



LAND CAPABILITY FOR AGRICULTURE (LCA) ASSESSMENT

**206 Narvaez Bay Road, Saturna Island, BC
[PIDs 004-521-889 and 015-692-205]**

PREPARED FOR:

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June 27, 2023

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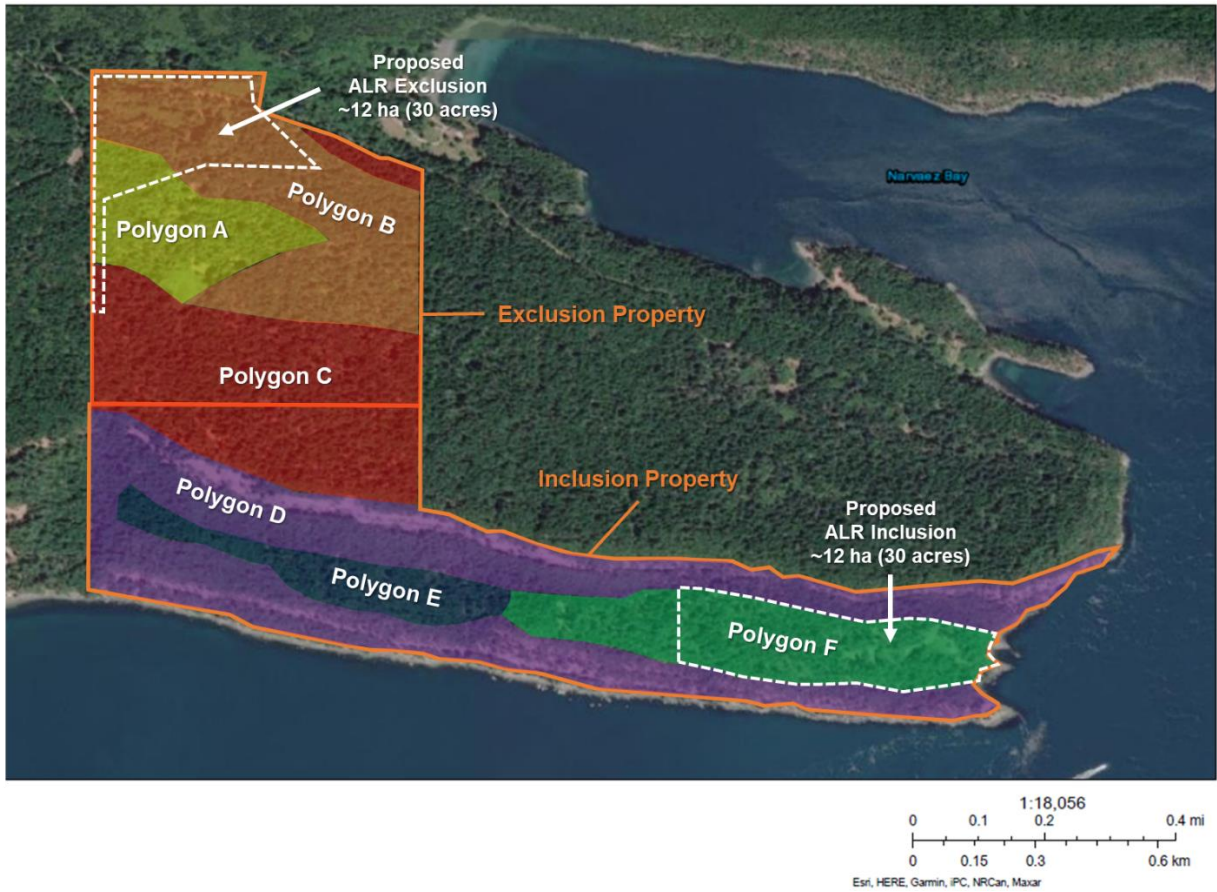
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Executive Summary

On March 22 and 23, 2023, Madrone Environmental Services Ltd ('Madrone'), conducted a Land Capability for Agriculture (LCA) assessment for two parcels located on Saturna Island, BC, owned by Ronald H. Hall ('the Client'). Madrone understands that this LCA Assessment is intended to be submitted by the Client as part of an Agricultural Land Reserve (ALR) exclusion and inclusion application for review and consideration by Islands Trust and the Agricultural Land Commission (ALC). One parcel is located at 206 Narvaez Bay Road and contains the provincial parcel identification (PID) 004-521-889 (referred to as 'the Exclusion Property' as part of this parcel is being proposed for exclusion from the ALR by the Client). The other parcel has no address but contains the PID 015-692-205 (hereafter referred to as 'the Inclusion Property' as part of this parcel is being proposed for inclusion into the ALR by the Client). No areas within the Inclusion Property are currently within the ALR.

