Osborne Land Productivity Report

Te Moana Road

Waikanae

Feb 2023

LandVision Ltd

1 SUMMARY

A land resource inventory and land use capability survaey at 1:6,000 was undertaken for the property in accordance with the LUC handbook.

The property comprises of 5.8 ha of which 1.5 ha are considered effected (grazed) pasture, 0.8 ha unimproved pasture (very low quality and mostly native grasses) 2.0 ha of cutover forestry, 1.0 ha in wetland association species or open water, and 0.5 ha in exotic/native tree species. The underlying geology is formed from wind brown sand. About 2.1 ha are sand flats of which 1.3 ha are dry sand flats and 0.8 ha are wet sand flats. There is about 2.8 ha of sand dunes of which 0.8 ha are considered reasonably stable and 2.0 ha more fragile. There is also about 1.0 ha of interdunal wetland and the underlying geology of these is a combination of windblown sands and peat.

The property has four dominant soil types. The soils on the sand flats are differentiated on drainage. The poorly drained soils are the Pukepuke soils whilst the well-drained flats are the Himatangi soils. The soils of the fragile dunes are the Foxton series and the stable dunes are the Himatangi soils. The areas of peat are associated with the Omanuka series.

Landuse capability classification is derived from a combination of underlying geology, soil type, slope, erosion type and severity and vegetation. At paddock scale mapping the property has six dominant LUC units ranging from LUC class III to VIII. In total there are 0.8 ha of class III land, 1.3 ha of class IV land, 3.6 ha of class VI land and 0.2 ha of class VIII land.

With respect to the NES for Productive Land LUC Class III land is considered highly productive. This is true for some class III LUC units but not all. LUC unit IIIw3 is one of those LUC units that should have been excluded as it has very weak soil structure and a drainage limitation. Both these characteristics limit its productive potential to arable use. The property only has about 0.8 ha of IIIw3 land which is insignificant.

The existence of a substantial wetland on site creates further complications and cost to comply with the NPS Freshwater as drainage irrigation is restricted within 100 m. This limits the opportunity to realise any productive yield gaps.

The financial feasibility of this site is tenuous, and it would require off farm income for the operator to pay themselves or paydown debt. In some years the site will make a loss which on a site of this size will be difficult to sustain. The current earnings potential on this site are assessed at $131(10 year average). This number is very optimistic as it includes a highpoint in returns over the last 10 years and ignores the obvious and unavoidable lack of scale that a standard finishing enterprise enjoys. A standard finishing operation earns approximately $300K (gross) as a comparison and as such has sufficient discretionary cash to paydown debt, develop and pay the operator a living allowance. This will not happen with an average economic farm surplus of $131.

The NPS HPL requires the applicant to demonstrate that the permanent or long-term constraints cannot be addressed through reasonably practicable means. In this case, the range of limitations cannot be cost effectively mitigated, significantly limit primary production, and cannot be feasibly removed.

2 TABLE OF CONTENTS

3 About the Author

This report has been prepared by Lachie Grant, sole director of LandVision Ltd. I have a M Agri Sci (hons) from Massey University majoring in land resource management, pedology, soil erosion processes and agricultural engineering. I have also completed bachelor of agricultural science from Massey with a focus on soils, farm management and land resource management.

Since completing my post graduate studies back in the early 1991 I have held the positions of land management officer/soil conservator with Horizons Regional Council (11 years) and regional land manager for Taranaki Regional Council (3 years) before establishing LandVision Ltd in 2005.

LandVision Ltd is an independent technical agricultural/land and resource management consultancy company with offices in Hawkes Bay, Nelson, Wanganui, and Tauranga. We are a team of multi-skilled staff with extensive experience across farm planning and management, soil and LUC mapping, nutrient budgeting, environmental management, compliance, and policy. In the last 20 years we have undertaken farm planning, land resource inventory/land use capability mapping for over 1.2 million hectares across New Zealand to the protocols outlined in the NZLRI handbook.

With regards the NES HPL I have prepared over 25 HPL assessments across the country and peer reviewed over a dozen reports for six different councils. Further to this I have internally peer reviewed approximately another 20 reports for other LandVision staff.

This report has been peer reviewed by Ian Millner from LandVision. He holds a science degree and a very strong background in land resource management, farm management, and planning. He is also a qualified hearing commissioner. He has prepared approximately 20 reports (including one in Marlborough) and peer reviewed in excess of 30 reports for various councils throughout the country. Ian is undoubtably one of the most experienced consultants in New Zealand for HPL.

4 Background Information

This report was originally prepared in February 2023 when remapping of LUC at the paddock scale was accepted for HPL assessments. In May 2024 case law[1] was established that only the NZLRI at 1:50,000 scale was the only determinant of whether the NES HPL is triggered (). Paddock scale LUC mapping cannot be used as a determinant of whether the NES HPL is triggered. The associated LRI and LUC can however be used for addressing the constraints of a subdivision that is triggered by the regional scale mapping

It is noted that the NZLRI was mapped at 1:50,000 which means that to meet LUC mapping protocols, it is one observation every 25 ha. For paddock scale mapping at 1:6000 it is one observation every 3,600m2. This report should not be used for arguing that the NZLRI is wrong but the paddock scale mapping shows there are significant limitations to the land to have a highly productive use.

