BEFORE THE SELWYN DISTRICT COUNCIL

UNDER the Resource Management Act 1991

AND

IN THE MATTER of Plan Change 68 to the Selwyn District Plan

Urban Holdings Limited, Suburban Estates Limited and Cairnbrae Developments Limited (Applicants)

STATEMENT OF EVIDENCE OF VICTOR MKURUTSI MTHAMO ON BEHALF OF URBAN HOLDINGS LIMITED, SUBURBAN ESTATES LIMITED, AND CAIRNBRAE DEVELOPMENTS LIMITED

VERSATILE SOILS

Dated: 6 March 2022

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1 **INTRODUCTION:**

1.1 My full name is Victor Mkurutsi Mthamo.

1.2 I am a Principal Consultant for the environmental science, engineering and project management consultancy Reeftide Environmental and Projects Limited (Reeftide). I have been in this role for over 9 years. Prior to this I was a Senior Associate with the surveying, environmental science and engineering, and resource management consulting firm CPG New Zealand Limited (now rebranded to Calibre Consulting Limited), where I was also the South Island Environmental Sciences Manager. I have worked in the area of environmental science and engineering for over 26 years.

1.3 I have the following qualifications: Bachelor of Agricultural Engineering (Honours) with a major in Soil Science and Water Resources (University of Zimbabwe); Master of Engineering Science in Water Resources (University of Melbourne); Master of Business Administration (University of Zimbabwe). I hold an Advanced Certificate in Overseer Nutrient Management modelling qualification. I am a member of Engineering New Zealand (CMEngNZ) and I am a Chartered Professional Engineer (CPEng) and an International Professional Engineer (IntPE). I am a past National Technical Committee Member of both (i) Water New Zealand and (ii) New Zealand Land Treatment Collective (NZLTC).

1.4 My specific experience relevant to this evidence includes:

(a) The design and implementation of numerous on-farm irrigation schemes, soil investigations and land use assessments. Examples of projects include Hunter Downs Irrigation Scheme, North Bank Hydro Project, Mararoa-Waiau Rivers Irrigation Feasibility Study and North Canterbury Lower Waiau Irrigation Feasibility Assessment.

(b) Assessment of large subdivisions in relation to stormwater management, earthworks and the associated actual and potential impacts on soils, groundwater and surface waterways and how to effectively use erosion and management control plans to mitigate the potential impacts that may occur during the construction works. This work is relevant to my input in this hearing as it demonstrates the ability to assess and present soil mitigation

strategies associated with earthworks and rehabilitation of sites post development.

(c) Assessment of effects on soils and groundwater associated with onsite and community wastewater discharge systems such as the Wainui Community wastewater discharge consent.

(d) Assessment of actual and potential effects on groundwater and surface water associated with groundwater and surface water takes.

(e) Quarry soils and rehabilitation expert for the extension of the Road Metals Quarry on West Coast Road in Templeton in 2018. My evidence at the hearing covered the effect on soils and groundwater resulting from the changes to site levels post rehabilitation. I assessed the effectiveness of adopting a 300 mm topsoil layer and whether or not this was sufficient for:

(i) plant growth, and

(ii) providing contaminant attenuation, treatment and removal to protect the underlying groundwater.

(f) Soils and rehabilitation expert witnessing for the proposed Roydon Quarry in Templeton in 2019 and 2020. Fulton Hogan's proposal was for the establishment of a quarry and extraction aggregate. I provided an assessment of the soils' versatility and the effect of the changes to the land use on the land's productivity potential.

(g) Expert witnessing at the proposed Fulton Hogan Miners Quarry extension in 2020 and 2021. I provided an assessment of the soils, their versatility and productivity potential with and without mitigation post quarrying.

(h) More recently, I have been involved as a soils expert witness providing evidence regarding the effects of the following plan changes on land/soil versatility and productivity potential:

(i) Plan Change 66 (PC66) in Rolleston.

(ii) Plan Change 67 (PC67) in West Melton.

(iii) Plan Change 71 (PC71) in Rolleston.

(iv) Plan Change 75 (PC75) in Rolleston.

1.5 I have been involved with the proposed Plan Change 68 (PC68) since the end of November 2021 when I was engaged by Urban Holdings Limited, Suburban Estates Limited and Cairnbrae Developments Limited (Applicants) to carry out an assessment of the effects of the PC68 proposal on the potential loss of productive land.

2 CODE OF CONDUCT

2.1 I have read and am familiar with the Environment Court's Code of Conduct for Expert Witnesses, contained in the Environment Court Practice Note 2014, and agree to comply with it. My qualifications as an expert are set out above. Other than where I state that I am relying on the advice of another person, I confirm that the issues addressed in this statement of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

3 SCOPE OF EVIDENCE

3.1 My evidence is presented on behalf of the Applicant and addresses the following:

(a) An overview of the existing PC68 area and the proposed land use under PC68.

(b) The productivity of the existing soils within the PC68 area, and the environmental factors affecting that classification.

(c) The effects of PC68 on highly productive soils.

3.2 In preparing my evidence I have reviewed:

(a) The request for PC68, including the section 32 Evaluation Report and the Infrastructure Report accompanying it.

(b) The section 42A report and supporting technical reports prepared on behalf of the Selwyn District Council.

(c) Submissions on PC68 relevant to my area of expertise.

3.3 I also note that I have not done any site-specific tests (e.g. soils). My assessment and evidence rely on:

(a) My knowledge of the area (Prebbleton) and the site, as I live within 1 km of the site.

(b) Information in the public domain (e.g. on soils, groundwater including the bore logs of wells in and around the site) as I have highlighted in my evidence.

4 SUMMARY

4.1 The PC68 area includes 36.13 ha of Land Use Capability (LUC) Class 2 soils and 7.57 ha of LUC Class 3 soils.

4.2 A review of site-specific factors relevant to the productivity of those soils indicates that:

(a) The climate in the area causes soil moisture deficits. Water is not available for irrigation to mitigate the effects of the deficits and meet the crop demand. This severely constrains intensive crop production. The volume of water required for irrigation is 472,028 m^3. I have estimated that almost $1M is required just to buy and transfer consents to the PC68 area to irrigate for full productivity.

(b) Nutrient application rates will be limited by the nutrient limits set out in the Canterbury Land and Water Regional Plan. Reducing nutrient applications affects the crop yield potential. Therefore, the soil's productivity potential is not realised.

(c) Advances in technology and farming techniques over the years have been such that the removal of up to 43.7 ha of these soils is unlikely to result in any significant loss in production as this can be made up for elsewhere in the district, and even on soils of lower LUC classes.

(d) The developable area in the context of the total LUC 2 and LUC 3 soils in the district and the region is very small (0.031% and 0.0052% respectively).

(e) The PC68 will not result in any significant cumulative loss of versatile soils both at a district and a regional level. The change in LUC Classes 1-3 as a result of all plan changes (operative and proposed) between January 2018 and November 2020 (when PC68 was lodged) is <0.36% and <0.06% within the district and the region respectively.

(f) The site is bound by existing subdivisions and lifestyle blocks. I expect significant resultant reverse sensitivity issues associated with intensifying agricultural production in such an area.

4.3 The Officer's s42A report supports the inclusions of additional blocks within the plan change. This will increase the reduction in LUC Class 2 soils from 36.13. ha (without these blocks) to 48.82 ha. The cumulative reduction in LUC1-3 Class soils will increase from:

4.4 0.356% to 0.365% within the district.