Based on ten detailed soil pits (which meets requirements under *ALC Policy P-10* "CRITERIA FOR AGRICULTURAL CAPABILITY ASSESSMENTS) and thirteen scratch pits, assessment of local landforms, drainage, and vegetation, and interpretation of satellite imagery, contour mapping, and slope mapping derived from LIDAR imagery, Madrone has delineated and mapped six polygons on the Properties each with a different soil type and LCA rating (shown in the figure and described in the table on the next page of this *Executive Summary*).

Based on the collected information from our field assessment and background review, it is the objective, professional opinion of Madrone that the ALR exclusion and inclusion proposal by the Client (Figure 8; *Appendix A*) increases the overall capability of agriculture on Saturna Island should the proposal be accepted by Islands Trust and the ALC. The proposal, which would result in a 'no net loss' of land in the ALR, would improve ALR by at least two LCA classes (i.e., an improvement from Class 5 to 6 land in the Exclusion Property to Class 3 in the Inclusion Property) over an area of ~12.0 ha (30 acres). As such, the proposal would accommodate and encourage long-term farming by the landowner (i.e., the Client) by substantially broadening his options for agricultural activities. Moreover, the proposed ALR exclusion area will not, in Madrone's professional opinion, affect the integrity and continuity of the land base of the ALR in the Exclusion Property.



Soil polygon (~ha/% of total assessment area)	Texture and coarse fragment content* in upper 25 cm	Distinguishing characteristics	Unimproved LCA rating**	Best improved LCA rating ***
Polygon A 10.8 ha (26.7 acres); ~18.2% of the Exclusion Property	Variable; between 10 to 20% coarse gravels and cobbles	11 to 15% complex slopes; near surface bedrock (25 to 50 cm depth)	6A 5R 4T 3P	2A 5R 4T 3P
Polygon B 28.6 ha (70.7 acres); ~48.3% of the Exclusion Property	Variable; between 10 to 20% coarse gravels and cobbles	16 to 30% complex slopes; near surface bedrock (25 to 50 cm depth)	6A 5RT 3P	2A 5RT 3P
Polygon C 19.8 ha (48.9 acres); ~33.5% of the Exclusion Property ~11.8 ha (29.2 acres); 13.0% of the Inclusion Property	Between 21 to 40% coarse gravels and cobbles; colluvium	31 to 60% complex slopes; near surface bedrock (<25 cm depth)	6ART 4P	2A 6RT 4P
Polygon D 55.7 ha (137.6 acres); ~61.4% of the Inclusion Property	Between 21 to 40% coarse gravels and cobbles; colluvium	Steep bedrock cliffs	7RT 4P	7RT 4P
Polygon E 6.5 ha (16.1 acres); ~7.2% of the Inclusion Property	Variable; between 10 to 20% coarse gravels and cobbles	16 to 30% complex slopes	6A 5T 3P	2A 5T 3P
Polygon F 16.7 ha (41.3 acres); ~18.4% of the Inclusion Property	Variable; between 10 to 20% coarse gravels and cobbles	11 to 15% simple slopes; occasionally areas of poor drainage	6A 3PT 2W	3PT 2W

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LAND CAPABILITY FOR AGRICULTURE (LCA) ASSESSMENT

206 Narvaez Bay Road, Saturna Island, BC [PIDs 004-521-889 and 015-692-205]

1 Introduction

Ronald Hall ('the Client') has retained Madrone Environmental Services Ltd. ('Madrone') to conduct a Land Capability for Agriculture (LCA) Assessment for two parcels located on Saturna Island, BC. Madrone understands that this LCA Assessment is intended to be submitted by the Client as part of an Agricultural Land Reserve (ALR) exclusion and inclusion applications for review and consideration by Islands Trust and the Agricultural Land Commission (ALC).

One parcel is located at 206 Narvaez Bay Road and contains the provincial parcel identification (PID) 004-521-889 (hereafter referred to as 'the Exclusion Property' as part of this parcel is being proposed for exclusion from the ALR by the Client). The Exclusion Property is partially within the provincial (ALR), and as such, is subject to the *ALC Act* and *BC Regulation 171/2002 (Agricultural Land Reserve Use, Subdivision and Procedure Regulation)*, in addition to the bylaws of the Island Trust. The other parcel has no address but contains the PID 015-692-205 (hereafter referred to as 'the Inclusion Property' as part of this parcel is being proposed for inclusion into the ALR by the Client). No areas within the Inclusion Property are currently within the ALR. For the purpose of this report, the Exclusion Property and Inclusion Property are collectively referred to as 'the Properties' where appropriate. The Client owns both the Exclusion Property and the Inclusion Property, and as such, he is also referred to as 'the Landowner' in this LCA Assessment report.