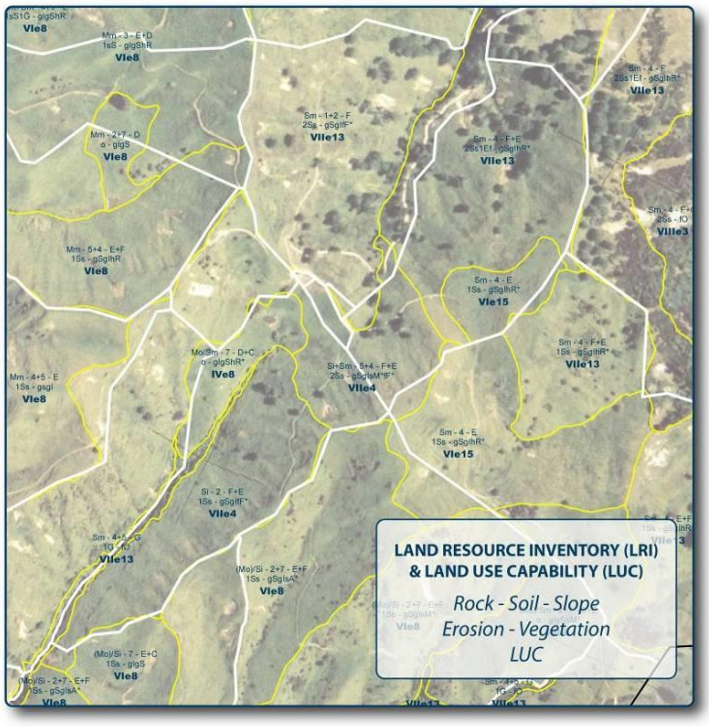
5 Purpose

The purpose of this report is to determine the land use capability classification of land within a proposed subdivision at Te Moana Road Waikanae as required under the NES for Productive Land.

[1] Blue Grass Limited v Dunedin City Council [2024] | Hobec

6 LAND RESOURCES

6.1 LAND RESOURCE INVENTORY AND LAND USE CAPABILITY ASSESSMENT



The land resource has been described and evaluated according to the Land Resource Inventory (LRI) and Landuse capability classification system (LUC). The land resources survey was undertaken at a 1:6,000 scale by Mr L Grant in January 2023 in accordance with the LUC Handbook 3rd Edition (Lynn *et al* 2021)[2]. The mapping observation points are shown on the Observation Points Map in Appendix 1.

The LRI system involves mapping landscape units according to five inventory factors (rock type, soil unit, slope class, erosion type and severity, and vegetation). The soil resources have been mapped according to the Soil Description Handbook (Milne *et al* 1995)[3].

From the LRI assessment, the area was then classified as LUC, which further groups similar units according to their capacity for sustainable production under arable, pastoral, forestry or conservation uses across the region. The LUC code is broken down into three components, which show the general capability (I-VIII classes), the major limitations (four subclass limitations of wetness, erosion, soil and climate), and the capability unit to link with regional classifications and known best management practices. The LUC unit is shown in bold in Figure 1, (e.g. VIIe4) and the LRI is shown by a series of symbols laid out in a set pattern as shown in the bottom right corner. The LUC assessments have been made as if any improvements are made to modify or improve any limitations.

The LUC units used in this report are from the LUC classification of the Wellington Region (Page 1995)[4]. In general the LUC units on sand flats are determined by the depth to the watertable and those LUC units of sand dunes are determined by topsoil depth.

[2] Lynn I, A Manderson, M Page, G Harmsworth, G Eyles, G Douglas, A MacKay, P Newsome (2021): Land Use Capability Survey Handbook 3rd Ed.

[3] Milne J, B Clayden, P Singleton, & A Wilson (1995): Soil description handbook.

[4] Page M.J (1995): Land use capability classification of the Wellington Region. A report to accompany the second edition of the NZLRI.

6.2 LAND RESOURCE DESCRIPTION BY LUC UNIT

LUC and description	Total area (ha)	Parent material	Dominant soil type	Slope degree	Dominant vegetation	Erosion degree and severity	
						Actual	Potential
IIIw3 Low lying, imperfectly to poorly drained sand plains amongst the inland dunes between Waitarere and Waikanae. Water tables are at or near the surface in winter. 	0.8	Windblown sands.	P	0-3	Pasture.	Nil.	Negligible.
IVe4 Flat, free-draining, higher sandplains amongst the older inland dunes. Soils have a moderately developed structure and are subject to seasonal moisture deficiencies. There is a potential for severe wind erosion when cultivated. 	1.3	Windblown sands.	Hm	0-3	Pasture.	Nil.	Negligible.
VIe5 Strongly rolling to moderately steep consolidated sand dunes inland of the recent unconsolidated sand dunes. Soils are weakly developed, and somewhat excessively drained. There is a potential for moderate wind erosion. 	2.0	Windblown sands.	F	16-25	Pasture.	Nil.	Slight to moderate wind erosion.

LUC and description	Total area (ha)	Parent material	Dominant soil type	Slope degree	Dominant vegetation	Erosion degree and severity	
						Actual	Potential
VIs4 Flat to undulating, free draining, higher sandplains. Soils have little profile development and are subject to seasonal soil moisture deficiencies. 	0.8	Windblown sands.	Hm	0-7	Pasture.	Nil.	Negligible.
VIw1 Peaty swamps and swamp margins with high water tables and capable of only limited drainage. 	0.8	Peat and windblown sands.	Om	0-3	Wetland vegetation.	Nil.	Nil.
VIIIw1 Non-drainable swampy depressions and dams or lakes. 	0.2	Wetland	Wetland	0-3	Wetland	Nil.	Nil.