4.5 0.060 % to 0.061% within the region.

4.6 For these reasons, it is my opinion that the effect of PC68 on district and regional agricultural productivity potential is insignificant or less than minor.

5 DESCRIPTION OF THE SITE AND THE PROPOSED PLAN CHANGE

5.1 The PC68 area comprises approximately 67.5 ha of land lying between Trents Road, Shands Road, Hamptons Road and Sterling Park subdivision, Prebbleton.

5.2 The site comprises relatively flat ground, with gentle undulations and shallow depressions in some areas.

5.3 Land uses within the PC68 area has included (in the past) and includes:

(a) Rural lifestyle blocks;

(b) Residential and Horticultural – glasshouses growing asparagus and flowers; and

(c) General rural farming activities.

5.4 The PC68 request seeks to rezone these land parcels from Rural (Inner Plains) to Living Z yielding at least 820 low to medium density residential lots.

6 DISCUSSION OF THE CONCEPT OF HIGHLY PRODUCTIVE LAND OR VERSATILE SOILS

Introduction

6.1 The primary purpose of my evidence is to discuss the effect of the proposed plan change on the land's productive potential. Land productive potential encompasses many facets, of which soil is one of them.

6.2 Most discussions on soils that relate to its ability to support a multitude of productive uses refer to the soils as being versatile. The words high productive land/soil, high class land/soils, versatile soils/land are always used

interchangeably (though there could be some technical differences between them). In my evidence I have adopted the general approach where the words are used interchangeably.

6.3 High productive land or versatile soils are regarded as the best possible land or soils for agricultural production because of their properties. Various documents and statutory planning tools in New Zealand provide definitions of versatile soils. Therefore, it is necessary to provide a common understanding of what versatile soils are. Some of the most pertinent definitions are discussed in the following sections.

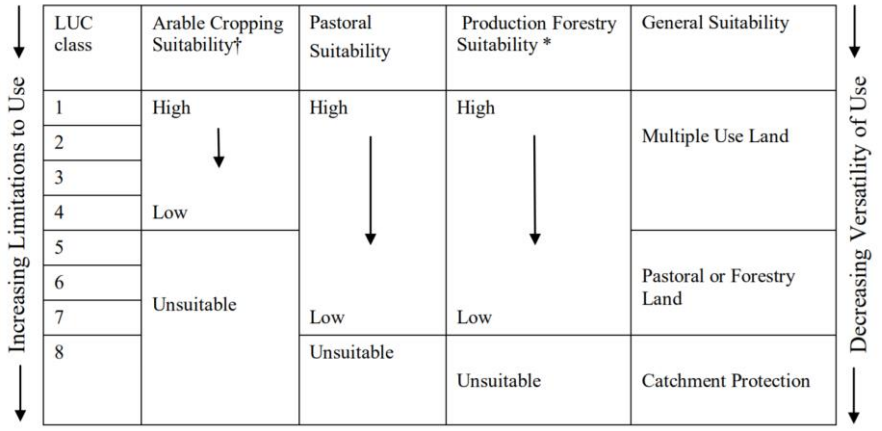
New Zealand Land Resource Inventory

6.4 The Land Use Capability (LUC) classification system is described by Lynn et al. (2009)1. It is a general purpose, qualitative evaluation system which has been widely applied in New Zealand for land use planning, especially for management and conservation.

(a) According to the LUC Class system:

(i) Land can be divided into 'classes' depending on its suitability for different land uses. The Land Use Capability (LUC) assessment ranks land according to its long-term productive ability. Class 1 land is highly suitable for agriculture, while Class 7 or 8 land is better suited for conservation.

6.5 Versatile soils are defined as Class 1, 2, or 3. Figure 1 shows the potential land uses and the relationship between the versatility and LUC classes.



[1] *Lynn IH, Manderson AK, Page MJ, Harmsworth GR, Eyles GO, Douglas GB, Mackay AD, Newsome PJF 2009. Land Use Capability survey handbook: a New Zealand handbook for the classification of land, 3 rd ed. Hamilton, Agresearch; Lincoln, Landcare Research; Lower Hutt, GNS Science. 163 p.*

Figure 1 – Relationship between the Versatility and LUC Classes (Lynn et al, 2009[2])

Canterbury Regional Policy Statement

6.6 The Canterbury Regional Policy Statement (CRPS) states that "*Soil versatility is an expression used to describe the land use capability of soils. A highly versatile soil has few limitations for use, that is it will be suitable for primary production with few inputs such as additional water or nutrients. Less versatile soil will need more inputs to achieve similar production or will simply be unsuitable for agriculture or forestry. In the Canterbury Regional Policy Statement, versatile soils are those soils that are classified as Land Use Capability I or II in the New Zealand Land Resource Inventory*".

(a) Policy 5.3.12 in Chapter 5 of the CRPS notes that "Different soils are valued for different reasons. Versatile soils (Classes I and II under the Land-use Capability Classification System) are that part of the soil resource that will support the widest range of productive uses with the least inputs. Soils with lower versatility can be valued for o*ther rural productive activities, such as vineyards".*

(b) Therefore, in summary the CRPS defines versatile soils as those that are in LUC Classes 1 and 2. Class 3 is not included. The total area in LUC Classes 1 and 2 in Canterbury is 293,700 ha[3].

Selwyn District Council

6.7 Various Selwyn District Council (SDC) statutory documents make reference to versatile soils. For example, in the Township Volume of the Operative Selwyn District Plan (OSDP):

(a) Objective B1.1.2 seeks to ensure that the Plan achieves s.5(2) of the RMA by ensuring that new residential or business activities do not create shortages of land or soil resources for other activities in the future.

(b) Policy B1.1.8 seeks to avoid rezoning land which contains versatile soils if the land is appropriate for other activities and there are other areas adjoining

[2] http://envirolink.govt.nz/assets/Envirolink/83-mldc7-MarlboroughSoilsAdvice.pdf
[3] https://www.tandfonline.com/doi/full/10.1080/00288233.2015.1092996

townships which are appropriate for residential or business development which do not contain versatile soils.

(c) The current Rural Volume of the District Plan is concerned with the irreversible use of versatile soils.

(d) The OSDP definition of versatile soils or highly productive land relies a lot on the definition in the CRPS (Paragraph 6.66.6). Therefore, versatile soils are those soils that are in LUC 1 and 2 as per the RPS. According to SDC[4] there are 6,522ha of LUC Class 1 land and 46,111ha of LUC Class 2 land giving a total of 52,633ha that are classified as versatile soils in the Selwyn District.

Proposed National Policy Statement for Highly Productive Land (propose NPS-HPL)

6.8 The overall purpose of the Proposed National Policy Statement for Highly Productive Land (proposed NPS-HPL) is to improve the way highly productive land is managed under the Resource Management Act 1991 (RMA).

6.9 Under the proposed NPS-HPL:

(a) Highly productive land means it has been designated LUC Class 1, 2 or 3 by default.

(b) The objective is not to provide absolute protection for highly productive land.

(c) Councils will then be able to consider a number of other factors to exclude some of this land, or to identify other highly productive land. Examples of these other factors are: the suitability of the climate for primary production; the size of land properties to support primary production; water availability; and access to transport routes and appropriate labour markets.

6.10 I note that the proposed NPS-HPL is still at the consultative stage and has no legal effect yet, and the provisions will likely change to some extent at least.