This LCA Assessment report, signed and stamped by a Professional Agrologist, evaluates the agricultural suitability of the land that is proposed to be excluded and included from the ALR. Results and conclusions of this LCA Assessment have been prepared for both the Client to assist with proposal planning, and for regulatory offices who will be reviewing the Client's applications. Madrone understands that the Client

intends to submit a proposal with the aim of “no net loss” within the ALC (i.e., the area(s) the Client is proposing to exclude from the ALR will be equal to the area he is proposing to include into the ALR).

Daniel Lamhonwah, PhD, MES, P.Ag of Madrone, will act as the Qualified Professional on record for the ALR exclusion and inclusion applications the Client intends to make to Islands Trust and the ALC. Dr. Lamhonwah is the Agrology Team Lead at Madrone Environmental Services Ltd. where he has been practicing as an agrologist for 5 years following his work as a doctoral researcher at Queen’s University where he focused on climate change impacts to watershed chemistry and water availability. He is a Professional Agrologist (P.Ag) in good standing with the British Columbia Institute of Agrologists (BCIA), and has identified practices areas in arable land evaluation, conservation planning and management, soil and terrain classification, mapping and land evaluation, and irrigation planning and management. He has technical lead and project management experience in agricultural land capability assessments, farm plan development, soil surveying, water quality testing, irrigation and drainage planning, soil importation planning and monitoring, and agricultural land reclamation planning.

2 Background Information

2.1 Location and Property Overview

The Properties are situated adjacent to one another and located on the southeast side of Saturna Island, BC, by Narvaez Bay. Civic information about the Properties provided by Islands Trust¹ is presented in **Table 1**. A map showing the boundaries of the Properties and visualization of the surrounding area is presented in **Figure 1** (*Appendix A*). According to mapping provided by the ALC², a portion of the Exclusion Property is within the ALR as shown in **Figure 1** (*Appendix A*).

Based on recent satellite imagery provided by Google Earth Pro³, both parcels appear to be densely forested with no development, other than non-paved access roads observed. Some meadow areas with less dense tree cover can be seen in the central portion of the Exclusion Property and on the east side of the Inclusion Property. Exposed bedrock and cliffs are also seen particularly along the northern and southern parcel boundaries of the Inclusion Property. Main access to the Exclusion Property via Narvaez Bay Road at the northwestern edge of the parcel; this public road connected to private logging roads that

¹ Islands Trust (2021). Mapit Web Map. <http://mapit.islandstrust.bc.ca/>. Accessed April 23, 2023.

² ALR Property and Map Finder (2021). <http://governmentofbc.maps.arcgis.com/apps/webappviewer/index.html?id=87dee902dc5e443fbff8ca7b43ub407>. Accessed January 24, 2023.

³ Google (2023). Google Earth Pro. Imagery dated 7/10/2022. <https://www.google.com/earth>. Accessed April 23, 2023.

allow vehicular access to the interior of the Exclusion Property. The Inclusion Property does not appear to be accessible via any public roads and only accessible by travelling through the Exclusion Property.

TABLE 1. CIVIC INFORMATION FOR THE PROPERTIES PROVIDED BY ISLANDS TRUST

	Exclusion Property	Inclusion Property
PID	004-521-889	015-692-205
Legal Description	NORTH EAST 1/4 OF SECTION 2, SATURNA ISLAND, COWICHAN DISTRICT, EXCEPT PART IN PLAN 31309	LOT 1, SECTIONS 1 AND 2, SATURNA ISLAND, COWICHAN DISTRICT, PLAN 49833
Zoning	RG	FG
Zoning Description	Rural General	Forest General
OCP land use	Rural	Resource
Within ALR?	Yes; Partial	No
Total area	59.2 hectares (146.3 acres)	90.7 hectares (224.2 acres)

2.2 Adjacent Land Use and Zoning

Surrounding land uses are summarized in **Table 2** and were corroborated using satellite imagery and zoning maps from the Islands Trust⁴. Note that only one of the parcels (PID 000-519-618) adjacent to the Properties is within the ALR, but only partially. Current agricultural activity on this parcel (PID 000-519-618) is unknown by Madrone.

2.3 Climate

The nearest Environment Canada weather station with complete historical weather data⁵ (1981 to 2010 Climate Normals; 30-year average) and available degree days and frost free days information is Mayne Island (ID 1014931; 48°50'41.000" N, 123°19'13.000" W), located ~17 km northwest of the Properties at an elevation of 28.0 m above sea level (masl). Weather station reports for this station are summarized below in **Table 3**.

Based on the collected information in **Table 3**, the Properties have a Climate Capability Class of 1c⁶. Climatic Capability Class is a shorthand ranking of specific limitations denoted by letters and preceded

⁴ Islands Trust (2021). Mapit Web Map. <http://mapit.islandstrust.bc.ca/>. Accessed April 23, 2023.