6.3 ASSESSMENT OF LAND STRENGTHS AND LIMITATIONS BY LUC UNIT

LUC unit	Land use	Area (ha)	Strengths	Limitations	Land use suitability	Conditions of use
IIIw3 Low lying, imperfectly to poorly drained sand plains amongst the inland dunes between Waitarere and Waikanae. Water tables are at or near the surface in winter.	Pasture.	0.8	Contour. Access.	High water table in winter.	Intensive pastoral farming.	Care with cattle during winter to avoid pugging and treading damage.
IVe4 Flat, free-draining, higher sandplains amongst the older inland dunes between Waitarere and Otaki. Soils have a moderately developed structure and are subject to seasonal moisture deficiencies. There is a potential for severe wind erosion when cultivated.	Pasture. Unimproved pasture.	0.8 0.5	Contour. Access. Good natural drainage.	Subject to seasonal moisture deficiencies. Potential for severe wind erosion if cultivated. Low natural fertility.	Intensive pastoral farming.	Maintain vegetative cover through grazing management and soil fertility to avoid risk of wind erosion. Pasture renewal through zero-tillage techniques such as direct drilling.
VIe5 Strongly rolling to moderately steep consolidated sand dunes inland of the recent unconsolidated sand dunes. Soils are weakly developed, and somewhat excessively drained. There is a potential for moderate wind erosion.	Cutover forestry.	2.0	Good winter country for stock. Good year-round access.	Potential for moderate wind erosion. Low natural fertility. Unsuited to cropping due to weakly developed soils. Seasonal moisture deficits.	Pastoral farming. Forestry.	Maintain vegetative cover through grazing management and fertility to avoid wind erosion.
VIs4	Exotic trees.	0.4	Contour. Access.		Pastoral farming.	Maintain vegetative cover through grazing

LUC unit	Land use	Area (ha)	Strengths	Limitations	Land use suitability	Conditions of use
Flat to undulating, free draining, higher sandplains near the coast between Waitarere and Waikanae. Soils have little profile development and are subject to seasonal soil moisture deficiencies.	Unimproved pasture.	0.4	Good natural drainage.	Subject to soil moisture deficiencies. Potential for slight wind erosion. Low natural fertility.		management and fertility to avoid wind erosion.
VIw1 Peaty swamps and swamp margins with high water tables and capable of only limited drainage.	Wetland association species.	0.8	Biodiversity values. Sediment trap and nutrient filter.	Extreme potential for pugging and compaction from stock and machinery. Potential stock trap.	Retirement.	Fence to exclude livestock.
VIIIw1 Non-drainable swampy depressions and dams or lakes.	Wetland.	0.2	Biodiversity value. Habitat for birdlife.	Drainage not feasible. High water table.	Retirement. Wetland habitat.	Fence to exclude livestock. Wetland enhancement.

6.4 SOIL RESOURCES

The soil resources are shown on the Soil Resources Map in Appendix 1 and described in Appendix 2. In summary all the soils are formed from windblown sand or peat. They generally fit the physiographic position in the landscape for sand country in the western lower North Island. Typically the sand flats are differentiated according to depth to water table – they are either the poorly drained Pukepuke soils where the watertable is within the top 30 cm of the surface or well drained Himatangi soils where there is no evidence of mottling. Typically the Pukepuke soils have been eroded by wind down to the watertable. The Himatangi soils have greater depth down to the water table. If there is peat present then the soils are the Omanuka peat soils. On the fragile sand dunes the soils are the Foxton series and these are dependent on the amount of topsoil development (which represents age of the dune). The more stable flatter dunes are the Himatangi series.

6.5 SOIL DRAINAGE

Open drains have been installed for an outlet from the wetland. Drainage of the 3w3 land is generally ineffective due to its low-lying nature relative to downstream outlets and the fragmented shape limit the opportunity. .

7 NPS HIGHLY PRODUCTIVE LAND

7.1 INTENT OF NPS HPL

The intent of the NES for HPL is to protect highly productive and highly versatile land for food production across LUC classes I to III.

7.2 NPS HPL SECTION 3.10: EXEMPTION FOR HIGHLY PRODUCTIVE LAND SUBJECT TO PERMANENT OR LONG-TERM CONSTRAINTS

(1) Territorial authorities may only allow highly productive land to be subdivided, used, or developed for activities not otherwise enabled under clauses 3.7, 3.8, or 3.9 if satisfied that:

(a) There are permanent or long-term constraints on the land that mean the use of the highly productive land for land-based primary production is not able to be economically viable for at least 30 years; and

(b) The subdivision, use, or development:

(i) Avoids any significant loss (either individually or cumulatively) of productive capacity of highly productive land in the district; and

(ii) Avoids the fragmentation of large and geographically cohesive areas of highly productive land; and

(iii) Avoids if possible, or otherwise mitigates, any potential reverse sensitivity effects on surrounding land-based primary production from the subdivision, use, or development; and

(c) The environmental, social, cultural and economic benefits of the subdivision, use, or development outweigh the long-term environmental, social, cultural and economic costs associated with the loss of highly productive land for land-based primary production, taking into account both tangible and intangible values.

(2) In order to satisfy a territorial authority as required by sub clause (1)(a), an applicant must demonstrate that the permanent or long-term constraints on economic viability cannot be addressed through any reasonably practicable options that would retain the productive capacity of the highly productive land, by evaluating options such as (without limitation):

(a) Alternate forms of land-based primary production:

(b) Improved land-management strategies:

(c) Alternative production strategies:

(d) Water efficiency or storage methods:

(e) Reallocation or transfer of water and nutrient allocations:

(f) boundary adjustments (including amalgamations):

(g) lease arrangements.