6.11 In summary, the proposed NPS-HPL considers land that is in LUC classes 1-3 as highly productive land or versatile soils by default until such a time Councils are better able to decide on what other factors should be considered to define the productive potential of specific pieces of land.

[4] *https://www.selwyn.govt.nz/__data/assets/pdf_file/0006/288312/Versatile-Soils-Baseline-Report.pdf*

Case Law

6.12 In Canterbury Regional Council v Selwyn District Council [W142/96], Environment Court Judge Treadwell5 preferred evidence to the effect that the term versatile soils/land should not be based just on the soils inherent properties (which is the LUC approach) but must be defined based on broader considerations than the land use capability. The comprehensive list of factors suggested by Judge Treadwell when defining versatile soils is provided in Table 1 below.

Table 1 – List of Factors Determining Versatility (Treadwell, 1997[5])

Soil texture	Soil structure	Soil water holding capacity
Soil organic matter stability	Site's slope	Site drainage
Temperature of the site	Aspect of the site	Stormwater movements
Floodplain matters	Wind exposure	Shelter planted
Availability of irrigation water	Transport, both ease and distance	Effect of the neighbours on the use
Access from the road	Proximity to airport	Proximity to port
Supply of labour	Previous cropping history	Soil contamination
Sunlight hours	Electricity supply	District scheme
Economic and resale factors		

6.13 I agree with the Court that the productive potential of the land should not be based on the LUC classes alone but should take into account other factors relevant to the overall success of a particular farming enterprise.

6.14 I also agree with the NPS-HPL proposal (Paragraph 6.9(c)) that consideration of other site-specific factors should be made in determining the productive potential of land beyond the default LUC Classes 1-3.

Summary Commentary of the Definitions of Soils Versatility

6.15 Under the CRPS and Operative Selwyn District Plan highly productive soils are soils in LUC Classes 1 and 2. In summary:

[5] *Canterbury Regional Council v Selwyn District Council [1997] NZRMA 25, Judge Treadwell presiding.*

(a) Selwyn District has 6,522ha of Class 1 land and 46,111ha of Class 2 land giving a total of 52,633 ha (Paragraph 6.7(d)).

(b) Canterbury Region has 293,700 ha (Paragraph 6.6(b)) of Class 1 and 2 soils.

6.16 Under the proposed NPS-HPL default highly productive soils are soils in LUC Classes 1, 2 and 3. However, the proposed NPS-HPL suggests that rather than rely on the default classifications Councils will need to do further work to define what highly productive soils are, taking into account site specific environmental, climatic, geographic, economic and social factors. Added to the LUC Class 1 & 2 totals above:

(a) Selwyn District has 87,927haof Class 3 soils giving a total of 140,560 ha[6] of LUC Classes 1-3 soils.

(b) Canterbury Region has 543,000 ha[3] of LUC Class 3 soils giving a total of 836,700 ha of Classes 1, 2 and 3 soils.

7 LUC CLASSES AND VERSATILITY OF THE SOILS IN THE PC68 AREA

7.1 S-Maps Online, Canterbury Maps and the Land Resource Inventory (LRIS) Portal provide details of the default LUC Classes within the PC68 area.

7.2 The LUC Classes of the PC68 soils are mapped on Canterbury Maps, S-Maps and LRIS Portal[7]. I have attached (**Attachment 1**) an image showing the LUC Classes under the PC68 area. In Table 2 below I provide details of the areas under each LUC Class.

Table 2 – LUC Classes within the PC68 Area

LUC Class	Area (ha)	%age
LUC 2	36.13	53.5%
LUC 3	7.57	11.2%
LUC 4	23.8	35.3%
Total	**67.50**	**100%**

[6] https://www.mpi.govt.nz/dmsdocument/36624/direct
[7] https://soils.landcareresearch.co.nz/soil-data/the-lris-portal/

8 MY THOUGHTS REGARDING THE USE OF LUC CLASSES IN DEFINING LAND/SOIL PRODUCTIVITY

8.1 The use of the LUC based on information from S-Maps, NZLRI and Canterbury Maps provides a high-level description of the land and soils. While this is a good planning tool, it is important to note that:

(a) The NZLRI LUC map information should be treated with caution due to the scale (which can be up 1:50,000 scale), especially with regard to the accuracy of LUC map unit boundaries. Applying regional scale LUC (and soil) map information at property scale should only be used as a guide rather than assumed to represent the definitive soils and LUC map units for the property.

(b) The LUC classes are based on high level soil properties to ascertain productivity potential and these do not necessarily drive land and soil quality. Soil properties such as physical limitations, land use suitability, slope limitations, characteristic soil stoniness, depth and workability, texture, drainage salinity and elevation, can change over very short distances. Therefore, wholly relying on the LUC classes in determining a particular piece of land can be misleading.

8.2 Therefore, it is my opinion that:

(a) The areas in Table 2 are just the default LUC classes and should not be used to describe the productive potential of the PC68 land. I noted in Paragraphs 6.13 and 6.14 that the soils' productive potential is not based just on the LUC classes.

(b) There are other factors that must be taken into account such as those in Table 1 or those suggested in the draft NPS-HPL (Paragraph 6.9(c)).

9 ASSESSMENT OF SITE-SPECIFIC FACTORS AFFECTING THE PC68 SOILS' PRODUCTIVE POTENTIAL

Introduction

9.1 In this section I discuss site specific considerations necessary to understand the soils productivity potential beyond the assumptions drawn from use of the default LUC classes (Paragraphs 6.9(c), 6.13, 6.14 and 8.2).

Site Specific Soil Properties

9.2 S-Maps Online[8] and Canterbury Maps[9] provide details of the soils under the PC68 site. The soil type is predominantly Templeton silt loam. Table 3 summarises the soils types, the area over each type and the drainage and permeability characteristics.

Table 3 – Overview of Soils at the PC68 Site

Soil	Sibling	Area (ha)	Proportion	Drainage Characteristics
Eyre	Eyre_1a.1	22.6	34%	Well drained
	Eyre_2a.1	14.1	21%	Well drained
	Eyre_4a.1	9	14%	Well drained
	Eyre_3a.1	4	6%	Well drained
Templeton	Temp_2a.1	13.2	20%	Moderately well drained
	Temp_1a.1	1	2%	Moderately well drained
	Temp_4a.1	1	2%	Moderately well drained
	Temp_3a.1	0.8	1%	Moderately well drained
		65.7	100.0%	

9.3 The Templeton soils:

(a) Are deep > 100 cm.

(b) Have a Profile Available Water – 56.3-157 mm.

(c) The Eyre soils:

(d) Are shallower – 25-45 cm;

(e) Extremely gravelly; and

(f) Have a profile available water of up 118 mm.

9.4 The site-specific soil information seems to confirm the LUC Class 2 and 3 soils in Table 2. However, note Templeton soils make up all of the LUC 3 Class soils and the Eyre soils are all in LUC Class 2 soils.

9.5 More importantly, as I noted in Paragraph 8.2 there are other factors that should be considered to define the soil productivity. I now discuss these in subsequent paragraphs.

[8] https://smap.landcareresearch.co.nz/
[9] https://canterburymaps.govt.nz/

Soil Moisture Deficits

9.6 The Selwyn District climate can be very hot and dry during spring and summer at a time when most agricultural production needs moisture the most.

9.7 These weather conditions significantly affect crop production and ultimately compromises the soil's natural capital or productive potential as it will not matter how inherently fertile or productive the soils are as moisture or irrigation is critical to support crop growth.