⁵ Government of Canada (2022). Canadian Climate Normals 1981-2010 Station Data. Maye Island (ID 1014931). [Canadian Climate Normals 1981-2010 Station Data - Climate - Environment and Climate Change Canada \(weather.gc.ca\)](https://climate.weather.gc.ca/climate_normals/1981-2010_station_data.html). Accessed April 23, 2023.

⁶ BC Ministry of Environment (1981). Climate Capability Classification for Agriculture in British Columbia. https://www.alc.gov.bc.ca/assets/alc/assets/library/agricultural-capability/climatic_capability_for_agriculture_in_bc_1981.pdf. Accessed April 23, 2023.

by numbers between the ideal (ranking of 1) and untenable (ranking of 7) indicating the severity of the limitation.

- Class 1c definition: Frost free period greater than 150 days; effective growing degree days (EGDD) are greater than 825, and the growing degree days accumulated above 5°C ranges between 2060 and 2225.
- Moisture class: needs to be determined by taking soil samples and evaluating the ratio of clay, silt, and sand (soil texture).
- According to this classification, the general area can grow a wide variety of fruits, berries, grapes, vegetables, nuts, cereal grains, and forage crops.

TABLE 2. ADJACENT LAND USES AND ZONING.

Adjacent Lot PID	Adjacent Lot Civic Address	Direction from the Exclusion Property and Inclusion Property	Area	OCP Land Use	Actual Use	Zoning	ALR?
009-628-606	None	North; north	65.36 ha (161.50 acres)	National Park Reserve	Forest	NP – National Park	No
015-812-821	None	North; north	2.27 ha (5.60 acres)	National Park Reserve, Rural	Forest	NP – National Park	No
015-812-839	None	Northeast; north	5.58 ha (13.79 acres)	National Park Reserve, Rural	Forest	RG – Rural General	No
008-949-174	None	East; north	36.59 ha (90.42 acres)	National Park Reserve, Rural	Forest	NP – National Park	No
008-949-221	None	East; north	30.83 ha (76.17 acres)	National Park Reserve, Rural	Forest	NP – National Park	No
009-628-355	None	East; northeast	58.85 ha (145.42 acres)	National Park Reserve, Rural	Forest	NP – National Park	No
000-519-618	None	Southwest; west	25.52 ha (63.07 acres)	Farmland, Forest Land, National Park Reserve, Rural	Unknown	RG – Rural General	Partially
029-459-761	None	Southwest; west	15.07 ha (37.24 acres)	Forest Land, National Park Reserve, Rural	Forest	W – Watershed	No
000-519-600	202 Narvaez Bay Road	West; northwest	64.76 ha (160.03 acres)	Heritage Forest, National Park Reserve, Rural, Watershed	Forest	W – Watershed	No

TABLE 3. 1981 TO 2010 CLIMATE NORMS RECORDED AT MAYNE ISLAND (ID 1014931)

Parameter	1981 to 2010 Climate Normals
Annual precipitation (mm)	812.8
Seasonal precipitation (May to September inclusive, mm)	153.9
Frost Free Period (FFP, average days)	229
Growing Degree Days (GDD, base temperature >5 °C)	2061.8
Growing Degree Days (GDD, base temperature >10 °C)	837
Effective Growing Degree Days (EGDD, base temperature >5 °C)	1600 to 1800 ⁷
Daily yearly average temperature (°C)	10.2
Days of precipitation (days in the year with >=5 mm rain)	53.6

2.4 Landforms and Geology

Based on contour elevation mapping (2 m interval) provided by the Islands Trust⁸, elevations on the Exclusion Property range from ~120 to 221 m above sea level (asl) and ~0 to 269 masl on the Inclusion Property. Madrone's interpretation of contour mapping and satellite imagery indicates that the Properties are characterized by highly complex topography, with slopes ranging from gentle (4 to 15°; 6 to 26% gradient) to steep (>35°; >70% gradient)⁹. There are localized areas on the eastern side of the Inclusion Property that appear to contain plains (0 to 3°; 0 to 5% gradient).

Geological bedrock mapping indicates that the Properties are situated overtop Nanaimo Group undivided sedimentary rocks which is characterized by Boulder, cobble and pebble conglomerate, coarse to fine sandstone, siltstone, shale, coal (Santonian to Maastrichtian).

2.5 Mapped Hydrology

Mapping from the Islands Trust⁸ shows a watercourse flowing from north to east on the west side of the Inclusion Property in a gullied area. No water bodies (e.g., lakes or ponds) or wetland areas are mapped by Islands Trust as being on the Properties. The direction of surface and subsurface runoff is inferred by Madrone to be unidirectional, flowing from areas of topographic high to the either Narvaez Bay to the north or Boundary Pass to the south.

