy	Loamy	Loamy	Loamy	Loamy
Moisture Condition:	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet
Weather Conditions	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet
Soil structure & consistence	1	1	1	1	0	1	1	2
Soil Porosity	1	1	1	1	1	1	2	2
Soil Colour	0	1	1	0	1	0	1	1
Number & Colour of Soil Mottles	1	0	0	0	0	1	0	1
Earthworm Counts	0	0	0	0	0	0	0	0
Surface Relief	2	2	2	2	2	2	2	2
Ranking Score	**10**	**10**	**10**	**8**	**7**	**10**	**13**	**18**

Soil Testing Analysis

AgFirst undertook some soil samples from Formosa and the 620 Site. These tests were carried out in accordance with the soil sampling procedure for sheep and beef farms. At each location, numerous core samples were taken of the topsoil down to 7.5 cm and analysed by Hill Laboratories – Soil Mixed Pasture, Dry Stock (Sedimentary).

The results from the soil test analysis indicate that the majority of the macro nutrients are within the optimum range for a sheep and beef farm, albeit with some variability. The results of the soil tests are presented in Table 2 and summarised below:

- **pH** – Except North Farm (620 Site), all the pH levels are below optimum levels and would require lime to raise the pH.
- **Olsen P** – The Olsen P level are mostly well within the optimum range, with lowly stocked flat farms requiring an Olsen P of 20.
- **Potassium** – Most of the soil tests returned results within the optimum range, with South Farm (620 Site) requiring a capital application of potassium.
- **Sulphate Sulphur** – The sulphate-S across most of the sites was very low, showing soils are deficient in immediately available sulphur.
- **Magnesium**- These were all above the optimal range.

The results of the test are presented in Appendix B and summarised in Table 2.

Table 2: Soil test results

Sample Location	Hole 9	Hole 13	Hole 16	Farm North	South Farm	Optimum Range Drystock Farming
Soil Type	Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary	
Sample Depth (cm)	7.5	7.5	7.5	7.5	7.5	**7.5**
pH (pH Units)	5.5	5.5	5.6	6	5.5	**5.8-6.0**
Olsen Phosphorus (mg/L)	13	35	20	35	20	**20-30**
Potassium (MAF Units)	5	6	9	10	3	**5-8**
Sulphate Sulphur (mg/kg)	5	5	10	6	6	**10-12**
Magnesium (MAF Units)	22	29	29	40	23	**8-10**
Calcium (MAF Units)	4	5	5	13	6	**N/A**
Sodium (MAF Units)	7	6	7	7	10	**N/A**
Organic Matter (%)	11.4	12.4	11.9	15.9	15.3	**N/A**

The results from the VSA and the soil test results do not indicate consistency across the two blocks. The soils largely do not appear to be deficient in many of the key elements. However, the VSA is not an indication of nutrients, but rather an assessment of soil health, and although the key elements are present, due to largely degraded soils and poor structure and drainage on the Formosa block, it is unlikely that the nutrients which are present would be very mobile and available for the pasture.

Taking into account all of the above factors, the soil quality on the Formosa block is largely unsuitable for agricultural production. The soil quality on the 620 site is moderate and would support medium intensity agricultural production (e.g. moderate intensity sheep and beef farming), but is not suited for high intensity agricultural production or intensive horticulture.

6.0 LAND USE POTENTIAL

As previously outlined the soil classification based on the detailed soil assessment undertaken by AgFirst indicates there is 60.6 ha of Prime soil verified (22.0 ha on Formosa, 38.6 ha on the 620 site and none on the 712 Site). This equates to 23.7% of the land that has been mapped with a paddock scale LUC classification.

In addition to this, based on a desktop analysis of the Collective Lifestyle Blocks, there is a further 27.2 ha of Prime land. However, there is a high likelihood that this area is being over represented – as supported by the detailed soil survey undertaken on the surrounding land.