9.8 To better understand the soil moisture deficits and the need for irrigation in the proposed plan change area I assessed the soil moisture deficits using data from the NIWA climate database (Cliflo[10]). I looked at a number of climatic stations and the data that they had. These included Templeton, Christchurch Aero, Christchurch Airport Botanical Gardens and the Selwyn District Council Burnham Wastewater Treatment Plant Station. The best climatic data I found to help make my point was from the Selwyn District Council Burnham Wastewater Treatment Plant (Agent No 4880). This station has data from 1953 to 2020. Regardless of the station I use the trends illustrated by the adopted station will still be valid. Tables 4, 5 and 6 provide summaries statistics on:

(a) Moisture deficit days;

(b) Mean moisture deficits; and

(c) Maximum moisture deficits.

Table 4 – No of Monthly Deficit Moisture Days

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
Mean	21	18	14	9	3	0	0	0	1	6	15	19	109
Min	7	5	0	0	0	0	0	0	0	0	0	1	62
Max	30	26	30	28	21	1	8	0	18	28	28	31	167

9.9 Table 4 shows that there was an average of 109 and a maximum of 167 days per year when soil moisture deficits were experienced. Most of these deficits were from later in spring and throughout the summer months. For some crops peak growth occurs in the December, January and February and this is when soil

[10] https://cliflo.niwa.co.nz/

moisture is most limiting to crop growth. The average number of deficits in January is 21 days out of 31 days in the month. There were a few times over the years when deficits were experienced every day in January.

Table 5 – Monthly Mean Moisture Deficits (mm)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	122	123	109	91	62	29	13	11	27	57	94	113
Min	60	44	35	18	2	1	0	1	2	8	26	55
Max	146	142	143	143	124	104	66	63	87	129	133	138

Table 6 – Monthly Maximum Moisture Deficits (mm)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	135	135	127	112	84	47	23	21	45	81	115	129
Min	101	75	61	46	5	2	2	4	6	23	56	86
Max	149	147	146	146	144	112	88	74	105	142	140	146

9.10 The monthly soil moisture deficits in the summer months ranged from 113-149 mm per month as shown in Tables 5 and 6. These deficits explain the low intensity production within the proposed plan change area.

(a) I also expect that due to climate change, the soil water deficit will continue to increase to a point that even dry land farming could become unsustainable.

9.11 Paragraphs 9.6-9.10 demonstrate the critical need for irrigation water if agricultural productivity on the PC68 land is to be maximised as these soil moisture deficits stunt crop growth regardless of the soil's natural capital.

(a) Therefore, the soil's versatility or production potential is lower than what the LUC classes suggest unless irrigation water is applied to compensate for the deficits.

Irrigation Water Availability

9.12 The soil moisture deficits I discussed in Paragraphs 9.6-9.11 need to be compensated for by providing irrigation if the land is to achieve its productivity potential. For example, the average deficit of 122 mm in January would need at

least an equivalent amount of irrigation water to ensure that the soil moisture stayed between field capacity and the allowable depletion point.

9.13 I used IrriCalc[11] to estimate the irrigation requirements in 9 out of10 years for pasture assuming an irrigation system with an 80% efficiency.

9.14 IrriCalc is a tool for calculating irrigation water demand. It is an approved method and meets the Canterbury Land and Water Regional Plan Schedule 10 requirements.

(a) The annual irrigation volume estimated using IrriCalc is 472,028 m^3 (using one soil profile available water depth). This volume is based on pasture. Volumes for other crops (arable and horticultural) will be 90-110% of the pasture volumes). **Attachment 2** is the IrriCalc output.

9.15 Table 7 summarises the monthly irrigation application depths based on long term climatic data.

Table 7 – Irrigation Requirements for Pasture in the Plan Change Area

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	129	107	47	27	0	0	0	0	6	55	76	129
90%tile	189	189	63	63	0	0	0	0	6	126	126	189

9.16 Table 7 shows that in January an average of 129 mm and 189 mm of irrigation is required in 9 out of 10 years to maintain a good pasture system. These irrigation requirements support or are supported by the moisture deficits in Tables 5 and 6 with any differences due to the range of climatic data used by the different tools.

9.17 I interrogated the Canterbury Maps GIS[12] to check for consents to take water for irrigation. There are three consented takes (**Attachment 3**). However, only one of these (CRC130317) is an active consent for irrigation. CRC130317 permits:

(a) The taking and use of groundwater at a rate of 14 L/s and

(b) Annual volume not exceeding 15,000 m^3.

9.18 In Paragraph 9.14(a) I estimated the annual volume required to meet the moisture deficit to be 472,028 m^3. The available annual volume is only 15,000 m^3. This leaves a shortfall of 457,028 m^3. Stated differently, the 15,000 m^3

[11] http://mycatchment.info/

[12] https://canterburymaps.govt.nz/

available is sufficient to irrigate 2.14 ha leaving the other 65.36 ha without irrigation water for maximum productivity.

9.19 The PC68 site is within the Selwyn-Waimakariri Groundwater Allocation Zone. This zone is over-allocated and applications for new consents to take groundwater for irrigation are prohibited.

(a) The only other possible option to acquire water for irrigation would be to buy and transfer an existing consent to the PC68 site. With regards to the transfer of consents:

(i) I have looked at the trading history at Hydrotrader[13] – a groundwater consent and water trading website. There are no readily available consents for purchase and transfer within the zone. However, this does not mean that they will not be available in future.

(ii) The Canterbury Land and Water Regional Plan requires 50% of any volume transferred be surrendered. That is, a consent or consents with a combined annual volume of 944,056 m^3/year would have to be purchased to provide for the annual volume of 472,028 m^3/year.

(iii) The average price of water is \$1.05/m^3 which means if a consent (for 944,056 m^3) this would cost almost \$1M to get a net volume of 472,028 m^3. This is a prohibitive cost. For low margin crops it will take several years to recoup this cost this is even before the opportunity cost is taken into account.

(iv) The almost \$1M cost of water is a huge initial cost that has to be incurred even before a well or wells are drilled to take the water and for the irrigation equipment.

(v) The unavailability of irrigation water or its high cost, were this to be found makes the economics of irrigated production a hindrance to intensive production and without irrigation the land is not as valuable as the LUC classification would imply.

9.20 Therefore, the high evapotranspiration rates and low rainfall and the accompanying moisture deficits significantly reduce the productive potential of the land.

[13] http://hydrotrader.co.nz/trade-history

9.21 I conclude that without adequate irrigation water, only dry land production can be carried out. Therefore, the PC68:

(a) Area will never be fully productive regardless of the fact that the soils are in LUC Classes 2 and 3.

(b) Soils are not highly productive soils based on the inadequacy of water for irrigation necessary to meet the moisture deficit and meet the crop demand. Crops grown in the area will not fully achieve the maximum possible yields as long as water is lacking.

Statutory Planning Tools and Compliance

9.22 The CLWRP's Selwyn Te Waihora Sub-regional plan has limits on the discharge of nitrates and phosphorus from various farming activities. The CLWRP Plan Change 7 also limits some farming activities (e.g. commercial vegetable growing operations) due to the proposed nutrient limits.

9.23 The CLWRP requires that baseline nutrient budgets be established based on the farming activities during the period 2009-2013. As the productivity of the PC68 Site has always been low due to lack of irrigation water, the baseline nitrogen leaching rates are also very low.