(3) Any evaluation under sub clause (2) of reasonably practicable options:

(a) must consider the potential economic benefit of using the highly productive land for purposes other than land-based primary production; and

(b) must consider the impact that the loss of the highly productive land would have on the landholding in which the highly productive land occurs; and

(c) must consider the future productive potential of land-based primary production on the highly productive land, not limited by its past or present uses.

(4) The size of a landholding in which the highly productive land occurs is not of itself a determinant of a permanent or long-term constraint.

(5) In this clause:

> **Landholding** has the meaning in the Resource Management (National Environmental Standards for Freshwater) Regulations 2020
>
> **Long-term constraint** means a constraint that is likely to last for at least 30 years.

7.3 Assessment Of Section 3.10

This assessment is for a small (0.8ha) piece of LUC III land within a 5.8 ha (approx.) landholding. This landholding is surrounded by significant roading (including SH 1) and urban and lifestyle development.

Full unit descriptions are provided in Section 4 and a summary of the relative areas of various LUC units found in the table below.

Unit	Area (ha)	%
IIIw3	0.76	13.1
IVe4	1.29	22.3
VIe5	1.96	33.8
VIIIw1	0.17	2.9
VIs4	0.80	13.8
VIw1	0.82	14.1
Total	**5.80**	**100**

As shown the table above the site is predominately class 4 – 8 (about 86%) with a relatively minor portion being LUC Class III.

Of significance is two wetland units (VIIIw1 and VIw1) that cumulatively account for approximately 1 ha.

7.3.1 Assessment under current condition

Where an individual LUC unit (where classes are further delineated into subclasses and units e.g., IIIs2 or VIe4) is developed its classification will be based on the dominant limitation or where multiple limitations exist the following priority is observed: erodibility (e) > excessive wetness (w) > rooting zone limitations(s) > climate (c).

When allocating different units to blocks of land the following assumptions are made:

- The permanent physical limitations of the land remain.
- **The rectifiable limitations may be removed**.
- An above average level of land management is practiced.
- Appropriate soil conservation measures will be applied and maintained.

Physical limitations have three distinct categories:

- Permanent limitations that cannot be removed – examples of this type of limitation include climate, rock type, slope, and soil attributes where the ability to modify does not exist or is cost prohibitive.

- Removable limitations are those where the limitation can technically be removed but where it requires considerable effort and investment (e.g., soil wetness, flooding, gravel picking).

Modifiable limitations are those that can be removed via ongoing investment and management. Examples include erosion, soil moisture deficits and nutrient deficiencies described with a soil limitation the limitation is considered permanent and cannot be rectified or removed.

The unit of LUC Class III described on this property is IIIw3. This unit is unique to the localised area and described as:

- Low lying, imperfectly to poorly drained sand plains amongst the inland dunes between Waitarere and Waikanae. Water tables are at or near the surface in winter.

Clearly, high water tables limit the versatility of this site to LUC Class III land (as opposed to LUC Classes I and II). LUC Class III is described as having moderate limitations to arable use. High water tables generally occur in winter but may also occur during wet springs and Autumns. A high water table significantly reduces the rooting depth of pastoral and arable plants and creates conditions where the mechanical harvesting of crops (especially in winter) becomes limited.

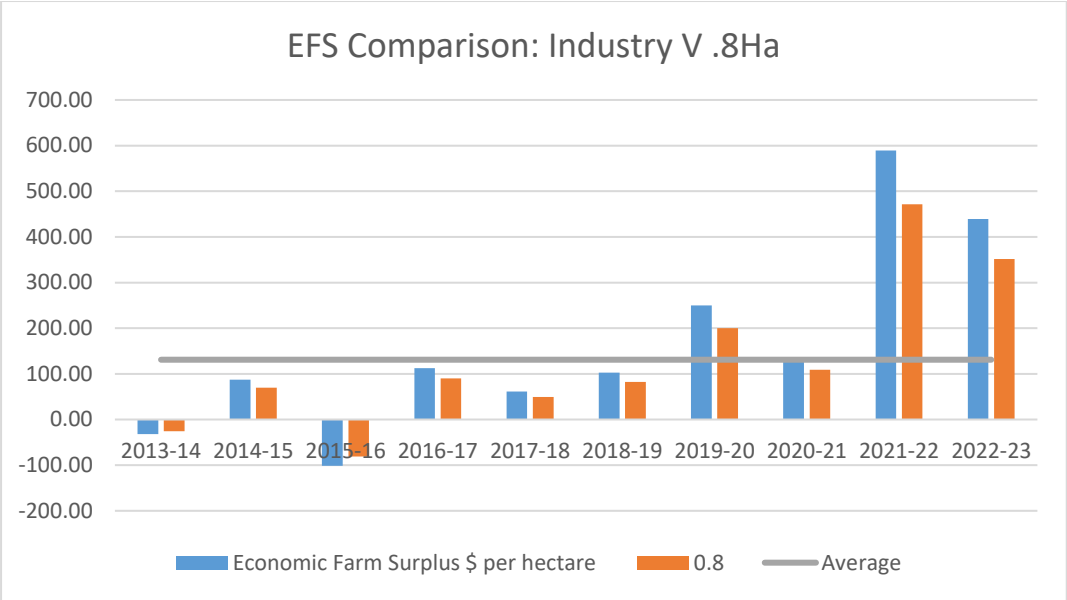
It is evident on site that attempts have previously been made to drain the site to improve versatility, but this does not appear to have been successful as the limitation has remained. This is a common issue with drainage where the land unit occurs in a natural depression which prevents effective drainage. The recent NPS FW creates further restrictions as discussed below.

In its current condition the highest and best use to the land is sheep and beef. This is because many arable and horticultural crops are significantly limited by high water tables and require scale.