Considering the entire Plan Change area, there is a possible 87.8 ha of Prime land, which is 28.6% of the assessment area.

Formosa would not be suitable for high return vegetable or horticulture use nor dairying due to soil type and/or contour limitations. Returns from established sheep and beef farm systems are low and the production of this land would be limited by poor quality soils especially in the short to medium term when they were recovering from the structural damage associated with golf course establishment and maintenance. Additionally, the large-scale development would require time and a significant cash input. The land would require development costs such as fencing, soil aeration, drainage, stock handling infrastructure, and stock water reticulation systems.

The 620 Site is dominated by strongly rolling LUC 6 land. LUC 6 is considered a risk when grazing heavy livestock due to erosion damage, with soil conservation measures often required. It is also largely unsuitable for cultivation due to being un-navigable by a tractor.

The 712 and Collective Lifestyle Blocks are very similar in land use potential. All these blocks are existing residential/lifestyle subdivisions, with fragmented blocks that range from 1.26 ha up to 7.24 ha. Although the NZLRI slope indicates undulating and rolling slopes (4-15 degrees) and LUC 2 and LUC 3 soils, the 1:4,000 survey for the 712 Site has verified the slopes and LUC classifications are much less versatile. There is also a large gully feature that runs through the rear of the properties, with established native trees and bush and possible wetlands and natural waterways. This limits the productive potential of these blocks due to usable areas and a potential sensitive receiving environment. There is also the issue with access to the productive areas, with this being blocked with the residential developments along the road frontage.

Formosa, the 620 and 712 Sites along with the Collective Lifestyle Blocks are limited with regards to alternative productive and profitable agricultural land use options.

The National Environmental Standards for Freshwater (NES-FW) came into force on 3 September 2020. The NES-FW introduces new rules and regulations to:

- Stop further degradation of New Zealand's freshwater resources and improve water quality within five years.
- Reverse past damage and bring New Zealand's freshwater resources, waterways and ecosystems to a healthy state within a generation.

The NES-FW places restrictions on intensifying agricultural land nationwide. Under this rule, a landowner will require resource consent to intensify more than 10 ha of land involving land use

change to dairy farming. Intensification occurs when inputs such as irrigation, fertiliser and stock increase per hectare of land, or if a farm converts to a higher intensity land use (such as from sheep and beef farming to dairy farming). Intensification can increase pollution (nutrients, pathogens and sediment) entering waterways.

Based on this nationwide policy, as the existing land use across the properties is considered either non-agricultural (Formosa) and a very low intensity farm (620 Site), the rule will limit the opportunity for a productive and profitable agricultural system to operate. These implications would include:

- Formosa - as this is currently a golf course, with no livestock or crops grown on the property, any agricultural operation would be considered as an intensification, which would result in an increase in nutrient runoff and therefore require a resource consent.
- 620 Site – although this farm is an agricultural operation, it is a very low intensive farm that would not offer an economic return. Under the national regulations, any farm system changes that would be considered to intensify, may require a resource consent.
- 712 and Collective Lifestyle Blocks – Either not operated as a pastoral farming system or very low intensive farm that would not offer an economic return. Under the national regulations, any farm system changes that would be considered to intensify, may require a resource consent.

Regional councils will only grant resource consent where there is evidence the change will not lead to a deterioration in the health and wellbeing of the relevant water body or lead to over-allocation. In practice, this means the council will need to be satisfied that increases in contaminant discharges from intensification have been offset by de-intensification elsewhere in the catchment.

In addition to the NES-FW, the Ministry for Primary Industries (MPI) have proposed a national policy statement (NPS) for highly productive land. The government is currently reviewing submissions on this proposal and are planning to make a final decision in the first half of 2022. In summary this draft document aligns with the AUP, where it identifies LUC class 1, 2 and 3 as being the most versatile land, with the fewest limitations on its use and therefore highly productive land.