9.24 Future nitrogen leaching rates are required to not exceed the baseline rates and where they exceed the 15 kg N/ha/year, the plan requires reductions be implemented by 2022 on the following basis:

(a) *"…dairy farmers being required to reduce by 30%, dairy support by 22%, pigs by 20%, irrigated sheep, beef or deer by 5%, dryland sheep and beef by 2%, arable by 7%, fruit, viticulture or vegetables by 8% and all other sectors 0%. Properties do not need to reduce if their nitrogen loss is below 15kgN/ha/yr".*

9.25 For the proposed Plan Change 68 area baseline nitrogen budgets were not available which is to be expected on most lifestyle blocks. However, given the low intensity production system I expect the nitrogen leaching levels to be at the lower end of the scale i.e. most likely well below 15 kg N/ha/year. Which means that there is not much opportunity to increase N application rates to increase productivity. However, if the leaching rates are >15 kg N/ha/year, the reductions in Paragraph 9.24(a) would be required.

9.26 From my experience reducing nitrogen applications is accompanied by a decrease in yields, revenues and profitability. There is literature that supports this. A few examples of such literature are:

(a) A Landcare Research study called "*Modelling Economic Impacts of Nutrient Allocation Policies in Canterbury: Hinds Catchment*" in 2013 prepared for the Ministry for the Environment[14] concluded that loss in productivity could result in revenue reductions of up to 41% with an average of 14% across the farming systems studied.

(b) Reports prepared by the Agribusiness Group (2014)[15,16] on behalf of Ministry for Primary Industry found significant reductions in yield and profitability resulting from nutrient reductions.

(i) I have extracted Figure 2 below from the Agribusiness Report[16] reports. It shows the corresponding yield reductions associated with reductions in nitrogen.

Appendix One: Average Estimated Reduction in yield with reduction in applied N.

Reduction in N	Potato (Summer), Onions, Carrots,	Squash, Broccoli, Lettuce,	Cabbage, Spinach, Cauliflower	Potato (Winter)	Barley
10%	10%	15%	15%	25%	25%
20%	20%	25%	30%	35%	35%
30%	30%	40%	40%	50%	45%

Figure 2 – Yield Reductions Due to Reductions in N Applications

(ii) The Agribusiness reports also include budgets showing losses for some crops with the conclusion that *"At the 10% reduction in the amount of N applied the Gross Margin result is reduced to approximately one third to a half of that under the Status Quo situation and from there it dips towards a close to breakeven scenario which means that it would not be*

[14] *Landcare Research (2013). Modelling Economic Impacts of Nutrient Allocation Policies in Canterbury: Hinds Catchment. Prepared for the Ministry for the Environment.* https://environment.govt.nz/assets/Publications/Files/modelling-economic-impacts-of-nutrient-allocation-policies-canterbury.pdf

[15] *The Agribusiness Group (2014). Nutrient Performance and Financial Analysis of Lower Waikato Horticulture Growers. Prepared for MPI.* https://www.horizons.govt.nz/HRC/media/Media/One%20Plan%20Documents/Nutrient-Performance-and-Financial-Analysis-of-Horticultural-Systems-in-Horizons-Region-2014.pdf?ext=.pdf.

[16] *The Agribusiness Group (June 2014). Nutrient Performance and Financial Analysis of Horticultural Systems in the Horizons Region. Prepared for MPI.*

economic to grow the crop. This reflects the relatively tight margins which these crops are grown under".

(c) Samarasinghe et al (2011)[17] carried out research in Hurunui District and concluded that reduction in nutrients below the baseline levels resulted in >5% loss in revenue. For some enterprises this would be a net economic and financial loss.

9.27 Therefore, any natural capital that the 43.7 ha of LUC Class 2 and 3 soils in the PC68 area is negated by the statutory constraints imposed by the statutory planning rules.

Effects of the Surrounding Environment – Reverse Sensitivity

9.28 The PC68 area is adjacent to existing developed urban land and lifestyle subdivisions. To make the most of any highly productive soils agricultural production has to be intensified. This involves:

(a) Increased of fertilisers and chemicals with potential effects on air and water quality (within the statutory limits such as those I have discussed in Paragraphs 9.22-9.27).

(b) Increased use of machinery and equipment and the accompanying noise effects. However, use of these would be subject to the noise standards and operating hours to comply with the district planning requirements. This limits or affects the productivity on the land.

(c) Dust pollution associated with the cultivation of land and harvesting of crops.

9.29 In the judgement in *Canterbury Regional Council vs Selwyn District Council*[5] the Court acknowledged that low productivity can arise because of reserve sensitivity effects from residential neighbours.

9.30 The effects above impact what is required to work the land productively because of the adverse reverse sensitivity effects on the urban development. Therefore, while the land has default LUC Classes 2 and 3, its actual productive potential will be hindered by its proximity to an existing urban development.

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[17] *Samarasinghe , O. Daigneault A, Greenhalgh, S, Sinclair , R (2011) Modelling Economic Impacts of Nutrient Reduction Policies in the Hurunui Catchment, Canterbury. https://www.nzae.org.nz/wp-content/uploads/2011/Session4/42_Samarasinghe.pdf*

Effects of the Surrounding Environment – Fragmentation

9.31 Land fragmentation is defined as "*division of a land resource that changes the current or future range of possible activities and thereby alters the actual or potential uses of that land resource across a number of scales*"[18].

9.32 The PC68 site is bound by lifestyle blocks (1-6 ha) and residential subdivisions (Paragraph 9.28). The PC68 site itself comprises small lifestyle blocks (1-8 ha) with the largest block being approximately 21 ha. The small lots are owned by different individuals and entities. Consolidating ownership to create a large contiguous block that can be farmed intensely will be difficult.

9.33 It is my conclusion that based on the characteristics of land fragmentation and the existing location and land surrounding the PC68 site that land around the PC68 site is fragmented. This is supported by considerable literature on the impact of fragmentation on agricultural productivity.

9.34 Fragmented ownership is well documented as a hindrance for intensive land use productivity. On this basis, it is unlikely that the productive potential of the LU Class 2 and 3 soils will ever be realised assuming other constraints such as lack of irrigation water are addressed.

9.35 The fragmentation of ownership and size of the land parcels around the PC68 area means that it will be nearly impossible for large contiguous blocks (>50-100 ha which are more efficient to farm irrigated arable crops) to be available for crop and/or pastoral agriculture.

9.36 I discussed the issue of reverse sensitivity in Paragraphs 9.28-9.30. I also consider the fragmented ownership of the small blocks of land around the PC68 area to impact negatively on any potential future large scale or intensive farming activities within the PC68 area. This, therefore, will adversely affect the productive potential on the LUC Class 2 and 3 soils.

9.37 Therefore, because of the land fragmentation, the PC68 area is not as highly productive as the default LUC classes imply.

Agricultural Technological Advancements

[18] *Hart, G., Rutledge, D., Price, R. (2013) Guidelines for monitoring land fragmentation: review of knowledge, issues, policies and monitoring. Landcare Research, New Zealand.*

9.38 Agricultural technology and farming techniques which include precision farming, soil management, improved plant/crop varieties and cultivars have improved immensely over the last two decades. This now enables a range of pastoral and arable activities to be undertaken and successfully managed for high productivity on a range of soils.