⁷ General range of EGDD (baseline, 1971 to 2000) as reported by Agriculture and Agri-Food Canada (2018). Effective Growing Degree Days. https://publications.gc.ca/collections/collection_2018/aac-aafc/A59-53-2010-eng.pdf. Accessed April 23, 2023.

⁸ Islands Trust (2021). Mapit Web Map. <htSCR://mapit.islandstrust.bc.ca/>. Accessed April 23, 2023.

⁹ Howes and Kenk (1997). Terrain Classification System for British Columbia. Version 2. MOE Manual 10. https://www.for.gov.bc.ca/hfd/library/ffip/Howes_DE1997.pdf. Accessed April 23, 2023.

2.6 Provincial Soils Mapping

Based on provincial mapping (1:20,000 scale), there are five soil associations mapped on the Properties, with the predominant association being the Saturna soil series. The remaining four soil series on the Properties are Qualicum, Beddis, Tolmie and Bellhouse. **Figure 2** (*Appendix A*) visualizes the mapped soil associations on the Properties while **Table 4** details the physical characteristics¹⁰ of each soil association.

TABLE 4. CHARACTERISTICS OF SOIL ASSOCIATIONS PROVINCIALY MAPPED ON THE PROPERTIES.

Soil association	Classification	Defining Characteristics
Saturna	<i>Orthic Dystric Brunisol to Orthic Humo-ferric Podzol</i>	Sandy loam; well drained; 20 to 50% coarse fragment content
Qualicum	<i>Orthic Dystric Brunisol</i>	Loamy sand to sandy loam; rapidly to moderately well drained; 20 to 50% coarse fragment content
Beddis	<i>Orthic Dystric Brunisol</i>	Sandy loam; Moderately well to well drained; <20% coarse fragment content
Tolmie	<i>Orthic Humic Gleysol</i>	Loam or silty clay; poorly drained; no coarse fragment content
Bellhouse	<i>Orthic Sombric Brunisol</i>	Sandy loam; well drained; 20 to 50% coarse fragment content

2.7 Provincial Land Capability for Agriculture

The agricultural capability provincially mapped¹¹ for the Properties is summarized below in **Table 5** and visualized in **Figure 3** (*Appendix A*). The mapped agricultural capability polygons agricultural capability delineated by the province for the Properties loosely conform, in terms of boundaries and locations, to the provincially mapped soil associations (*2.6 Provincial Soils Mapping*). As mapped by the province, the Exclusion Property is characterized by an agricultural capability rating ranging from Class 4 to 6, with the dominant agricultural limitations being stoniness (P), topography (T), bedrock (R) and soil moisture (M). Similarly, as mapped by the province, the Inclusion Property is characterized by an agricultural capability rating ranging from Class 4 to 7, with the dominant agricultural limitations being topography (T), bedrock (R) and soil moisture (M).

¹⁰ Agriculture Canada (1988). Soils of the Gulf Islands of British Columbia Volume 2 Soils of North Pender, South Pender, Prevost, Mayne, Saturna, and lesser islands. Report No. 43 British Columbia Soil Survey. https://www.env.gov.bc.ca/esd/distdata/ecosystems/Soils_Reports/bc43-2_report.pdf. Accessed April 23, 2023.

¹¹ Province of British Columbia (2023). BC Soil Information Finder Tool (BC SIFT). <https://www2.gov.bc.ca/gov/content/environment/air-land-water/land/soil/soil-information-finder>. Accessed April 23, 2023.

TABLE 5. PROVINCIALLY MAPPED AGRICULTURAL CAPABILITY CLASSES ON THE PROPERTIES.

Geographic distribution	Mapped Surface Area	Class	Limitations
Northern 3/4 of the Exclusion Property	~49.0 ha (121.1 acres) ; 83% of the total surface area on the Exclusion Property	CC*: 5:5PT~3:4T~2:6TR IC**: 5:5PT~3:3T~2:6TR	Stoniness (P), Topography (T), Bedrock (R)
Southern 1/4 of the Exclusion Property and northern 1/4 of the Inclusion Property	~10.2 ha (25.2 acres); 17% of the total surface area on the Exclusion Property	CC*: 7:6TR~3:5MT IC**: 7:6TR~3:3T	Topography (T), Bedrock (R), Soil moisture (M)
Central area of the Inclusion Property extending from the eastern parcel boundary to nearly the western boundary	~33.5 ha (82.8 acres); 37% of the total surface area on the Inclusion Property	CC*: 5MT IC**: 4T	Topography (T), Soil moisture (M),
Areas of the Inclusion Property proximal to exposed bedrock and cliffs observed on satellite imagery	~57.2 ha (141.3 acres); 63% of the total surface area on the Inclusion Property	CC*: 8:6TR~2:7RT	Topography (T), Bedrock (R)

* Unimproved class rating

** Improved class rating

Note that the above information is from soils mapping by the provincial government completed over a large area (specifically the mapping detailed in 2.6 *Provincial Soils Mapping*) and was likely not field verified. Field investigations that involve detailed soil descriptions (such as LCAs informed by evidence gathered from a site assessment) should always be more accurate than generalized mapping products. The broad interpretation of soils and agricultural capability as recorded on the 1:20,000 maps do not take precedence over the site-specific assessment in this report.