Beef and Lamb NZ develop annual regional performance reports. These reports are based upon actual surveys of productive farms across a range of categories. The category that best represents this land is the class five western Nth Island finishing (Taranaki - Manawatu). Data from this survey shows that between the years 2013 – 2023 the farm profit per hectare for these farm types has ranged between $ -101 (negative) and $589.

Obviously, this data is developed from pastoral operations that are much larger than this site and therefore have greater areas from which to achieve economies of scale and leverage standing charges. An example of this is the cost of public liability insurance. Any reduction in public liability for this site will be marginal as the actual potential liability is still large due to the highly developed nature of surrounding land use. Therefore, standing charges such as insurance, ACC levies, rates will form a higher proportion of the cost structure for a smaller unit.

The average size (across 10 years) of farms involved in the Beef and Lamb NZ survey ranges between 194 ha and 214 ha. As the area of IIIw3 involved in this proposal is only 0.8 ha the potential profit has conservatively (as the actual performance will be further limited by scale) reduced EFS (economic farm surplus) to between $-81and $471 with an average across 10 years of $131. This is shown in the figure below.



Of note within this data set is the effect of the most recent two seasons. These seasons have significantly higher EFS then the previous eight. The average EFS (economic farm surplus) between 2013 and 2021 (eight out of ten years) is less than half the average for the full ten years at $61 (for 0.8 ha).

7.3.2 Assessment Under Potential Condition

Currently the site has very limited economic viability due to a combination of physical limitation and size preventing a viable production system from being established.

For a more sustainable production system to be developed consideration needs to be given to the feasibility of overcoming the limitations on site. There are three key limitations on site.

- Wetness: this limits machinery use and rooting depth which places significant restrictions on arable and horticultural uses.
- Scale: the lack of scale (as opposed to simply being small) adds proportionally higher cost structure to any primary land use.
- Lack of irrigation water: Irrigation is not currently on site. Irrigation is seen as a necessity for the reliable production of both arable and horticultural crops. Despite the existence of a wetness limitation the site is still subject to summer moisture deficits. The establishment and reliable production of horticultural crops without the certainty irrigation provides is not feasible given the significant (>100k Ha) capital cost to establish horticultural crops.

7.3.3 NPS Freshwater (2020)

The NPS Freshwater has placed additional limitations on the productive use of all land to protect the many values associated with fresh water. Of relevance to this site is the existence of a wetland adjacent to the unit of IIIw3. Under the NPS the application of irrigation to land or the drainage of land is a non-complying activity within 100 meters of a wetland. On a site of this size a buffer of 100m meters around a wetland involves a major proportion of the total site and is shown in Appendix 1.

The table below highlights the impact of additional regulatory obligations upon this site. Complying with the NPS Freshwater removes the two key remedial tools that might enable higher potential primary productivity on site. Without certainty of both drainage and irrigation the economic viability of the site it significantly limited.

Unit	Area (ha)	Area (ha)	Percentage outside 100 m	Area (ha)
	Greater than 100 m	Less than 100 m		
IIIw3	0.01	0.75	1.61	0.76
IVe4	0.40	0.89	30.74	1.29
VIe5	0.24	1.72	12.36	1.96
VIIIw1	-	0.17	-	0.17
VIs4	-	0.80	-	0.80
VIw1	-	0.82	-	0.82
Total	**0.65**	**5.15**	**11.24**	**5.80**

While a consent could in theory be applied for to drain and irrigate the site (assuming irrigation water is available) it would be a high bar to show that the IIIw3 land is not hydrologically connected to the wetland given the landscape processes that have produced both features and continue to control their respective attributes.

Due to the size of this property a 100m buffer implicates a major portion of the total area. This further reduces the versatility of IIIw3 land as surrounding land units are also substantially limited in their productive potential.

7.3.4 Overall Viability

Overall viability on this site is low. This is due to several issues that cumulatively reduce the productive potential and economic viability. These are:

- The small area of IIIw3 land has a significant wetness limitation. Mitigation of this wetness limitation is both technically and legislatively difficult due to the landscape factors involved and NPS Freshwater (2020).
- The potential economic cash surplus obtainable from the small area of IIIw3 land is minor (averaging $131 over 10 years). This will not cover basic cost structures or wages of management. To operate a beef and lamb finishing system on this block off farm income will be a necessity.
- The site lacks scale. Scale is a key attribute providing resilience during periods of low cashflow and economies of scale through which standing charges can be leveraged.
- A lack of scale also makes investing in remedial technology like drainage and irrigation unviable. In this case, investment in obtaining consent and installing drainage and irrigation is not feasible.
- The area of IIIw3 is a minor component of the overall land holding (which is small by industry standards). Therefore, the block should be considered predominately not highly productive land. Of note is the land surrounding this site is also predominately Class VI or roading/town.

Critically for this site, the cumulative effect of the limitations identified are not currently able to be reasonably and practically rectified. One of the clear values of highly productive soil is the versatility of use and the relative certainty of outcome, in that soils of a particular unit should have reasonably consistent physical characteristics and high potential production. Given the considerable hurdles to productive use on this portion of IIIw3, the sustainable operation of a productive land use is considered improbable.

8 KAPITI DISTRICT COUNCIL PEER REVIEW

Mr Sharn Hainsworth reviewed Version 1 of this report and below lists Mr Hainsworth's comments in red and responses to these.

The name of the author of the report is absent.

Addressed in the document.

The name of the LUC mapper.

Addressed in the document.

The date that the LUC survey was undertaken.

Addressed in the document.