9.39 These advances in agricultural production are largely about removing limitations to plant growth or increasing it. For example, irrigation, drainage, slope angle, etc are technologies that remove a limitation and contribute to changes in the manageable properties of the soil, but do not change the inherent attributes of that soil.

9.40 Therefore, soils in LUC Classes >3 can achieve productivity potential greater than that in soils with LUC Classes ≤3 by applying one more technological advances (e.g. cultivation, irrigation, fertiliser uses, better crop cultivars etc).

9.41 In summary, because of technology there is now more land potentially available as high value land i.e. land that is in the higher LUC Classes can produce high yields when appropriate agricultural practices are in place. Therefore, the proposed change of the 36.13 ha (LUC 2) and 7.57 ha (LUC 3) to residential within Selwyn District and Canterbury in general will not necessarily reduce the district's or the region's agricultural productivity or output.

Understanding the Scale of Change in LUC Class Due to the Land Use Change

9.42 In Paragraph 6.16 I discussed the area of land that falls in LUC Classes 1-3 within Selwyn and Canterbury.

9.43 In Table 8 below I have attempted to give a sense of the proportional loss of highly productive soil as a result of the proposed plan change under the NPS-HPL definition.

Table 8 – Potential Loss in HPL As a Result of the Proposed Plan Change

LU Class	Canterbury (ha)	Selwyn (ha)	Plan Change Area (ha)	Percentage of HPL Loss	
				Canterbury	Selwyn
LUC 1	23,200	6,522	0	**0.0052%**	**0.031%**
LUC 2	270,500	46,111	36.13		
LUC3	543,000	87,927	7.57		
Total Area	**836,700**	**140,560**	**43.7**		

9.44 If the NPS-HPL definition is adopted the reduction in highly productive land in the district and region would be 0.0052% and 0.031% respectively.

CUMMULATIVE CHANGES IN HPL

9.45 I have gone through all the Selwyn District Plan Changes (operative and proposed) to estimate the amount of LUC Classes 1- 3 soils to help me understand the net changes or loss in versatile soils since 2018 when Selwyn District published the baseline report[19] on versatile soils which quantified the amount of versatile soils at that time to when PC68 was lodged. This covers Plan Changes 49 to 68 (inclusive).

9.46 I searched through the Selwyn District Council and Canterbury Regional Council websites for land use consents that would also result in potential losses in versatile soils between January 2018 and 4 November 2020 (the PC68 lodgement date). The significant land use consents related to quarrying activities of which Roydon Quarry was the largest within LUC Classes 1-3. The other quarrying activities were outside of LUC Classes 1-3. I have listed the relevant ones in **Attachment 4**. Finding the relevant information from these websites was difficult. Therefore, it is possible that my list is not exhaustive as there are some small consents that I may not have been able to pick up. If they are, these would be few and of such a small scale that they would not change the total areas in **Attachment 4** by anything greater than a percentage point.

[19] *Selwyn District Council. 2018. Baseline Assessment. Versatile Soils. Report DW015. https://www.selwyn.govt.nz/property-And-building/planning/strategies-and-plans/selwyn-district-plan/selwyn-district-plan-review/supporting-information/baseline-reports2*

9.47 Tables 9 and 10 below provide summaries of (**Attachment 4**) the total loss in versatile soils in Selwyn and the cumulative loss from the regional pool as a result of the Selwyn District LUC1-3 plan changes that I was able to identify.

Table 9 – Changes in Versatile Soils in Selwyn Since 2018-PC68

LUC Class	Area	PC49-68	Net HPL after PCs	%age HPL Losses
LUC Class 1	6,522	2.30	6,519.70	0.035%
LUC Class 2	46,111	225.51	45,885.49	0.489%
LUC Class 3	87,927	272.63	87,654.37	0.310%
Total	**140,560**	**500.44**	**140,059.56**	**0.356%**

Table 10 – Regional Changes in Versatile Soils Due to LUC1-3 Changes in Selwyn Since 2018-PC68

LUC Class	Area	PC49-68	Net HPL after PCs	%age HPL Losses
LUC Class 1	23,200	2.30	23,197.70	0.010%
LUC Class 2	270,500	225.51	270,274.49	0.083%
LUC Class 3	543,000	272.63	542,727.37	0.050%
Total	**836,700**	**500.44**	**836,199.56**	**0.060%**

9.48 In summary:

(a) Table 9 shows that the cumulative potential loss in productive soils in the district since January 2018 (PC49) up to November 2020 when PC68 was lodged is 0.36%.

(b) Table 10 shows that the reduction in LUC1-3 soils in the region resulting from the Selwyn District LUC1-3 changes is 0.06%.

(c) Therefore, any concerns regarding cumulative effects would be overstated.

9.49 These potential reductions in the area of highly productive land are important given recent case law. In *Gock v Auckland Council* [2019] NZHC 276, the High Court found the Environment Court had erred in:

[93] … (b) its assessment of whether the relevant areas of premium soils were significant for their ability to sustain food production (to the extent undertaken) proceeded in error of law by:

(i) failing to take into account the insignificant area concerned [100ha] in the context of the total area of such soils in the Auckland region [63,000ha].

9.50 The issue of proportionality should, in my opinion, also be taken into consideration for the PC68 application.

SECTION 42A REPORT

9.51 I have read the section of Mr. Clease's s 42A Report dealing with versatile soils. I agree with his analysis, including his statement that there are virtually no pathways for urban expansion in the Selwyn portion of Greater Christchurch that do not extend over areas of versatile soil.

9.52 Mr. Clease also discusses a number of submissions which seek the inclusion of additional land in the Plan Change Boundary. Of these, Mr. Clease supports including the following:

(a) 701 Shands Road;

(b) 382 Trents Road;

(c) 386 Trents Road;

(d) 398 Trents Road;

(e) 400 Trents Road; and

(f) 414 Trents Road.

9.53 Table 11 below provides details of these blocks and the LUC classes of the soils within the blocks.

Table 11 – Blocks Supported for Inclusions and the Accompanying LUC Classes

Site	Owner	Size Block (ha)	LUC 1	LUC 2	LUC 3	Total
701 Shands Road	Simon Shamy	2.43	0	2.43	0	2.43
382 Trents Road	David Somerfield	2.1	0	2.18	0	2.18

386 Trents Road	Mark & Joanne Hamlyn	2.02	0	2.02	0	2.02
398 Trents Road	Mark & Joanne Hamlyn	2.02	0	2.02	0	2.02
400 Trents Road	Jonelle & Richard Bowman	2.02	0	2.02	0	2.02
414 Trents Road	Andrew & Dawn Eagle	2.02	0	2.02	0	2.02
Total		**12.69**	**0**	**12.69**	**0**	**12.69**

9.54 I have included the additional blocks in the cumulative losses of versatile soils in both the district and the region. This additional analysis is presented in **Attachment 5**. In summary:

9.55 The total reduction in LUC1-3 class soils in the district when these additional blocks are included is 0.365% which is a small increase from the 0.356% "loss" without these blocks.

9.56 The total reduction in LUC1-3 class soils in the region when these additional blocks are included is 0.061% which is a small increase from the 0.060% "loss" without these blocks.

9.57 It is, therefore, my conclusion that including these blocks in the plan change will not result in any significant additional loss in versatile soils.