3 Field Investigation

Alex Kramer, Articling Agrologist of Madrone, visited the Properties for the LCA assessment on March 22 and 23, 2023. Weather conditions at the time of assessment were a mix of sun and clouds with an air surface temperature of 6°C. No precipitation was recorded on Saturna Island in the 24 hours prior to Madrone's assessment. Mr. Kramer was accompanied by the Client during the duration of the assessment who assisted with his navigation on the forest roads. Accessibility for Madrone's ground assessment of the Properties was limited for areas containing steep slopes and areas that were too wet to access due to poor drainage. Where assessment of the Properties was not possible either by foot or machine due to topography or drainage limitations, available satellite imagery and a slope map derived by LiDAR imagery produced by Madrone (**Figure 4**; *Appendix A*) was used to inform understanding of site conditions.

The LCA assessment of the Properties included the detailed characterization of soils from ten soil pits (SP1 to SP 10; **Figure 5**; *Appendix A*), excavated by machine, based on accessibility. The LCA assessment, including the density and depths of soil pits, and observation of soil characteristics, meets the requirements under *ALC Policy P-10 CRITERIA FOR AGRICULTURAL CAPABILITY ASSESSMENTS*¹². Moreover, 13 scratch pits (SCR1 to SCR13 shown in **Figure 5**; *Appendix A*) were dug by shovel to a depth of 30 to 40 cm (or to bedrock) to further characterize soil properties for this LCA. The locations of the detailed soil pits and scratch pits (i.e., the sampling strategy) were chosen based on provincial soil mapping, satellite imagery, contour maps, on-site assessment of topography and surface drainage, current and planned land-use by the Client, and site accessibility.

Note that Madrone's LCA Assessment focused on the proposed inclusion and exclusion areas by the Client (**Figure 6**; *Appendix A*), however, was completed in a manner to provide Islands Trust and the ALC a sense of overall agricultural capability of the Properties for the purpose of informed decision making.

Photos taken by Madrone during the field investigation are presented in *Appendix C*.

3.1 General Site Characteristics

The current land-use and terrain on the Properties conform to the available satellite imagery and contour mapping provided by Islands Trust. The land cover is dominated by dense tree cover comprising mostly of second-growth Douglas fir and grand fir, with occasional stands of alder. Forest undergrowth included low-lying shrubs and grasses such as salal and ferns. The topography of the Properties is highly complex

¹² Agricultural Land Commission (2017). ALC Policy P-10 CRITERIA FOR AGRICULTURAL CAPABILITY ASSESSMENTS. https://www.alc.gov.bc.ca/assets/alc/assets/legislation-and-regulation/policies/alc_-_policy_p-10_-_criteria_for_agricultural_capability_assessments.pdf. Accessed April 29, 2023.

and variable, with moderately steep to steep sloped ridges observed throughout the Exclusion Property bordered by steep sloped bedrock cliffs towards the southern parcel boundary.

On the Inclusion Property, steep sloped bedrock cliffs were observed along the northern, western, and southern parcel boundaries. There are occurrences of more gently slope areas on the northwestern side of the Exclusion Property and on the eastern side of the Inclusion Property where alder meadows were observed. No flowing surface water or water bodies were observed by Madrone, however there were areas in the Inclusion Property that contained localized wetlands as determined by the identification of poorly drained, organic matter in the upper soil horizon. Madrone's field assessment confirms that there is no development on the Properties (other than unpaved forest roads) nor are there any agricultural activities currently taking place.

3.2 Climate Capability and Soil Moisture Balance

Site-specific climatic capability for agriculture was determined using field observations from two of the ten soil test pits (one in the Exclusion Property and one in the Inclusion Property) as representative of the climatic influence on soils distributed throughout the Properties (**Figure 4**; *Appendix A*).

Estimates for coarse fragment content and soil moisture class were used in conjunction with regional climate data to calculate the available water storage capacity (AWSC) and soil moisture deficit (SMD) values for the upper 50 cm of each of these soil profiles. The results were used to determine site-specific climatic and soil capability ratings for agriculture in the Properties which have been summarized in **Table 6**. A description of agricultural/climatic capability classifications are found in *Appendix D*.

3.3 Revised Land Capability for Agriculture

The revised LCA for the Properties was determined by information collected from all ten soil test pits and associated scratch pits (full descriptions in *Appendix B*), and the assessment of local landforms, drainage, and vegetation. Where access to the Properties was not possible for physical assessment (e.g., steep sloped cliffs, poor drainage), Madrone used satellite imagery, available contour mapping, and slope mapping derived from LIDAR imagery (**Figure 4**; *Appendix A*) were used to inform our professional opinion on LCA classes on the Properties.