The report identified two main pressures facing highly productive land on the edge of towns and cities:

- Expansion of urban areas, and the accompanying loss of productive land; and
- Change of land-use on the fringes of urban areas, in particular the increase in lifestyle blocks.

In this case, AgFirst does not believe there is a significant loss of highly productive land and there are severe agricultural limitations due to:

- The underlying issues with Formosa with regard to poor quality and highly modified soils
- The non-contiguous nature and lack of high-class land within the 620 Site
- The already subdivided nature of the 712 Site and Collective Lifestyle Blocks.

7.0 LAND USE SUMMARY

Due to the poor to moderate soil types on the Plan Change areas (Formosa Site, 620 Site, 712 Site and Collective Lifestyle Blocks), AgFirst does not believe that these land parcels have high productive agricultural value or offer many opportunities for additional land uses. Significant development costs would be required on Formosa to enable it to have any agricultural productive use. The only viable land use options for the 620 Site would be restricted to pastoral grazing of light stock on the steeper sloped areas and potentially harvesting supplements (maize, grass silage and hay) on the undulating contours. With regards to the 712 Site and the Collective Lifestyle Blocks, these areas are much too small to be considered for any sustainable agricultural production, with a maximum parcel size of 7.2 ha – which includes residential dwellings, gardens and trees.

Considering the land value for these coastal areas, given the soil and physical limitations and lack of prime land, any of the limited options of agricultural systems would be unlikely to return any serviceable revenue.

Rezoning this land from rural to residential will not have any impact on the protection of elite and prime soils. This is especially considering Formosa is currently zoned rural but is not an agribusiness operation, and the limited potential of the 620 Site considering its size and lack of quality land. The 712 Site and the Collective Lifestyle Blocks are also lacking in contiguous quality land that would be sustainable for any productive agricultural potential. In addition, due to the low productivity of the existing properties, any intensification of these areas would likely result in resource consent being required under the recent NES (Freshwater) regulations. The need to obtain a consent, and the likely difficulty in obtaining one would unlikely to be economically appealing, given the limited viable alternative land use options as described throughout this report

8.0 REFERENCES

Lynn IH, Manderson AK, Page MJ, Harmsworth GR, Eyles GO, Douglas GB, Mackay AD, Newsome PJF 2009. NZ Land Use Capability Survey Handbook – a New Zealand handbook for the classification of land 3rd Edition. Hamilton, AgResearch; Lincoln, Landcare Research; Lower Hutt, GNS Science. 163p.

APPENDIX A – SOIL VSA PHOTOGRAPHS

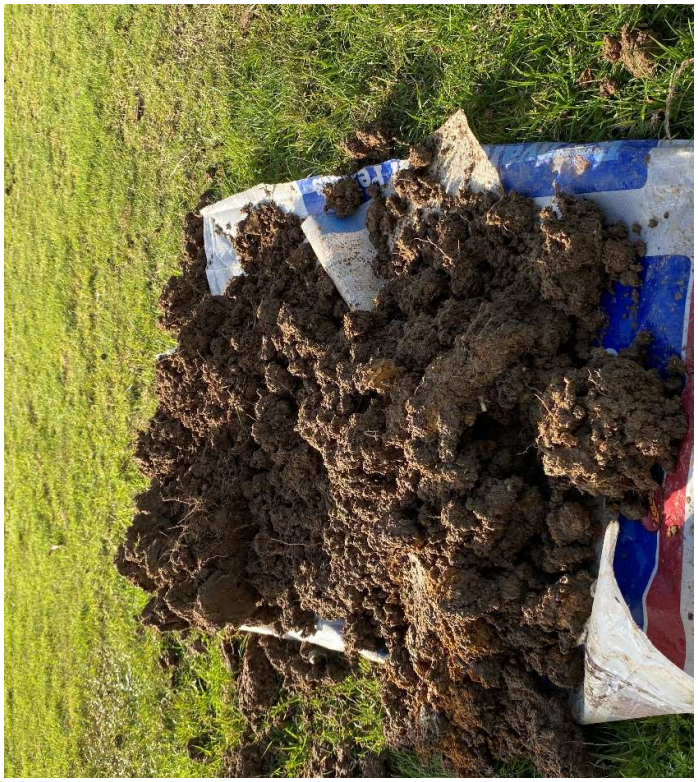
VSA # 1 – Score 10 (Moderate Soil Quality)