Evidence of antecedent soil moisture conditions at the time survey.

Considered irrelevant for the purpose of this report.

Mention of any permanent artificial drainage that has taken place on the site.

Addressed in the document but considered ineffective due to the heights of outlets and the watertable.

Evidence of the water table at the time survey, and an indication of the depth of the water table after any permanent artificial drainage on the site (this can potentially change LUC classifications of LUC map units at a site-specific scale, based on Section 3.3.5.2 of the LUC Survey Handbook (p 86), Lynn et al. (2021) or Lynn et al. (2009)).

LUC assessments are undertaken as if improvements are made to modify or remove any limitation. In this situation, the LUC unit 3w3 is in a depression area with no natural outlet. The soil profile as described in the appendix show the colour and depth to mottling. The photo for the Pukepuke soil clearly shows the orange mottling and wetting front. According to Milne et al (1995) page 148 the soil is classified as poorly drained. A poorly drained soil has a moderate to severe wetness limitation according to the NZRI handbook (ref below) and therefore at best, it is classified as class 3w land.

The handbook also comments that for removal or modifying of a limitation, it needs to be 'reasonable, feasible and economic.' The low-lying nature of the landscape show that it is not feasible. The small area shows that it would also not be economic. And finally, practically it would be difficult to shift the water from the site as the new highway would prevent it going east and the Te Moana Road would stop it going to the west.

The other area of land with a wetness limitation is a wetland and under the NES FW drainage of this area would not be entertained. A 100 m buffer zone in the report shows the no go area for drainage.

There are no grid referenced observations showing soil where soil or site observations were taken or made on the site to determine the 1:3,000 scale map units presented in the soil and LUC map provided.

A correction to the observation that the mapping scale is 1:6,000 scale rather than 1:3000. The map in Appendix 1 shows the observation points.

Most of the soil profile photos do not include a scale. One includes a spade, so it gives some indication of scale, but a measuring tape is important for scale in soil profile photos, when trying to determine if reductimorphic features (gleying) or ochreous mottles (red or orange mottles or manganese are occurring at specific depths within the soil profile, to the nearest 5 cm increment. This is especially important in difficult to decipher soils such as coastal sands in low-lying environments such as at 100 & 110 Te Moana Road, Waikanae.

Point taken but in this situation, it really adds no value. I am sure Mr Hainsworth is conversant with the Pukepuke soil and a tape measure in this case would not provide any further clarity. It is noted that most of

the soil bureau reports containing detailed soil descriptions and the S Map info sheets have no photos of the profiles. It is noted that the horizon depths for all soils are documented.

There are no references. This means no reference to use of Milne et al. (1995) (the Soil Description Handbook), no reference to Hewitt (2010), or Webb and Lilburne (2011), (the New Zealand Soil Classification), and no reference to Lynn et al (2009) or Lynn et al (2021), (the LUC Survey Handbooks). Neither is there any reference to any Soil Bureau Bulletins, any use of S-map Online (there is S-map coverage for the area, and it looks quite useful, especially the "map unit page", and the "improved factsheets", but they are at 1:50,000, compared with the 1:3,000 scale mapping of Land Vision Ltd, which is considerably more detailed), the Fundamental Soil Layer, the New Zealand Land Resource Inventory, or Landcare Research Science Series No 6 by Mike Page (LUC Classification of the Wellington Region) (1995), or to the nationally correlated NZCU LUC units. It would also be useful to have referenced the Protocols for Farm Scale Soil Mapping (Grealish (2019), Grealish et al. (2018) and Grealish (2017)).

Where appropriate these have been added but really they add no value.