In total, *six LCA polygons have been delineated for the Properties (Figure 7; Appendix A)* with each polygon being assigned an unimproved and improved LCA rating (**Table 7**). These six LCA polygons do not conform to what has been previously mapped in the area by the province, particularly in the Inclusion Property (**Figure 3**; *Appendix A*). Note that all polygons contain a Class 6 aridity (A) limitation which can be improved to Class 2A with proper irrigation management. In the sections below, other agricultural

limitations specific to each polygon are discussed. LCA Classes and limitations are defined in the guidance document *Land Capability Classification for Agriculture in BC*¹³.

3.3.1 Exclusion Property

The Exclusion Property contains three delineated LCA polygons based on Madrone's assessment. The smallest of these polygons, Polygon A, covers an area of ~10.8 ha (26.7 acres) which represents ~18.2% of the Exclusion Property. Polygon A is characterized by a dominant Class 5 depth to bedrock (R) limitation due to the near surface bedrock observed at 25 to 50 cm depth by Madrone. Polygon A also has a less severe Class 4 topography (T) limitation due to the 11 to 15% complex slopes, and a Class 3 stoniness (P) limitation due to the 10 to 20% coarse fragment content (coarse gravels and cobbles). None of the abovementioned limitations can be practically improved. ***As such, the most improved LCA class for Polygon A is Class 5R.***

The largest polygon in the Exclusion Property is Polygon B and covers an area of ~28.6 ha (70.7 acres) which represents ~48.3% of the Exclusion Property. Polygon B is characterized by a dominant Class 5 depth to bedrock (R) limitation due to the near surface bedrock observed at 25 to 50 cm depth by Madrone and a Class 5 topography (T) limitation due to the 16 to 30% complex slopes. Polygon B has a less severe Class 3 stoniness (P) limitation due to the 10 to 20% coarse fragment content (coarse gravels and cobbles). None of the abovementioned limitations can be practically improved. ***As such, the most improved LCA class for Polygon B is Class 5RT.***

The last polygon in the Exclusion Property is Polygon C and covers an area of ~19.8 ha (48.9 acres) which represents ~33.5% of the Exclusion Property. Polygon C is characterized by a dominant Class 6 depth to bedrock (R) limitation due to the near surface bedrock observed at <25 cm depth by Madrone and a Class 6 topography (T) limitation due to the 31 to 60% complex slopes. Polygon C has a less severe Class 4 stoniness (P) limitation due to the 21 to 40% coarse fragment content (coarse gravels and cobbles). None of the abovementioned limitations can be practically improved. ***As such, the most improved LCA class for Polygon C is Class 6RT.***

3.3.2 Inclusion Property

Polygon C, as described above (3.3.1 Exclusion Property) is also located on the Inclusion Property and covers an area of ~11.8 ha (29.2 acres) which represents ~13.0% of the Inclusion Property. The description of Polygon C on the Inclusion Property is identical to its description in the Exclusion Property. ***As such, the most improved LCA class for Polygon C is Class 6RT.***

¹³ BC Ministry of Environment and Ministry of Agriculture and Food (1983). Land Capability Classification for Agriculture in British Columbia MOE Manual 1. https://www.alc.gov.bc.ca/assets/alc/assets/about-the-alc/alr-and-maps/agricultural-land/land_capability_classification_for_agriculture_in_bc.pdf. Accessed April 29, 2023.

The largest polygon in the Inclusion Property is Polygon D and covers an area of 55.7 ha (137.6 acres) which represents ~61.4% of the Inclusion Property. Polygon D is characterized by a dominant Class 7 depth to bedrock (R) limitation and a Class 7 topography (T) limitation due to presence of steep bedrock cliffs. Polygon D has a less severe Class 4 stoniness (P) limitation due to the 21 to 40% coarse fragment content (coarse gravels and cobbles). None of the abovementioned limitations can be practically improved. ***As such, the most improved LCA class for Polygon D is Class 6RT.***

The smallest polygon in the Inclusion Property is Polygon E and covers an area of ~6.5 ha (16.1 acres) which represents ~7.2% of the Inclusion Property. Polygon E is characterized by a dominant Class 5 topography (T) limitation due to the 16 to 30% complex slopes. Polygon E has a less severe Class 3 stoniness (P) limitation due to the 10 to 20% coarse fragment content (coarse gravels and cobbles). None of the abovementioned limitations can be practically improved. ***As such, the most improved LCA class for Polygon E is Class 5T.***