RESPONSE TO SUBMITTERS RAISING VERSATILE SOILS ISSUES

9.58 I have reviewed the various submissions in particular the submission from Mr David Somerfield of 383 Trents Road who is concerned about the potential loss of productive land. In response to Mr Somerfield's submission:

(a) In my evidence I have discussed in detail that the designation of the land as LUC 2 and LUC 3 does not necessarily translate to high productivity. There are several factors that come into play that hinder productivity in LUC2 and LUC3 soils. I have summarised these in Paragraphs 10.2-10.3 and more detail in the body of my brief of evidence.

(b) The type of production being undertaken at 383 Trents Road can be carried out under other LUC Class soils given the use of glass houses. Therefore, the change of use of the PC68 area will not necessarily preclude the kinds of activities referred into the submission.

(c) The submission makes reference to Objective 3 of the NPS-HPL which requires protection of highly productive land. However, the NPS-HPL also seeks to avoid being too prescriptive and allows for site specific factors to be taken into consideration as I have discussed in Paragraph 6.16. In my evidence I

have outlined what these factors are and how when considered lead me to the conclusion that there are constraints to that make it difficult for the site to be fully productive.

10 CONCLUSION

10.1 The proposed Plan Change 68 will be in an area that has 36.13 ha of LUC Class 2 soils and 7.57 ha of LUC Class 3 soils. The LUC Class 2 soils will increase to 48.82 ha if the proposed additional areas are included.

10.2 It is my opinion that use of LUC Classes in defining soil versatility is only a first step and where site specific information is available this should be taken into account. This is confirmed by:

(a) The proposed NPS-HPL which recognises that the use of LUC classes is only as a starting point pending the availability of site-specific information when councils get to it.

(b) A High Court decision in *Canterbury Regional Council v Selwyn District Council* (Paragraph 6.12 above) which recommended consideration of a wide range of factors beyond the LUC classification.

10.3 On consideration of site-specific factors, it is my opinion that the effect of the proposed Plan Change 68 on the district and regional agricultural productivity potential is insignificant. This is because:

(a) The soil moisture deficits are significant. There is no available water to meet the crop water requirements. Irrigation consents would need to be sought at a cost of almost $1M.

(b) Statutory planning rules affect the use of nitrogen fertilisers to enhance productivity. Yield reductions as high as 50% are possible depending on the nitrogen reductions.

(c) There are reverse sensitivity issues arising from the presence of existing surrounding subdivisions and fragmentation of land.

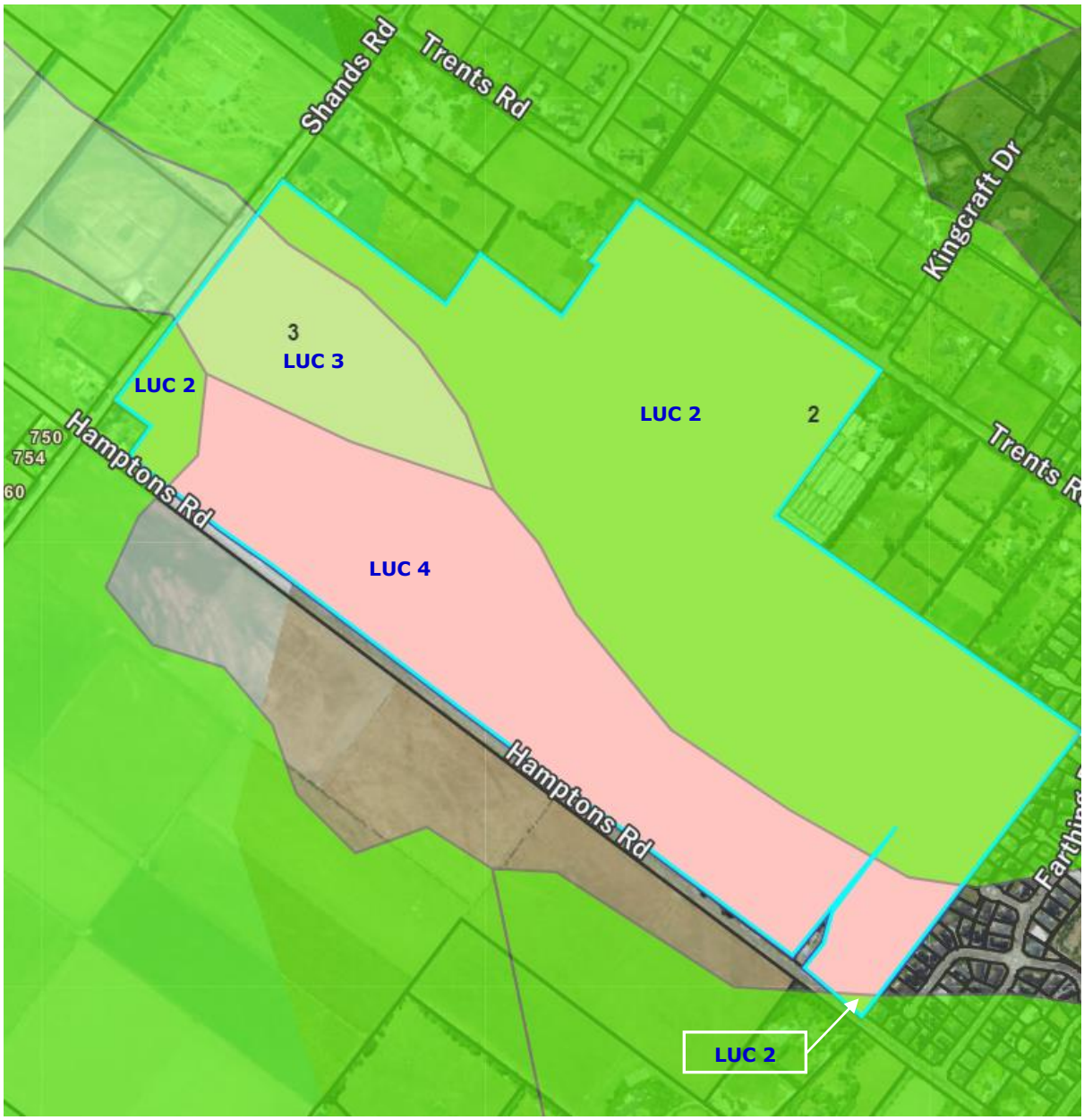
(d) For the reasons set out above, I do not consider that there are any matters relating to the versatility or productivity of the PC68 area which should preclude the approval of this plan change.

(e) Furthermore, the net changes in LUC1-3 soils within the district and the regional resulting from the proposed plan change is insignificant.