9 APPENDIX 1: MAPS

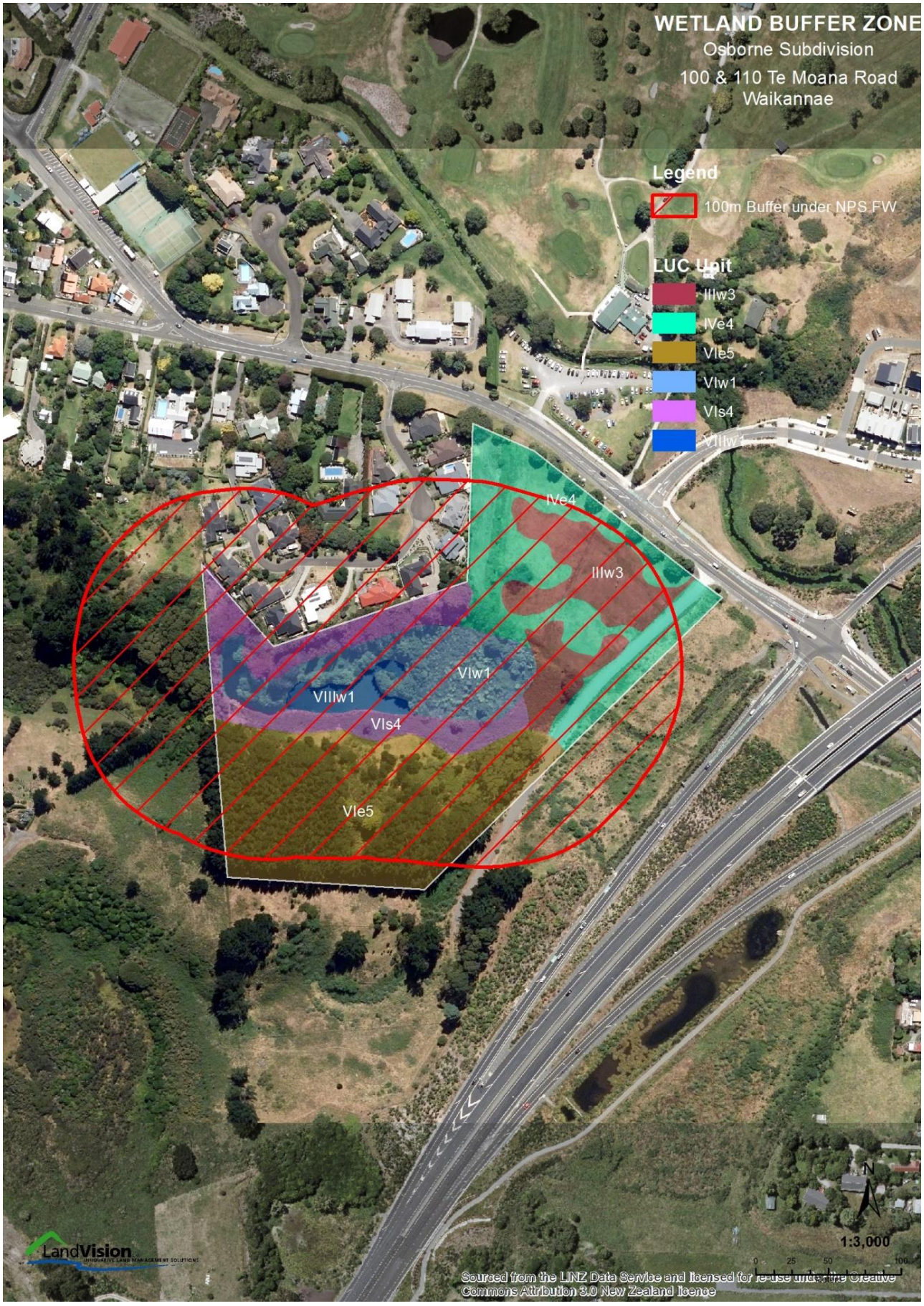
9.1 LAND USE CAPABILITY MAP

(Note: Mapped at 1:6,000)

9.2 SOIL RESOURCES MAP

(Note: Mapped at 1:6,000)

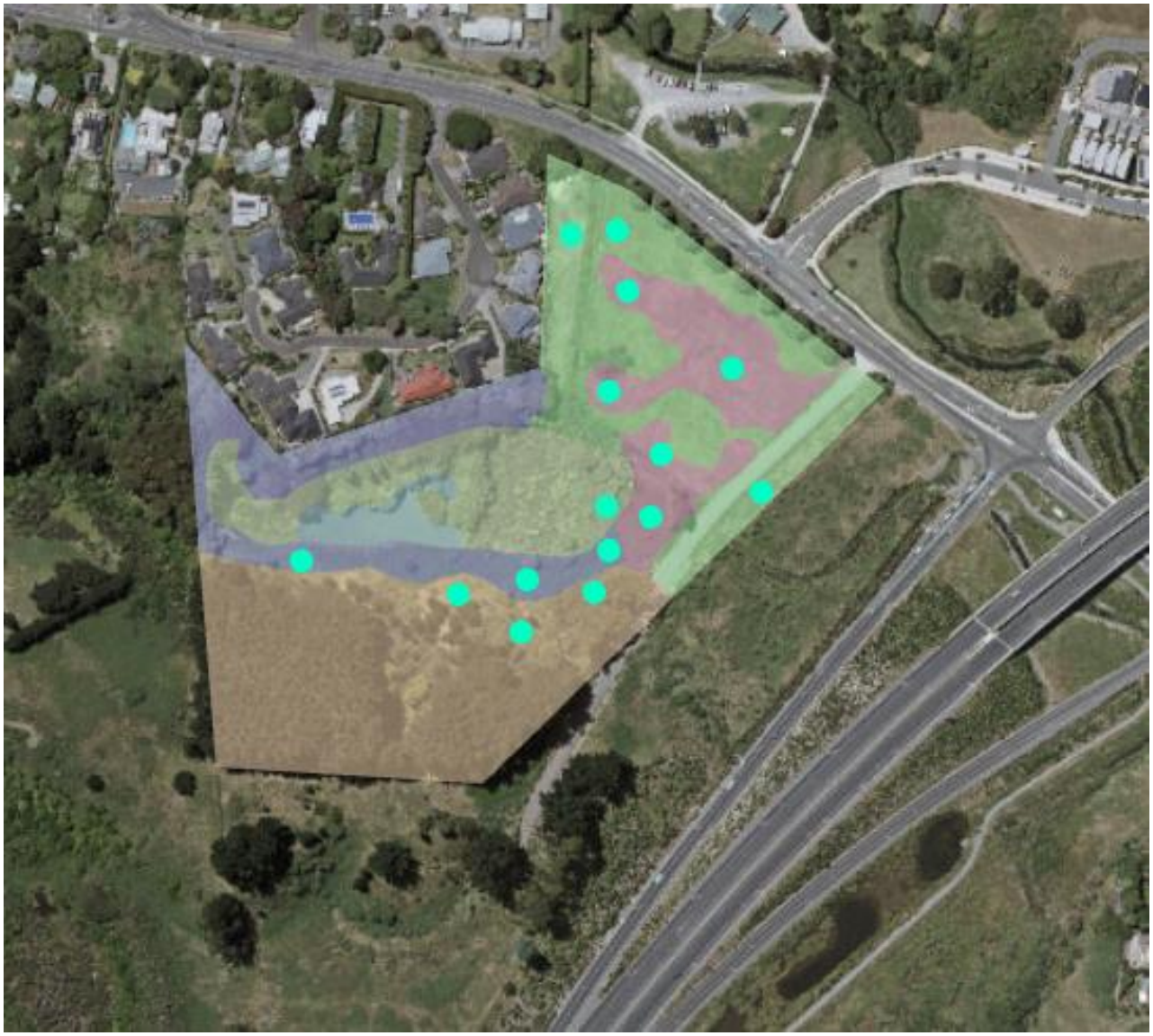
9.3 100 M WETLAND BUFFER ZONE



(Note: Mapped at 1:6,000)

9.4 OBSERVATION POINTS MAP

The green dots present the observation points used in the field mapping. These observation points may have included a hole, an auger hole or a track cutting observation. The shaded areas on the map are the LUC unit classification.