VSA # 2 – Score 10 (Moderate Soil Quality)

VSA # 3 – Score 10 (Moderate Soil Quality)

VSA # 4 – Score 8 (Poor Soil Quality)

VSA # 5 – Score 7 (Poor Soil Quality)



VSA # 6 – Score 10 (Moderate Soil Quality)

VSA # 7 – Score 13 (Moderate Soil Quality)

VSA # 8 – Score 18 (Moderate Soil Quality)

Hill Laboratories
TRIED, TESTED AND TRUSTED
R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand
T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Beachlands	Lab No:	2400879	shvpv1
Address:	PO Box 17254 Greenlane Auckland 1546	Date Received: Date Reported: Quote No: Order No: Client Reference:	14-Jul-2020 23-Jul-2020	
Phone:	021 750 985	Submitted By:	Mr J Allen	

Soil Analysis Results

Sample Name:		Hole 9	Hole 13	Hole 16	620A	620 farm house	
Lab Number:		2400879.1	2400879.2	2400879.3	2400879.4	2400879.5	
Sample Type:		SOIL Mixed Pasture, Dry Stock (Sed.)	SOIL Mixed Pasture, Dry Stock (Sed.)	SOIL Mixed Pasture, Dry Stock (Sed.)	SOIL Mixed Pasture, Dry Stock (Sed.)	SOIL Mixed Pasture, Dry Stock (Sed.)	
Sample Type Code:		S186	S186	S186	S186	S186	
pH	pH Units	5.5	5.5	5.6	6.0	5.5	-
Olsen Phosphorus	mg/L	13	35	20	35	20	-
Potassium	me/100g	0.29	0.37	0.56	0.68	0.23	-
Potassium	%BS	2.2	2.6	3.5	2.5	1.3	-
Potassium	MAF units	5	6	9	10	3	-
Calcium	me/100g	3.6	4.4	5.0	14.7	7.0	-
Calcium	%BS	27	31	31	54	38	-
Calcium	MAF units	4	5	5	13	6	-
Magnesium	me/100g	1.13	1.51	1.65	2.52	1.38	-
Magnesium	%BS	8.3	10.7	10.4	9.3	7.4	-
Magnesium	MAF units	22	29	29	40	23	-
Sodium	me/100g	0.18	0.16	0.18	0.23	0.29	-
Sodium	%BS	1.3	1.2	1.2	0.8	1.6	-
Sodium	MAF units	7	6	7	7	10	-
CEC	me/100g	14	14	16	27	19	-
Total Base Saturation	%	39	46	47	67	48	-
Volume Weight	g/mL	0.85	0.84	0.79	0.70	0.73	-
Sulphate Sulphur	mg/kg	5	5	10	6	6	-
Organic Matter*	%	11.4	12.4	11.9	15.9	15.3	-
Total Carbon*	%	6.6	7.2	6.9	9.2	8.9	-
Soil Sample Depth*†	mm	0-75	0-75	0-75	0-75	0-75	-
Soil Type*†		Sedimentary	Sedimentary	Sedimentary	Sedimentary	Sedimentary	-

Contact

James Allen

Agribusiness Consultant
027 474 3093
james.allen@agfirst.co.nz

AgFirst Waikato (2016) Ltd
26D Liverpool Street
PO Box 9078, Hamilton 3240, New Zealand
07 839 2683
waikato@agfirst.co.nz
www.agfirst.co.nz