Victor Mthamo

08 March 2022

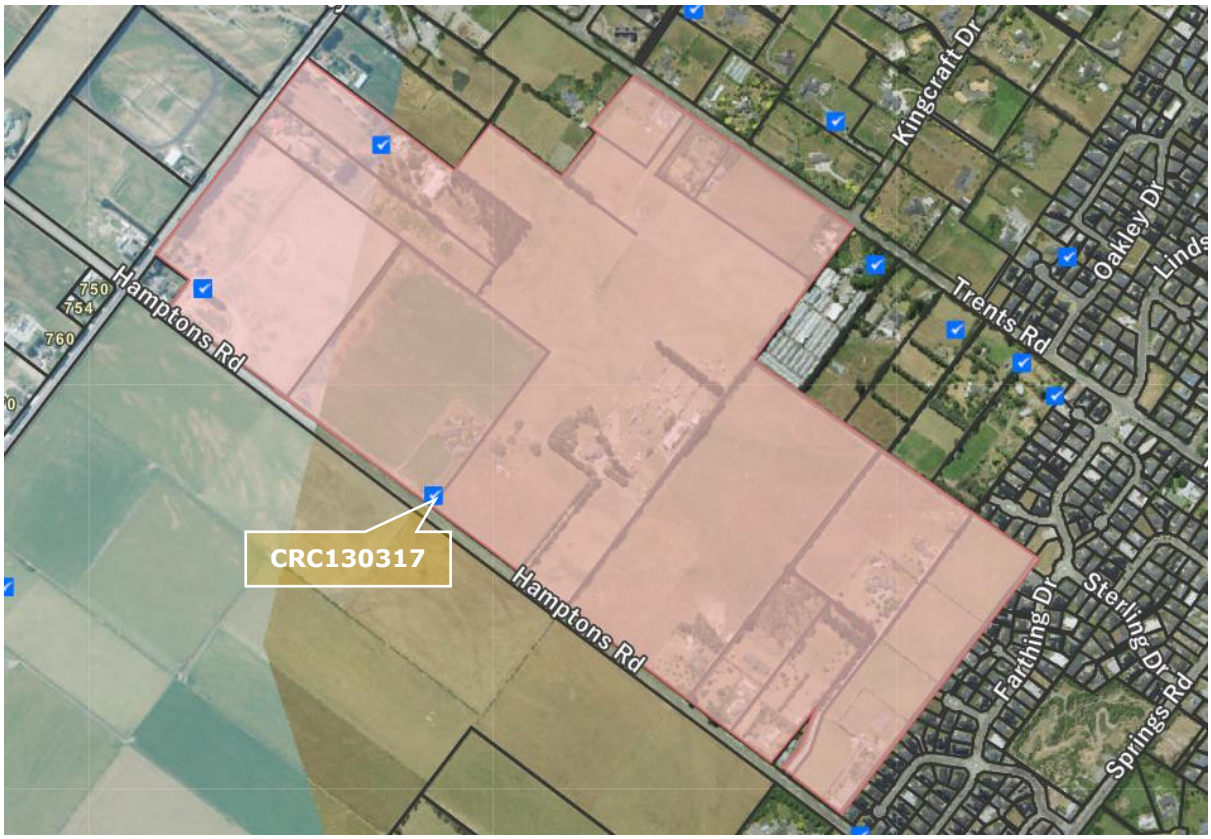
ATTACHMENT 1 – PC68 LUC CLASSES



ATTACHMENT 2 – IRRICALC ANNUAL VOLUME ESTIMATES

Farm Details		Plant Available Water Details			Irrigation Requirements				
Description		PAW(mm)	Indicative Likelihood	Area (hectares)		Per Hectare		Total Area	
Latitude	-43.583	140	35.2	67.5	System Capacity	0.61	(l/s/ha)	41.18	(l/s)
Longitude	172.493			0	System Capacity	5.3	(mm/day)		
Council	Canterbury			0	Daily Volume	53	(m^3/ha)	3,578	(m^3)
Climate Site ID	P130081			0	7 Day Volume		(m^3/ha)		(m^3)
Distance to Climate Site (km)	1.7			0	28 Day Volume		(m^3/ha)		(m^3)
Rainfall (mm)	630		Total area =	67.5	90% ile Annual Volume	6,993	(m^3/ha)	472,028	(m^3)

ATTACHMENT 3 – CONSENTED GROUNDWATER TAKES



ATTACHMENT 4 – QUANTIFICATION OF CHANGES IN VERSATILE SOILS IN SELWYN DISTRICT

Plan Change	LUC 1	LUC 2	LUC 3	Total	Comments
PC49	2.3	5.8		8.1	
PC50					Fonterra Darfield - no new loss of land
PC54			31.3	31.3	
PC59			19.5	19.5	Total PC59 area = 31.4 ha but 11.9 ha developed prior to 2018.
PC60			17.9	17.9	
PC61			30.76	30.76	Industrial
PC62		42.9	17.1	60	
PC63			60.6	60.6	
PC64	0	0	0	0	All in LUC Class 4
PC66		27.28		27.28	Commercial
PC67		13.7	19.7	33.4	
PC68		36.13	7.57	43.7	23.8 ha in LUC4. No LUC1
Roydon Quarry		99.7	68.2	167.9	Fulton Hogan. 2.9 ha is in LUC4
Total	**2.3**	**225.51**	**272.63**	**500.44**	

District Losses in LUC1-3 Class Soils

LUC Class	Area	PC48-80	Net HPL after PCs	%age HPL Losses
LUC Class 1	6,522	2.30	6,519.70	0.035%
LUC Class 2	46,111	225.51	45,885.49	0.489%
LUC Class 3	87,927	272.63	87,654.37	0.310%
Total	**140,560**	**500.44**	**140,059.56**	**0.356%**

Regional Losses in LUC1-3 Class Soils

LUC Class	Area	PC48-80	Net HPL after PCs	%age HPL Losses
LUC Class 1	23,200	2.30	23,197.70	0.010%
LUC Class 2	270,500	225.51	270,274.49	0.083%
LUC Class 3	543,000	272.63	542,727.37	0.050%

Total	**836,700**	**500.44**	**836,199.56**	**0.060%**

ATTACHMENT 5 – QUANTIFICATION OF CHANGES IN VERSATILE SOILS IN SELWYN DISTRICT WHEN THE PROPOSED ADDITIONAL AREAS ARE INCLUDED

Plan Change	LUC 1	LUC 2	LUC 3	Total	Comments
PC49	2.3	5.8		8.1	
PC50					Fonterra Darfield - no new loss of land
PC54			31.3	31.3	
PC59			19.5	19.5	Total PC59 area = 31.4 ha but 11.9 ha developed prior to 2018.
PC60			17.9	17.9	
PC61			30.76	30.76	Industrial
PC62		42.9	17.1	60	
PC63			60.6	60.6	
PC64	0	0	0	0	All in LUC Class 4
PC66		27.28		27.28	Commercial
PC67		13.7	19.7	33.4	
PC68		36.13	7.57	43.7	23.8 ha in LUC4. No LUC1
Roydon Quarry		99.7	68.2	167.9	Fulton Hogan. 2.9 ha is in LUC4
701 Shands Road		2.43		2.43	Simon Shamy
382 Trents Road		2.18		2.18	David Somerfield
386 Trents Road		2.02		2.02	Mark & Joanne Hamlyn
398 Trents Road		2.02		2.02	Mark & Joanne Hamlyn
400 Trents Road		2.02		2.02	Jonelle and Richard Bowman
414 Trents Road		2.02		2.02	Andrew & Dawn Eagle
Total	**2.3**	**238.2**	**272.63**	**513.13**	

District Losses in LUC1-3 Class Soils

LUC Class	Area	PC48-80	Net HPL after PCs	%age HPL Losses
LUC Class 1	6,522	2.30	6,519.70	0.035%
LUC Class 2	46,111	238.20	45,872.80	0.517%
LUC Class 3	87,927	272.63	87,654.37	0.310%
Total	**140,560**	**513.13**	**140,046.87**	**0.365%**

Regional Losses in LUC1-3 Class Soils

LUC Class	Area	PC48-80	Net HPL after PCs	%age HPL Losses
LUC Class 1	23,200	2.30	23,197.70	0.010%
LUC Class 2	270,500	238.20	270,261.80	0.088%

LUC Class 3	543,000	272.63	542,727.37	0.050%
Total	**836,700**	**513.13**	**836,186.87**	**0.061%**