(Note: Mapped at 1:6,000)

10 Appendix 2. Land Resources Legends

10.1 Extended Geological Legend

The dominant rock type on the property is windblown sand. There are also areas of peat around the wetland area.

10.2 Extended Soil Legend

The property is a combination of wet and dry sand flats and stable and potentially fragile sand dunes. There is also a small inter-dune wetland. The soils found on the property are described below.

	**Name: Pukepuke black sand.** **LUC map symbol:** P **Parent material:** Windblown sand. **Drainage status:** Poorly drained. **Soil consistence:** Friable to loose when moist, non-plastic when wet. **Degree of topsoil development:** Weakly developed. **Pugging susceptibility:** Low to moderate. **Profile description:** 25 cm weakly developed, fine granular, friable to loose when moist, non-plastic when wet, very dark yellow-brown black (WO 2a) loamy sand. On: 20 cm weakly developed to structureless, fine to coarse granules, loose when moist, non-plastic when wet, dusky orange grey (WO 1c) sand with few brown mottles. On: weakly developed to structureless, fine to coarse granules, loose when moist, non-plastic when wet, pale grey (G 5f) gleyed sand with few to many orange mottles. On windblown sand. **Comments:** High water table in winter and spring make this soil prone to damage from heavy cattle and machinery. **Management considerations:** Care with cattle and machinery during winter, spring and extended wet periods. Maintain vegetative cover to avoid wind erosion.
	**Name: Foxton black sand.** **LUC map symbol:** F **Parent material:** Windblown sand **Drainage status:** Well drained. **Soil consistence:** Friable when moist, slightly plastic when wet. **Degree of topsoil development:** Weakly developed. **Pugging susceptibility:** Low. **Profile description:** 25 cm weakly developed, fine granular crumb, friable to loose when moist, slightly plastic when wet, brownish black (WO 1a) loamy sand. On: weakly developed to structureless, coarse granules, loose to friable when moist, non-plastic when wet, dark grey (G 5c) sand with few indistinct brown mottles. On windblown sand. **Management considerations:** Maintain vegetative cover to avoid wind erosion.

	**Name: Omanuka peat.** **LUC map symbol:** Om **Parent material:** Windblown sand over peat. **Drainage status:** Poorly drained. **Soil consistence:** Friable when moist, slightly plastic when wet. **Degree of topsoil development:** Weakly developed. **Pugging susceptibility:** High to extreme. **Profile description:** 16 cm weakly developed, fine granular crumb, friable when moist, slightly plastic when wet, brownish black (SO 1a) sandy loam with few to many brown mottles. On: weakly developed, fine to medium crumb, loose to friable when moist, plastic when wet, dusky strong orange brown (SO 3b) peat with many brown mottles. On windblown sand over peat. **Comments:** Perched water table makes this soil prone to damage from stock and machinery.
	**Name: Himatangi sand.** **LUC map symbol:** Hm **Parent material:** Windblown sand **Drainage status:** Excessively well drained. **Soil consistence:** Friable when moist, non-plastic when wet. **Degree of topsoil development:** Weakly developed. **Pugging susceptibility:** Low to moderate. **Effluent application risk:** High (due to slope > 7^0) **Profile description:** 8-12 cm weakly developed, fine granular crumb, friable to loose when moist, non-plastic when wet, greyish dark-yellow brown (WO 2b) loamy sand. On: structureless, coarse granules, loose when moist, non-plastic when wet, very light grey (G 5g) sand. On windblown sand. **Comments:** High potential for wind erosion if vegetative cover is removed. **Management considerations:** Maintain vegetative cover to avoid wind erosion. More suited to forestry than pasture.

10.3 EXTENDED SLOPE LEGEND

The definitions of the slope classes mapped on the LRI Map are shown in the table below, along with a summary of the various slope classes found on the property.

Slope class	Degrees	Slope description	Access suitability
A	0-3°	Flat to gentle undulating	Tractor
B	4-7°	Undulating	Tractor
C	8-15°	Rolling	Tractor
D	16-20°	Strongly rolling	Some tractor, four-wheel bike
E	21-25°	Moderately steep	Two-wheel bike
F	26-35°	Steep	Walking and some two-wheel bike
G	>35	Very steep	Walking
+	*Indicates a compound slope*		
/	*Indicates average slope is borderline between two slope classes*		

Slope class	Area (ha)	Percentage (%)
A, A+B, B'	3.0	52
C+D	0.8	14
E	2.0	34

10.4 EXTENDED VEGETATION LEGEND

The vegetation types and the definitions of the symbols on the LRI Map are shown in the table below.

Vegetation type	Map symbol	Area (ha)
Semi-improved pasture	gS	1.5
Unimproved pasture	gU	0.8
Wetland association species.	hW	1.0
Exotic trees	fR	0.5
Cutover forestry.	cfF	2.0
Rushes	hR	-
Scattered vegetation.	*	-