The last polygon in the Inclusion Property is Polygon F and covers an area of ~16.7 ha (41.3 acres) which represents ~18.4% of the Inclusion Property. Polygon F is characterized by a dominant Class 3 stoniness (P) limitation due to the 10 to 20% coarse fragment content and a Class 3 topography (T) limitation due to the 11 to 15% simple slopes. Polygon F has a less severe Class 2 excess water (W) limitation due to the occurrence of excess water during the winter months that adversely affect deep-rooted crops. None of the abovementioned limitations can be practically improved. ***As such, the most improved LCA class for Polygon F is Class 3PT.***

4 Discussion and Conclusions

The LCA polygons mapped by Madrone indicate that the Exclusion Property contains Class 5 and Class 6 lands with multiple, unimprovable agricultural limitations including topography (T) and depth to bedrock (R). Class 5 lands are defined¹⁴ as containing limitations that restrict the capability to producing perennial forage crops or other specially adapted crops. Class 5 lands can be cultivated, and some may be used for cultivated field crops provided unusually intensive management is employed and/or the crop is particularly adapted to the conditions peculiar to these lands. Cultivated field crops may be grown on some Class 5 land where adverse climate is the main limitation, but crop failure can be expected under average conditions. Although cultivated field crops may be grown in Class 5 lands as per description by the ALC, it is the opinion of Madrone that the establishment of contiguous fields crops on the Exclusion

¹⁴ Agricultural Land Commission (2017). Agricultural Capability Classification in BC. https://www.alc.gov.bc.ca/assets/alc/assets/library/agricultural-capability/agriculture_capability_classification_in_bc_2013.pdf. Accessed May 1, 2023.

Property is not feasible due to the combination of the severe topography (T) and depth to bedrock (R) limitations.

Class 6 lands are defined¹⁵ as nonarable but capable of producing native and/or uncultivated perennial forage crops. Land in Class 6 provides sustained natural grazing for domestic livestock and is not arable in its present condition. Land is placed in this class because of severe climate, or the terrain is unsuitable for cultivation or use of farm machinery, or the soils do not respond to intensive improvement practices.

The majority of the Inclusion Property contains Class 7 lands which is defined as land with no capability for arable or sustained natural grazing. However, there is an ~16.7 ha (41.3 acres) area in the central to eastern portion of the Inclusion Property (delineated as Polygon F by Madrone) which contains Class 3 lands. Class 3 lands are defined as containing imitations that require moderately intensive management practices or moderately restrict the range of crops, or both. The limitations may restrict the choice of suitable crops or affect one or more of the following practices: timing and ease of tillage, planting and harvesting, and methods of soil conservation.

The relatively level topography of Polygon F (11 to 15% simple slopes) where the proposed ALR inclusion area is, contains deep-rooted Tolmie and Qualicum which would facilitate the production of beans, blueberries, cereals, cole crops, corn leaf vegetables, most forage crops, and peas with careful cultivation such as fertility management (e.g., cover cropping, fertilizers application), localized excess water management, and irrigation¹⁶. The south facing slopes on Polygon F will further facilitate a broad choice of crops due to presumed warmer and drier conditions (compared to slopes with a different aspect).

Based on the collected information from our field assessment and background review, it is the objective, professional opinion of Madrone that the ALR exclusion and inclusion proposal by the Client (**Figure 8; Appendix A**) increases the overall capability of agriculture on Saturna Island should the proposal be accepted by Islands Trust and the ALC. The proposal, which would result in a 'no net loss' of land in the ALR, would improve ALR by at least two LCA classes (i.e., an improvement from Class 5 to 6 land in the Exclusion Property to Class 3 in the Inclusion Property) over an area of ~12.0 ha (30 acres). As such, the proposal would accommodate and encourage long-term farming by the landowner (i.e., the Client) by substantially broadening his options for agricultural activities. Moreover, the proposed ALR exclusion

¹⁵ Agricultural Land Commission (2017). Agricultural Capability Classification in BC. https://www.alc.gov.bc.ca/assets/alc/assets/library/agricultural-capability/agriculture_capability_classification_in_bc_2013.pdf. Accessed May 1, 2023.

¹⁶ British Columbia Ministry of Agriculture, Fisheries and Food (n.d.). Soil Management Handbook for Vancouver Island. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/soil-nutrients/610000-7_soil_management_handbook_for_vancouver_island_draft.pdf. Accessed May 1, 2023.

area will not, in Madrone's professional opinion, affect the integrity and continuity of the land base of the ALR in the Exclusion Property.

Please contact Madrone if there are any questions about the contents of this report.

Sincerely,

MADRONE ENVIRONMENTAL SERVICES LTD.

Assessed and prepared by:

**This is a digitally signed duplicate of the official manually signed and sealed document*

Alex Kramer, MSc, A.Ag
Articling Agrologist

Senior reviewed by:

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Daniel Lamhonwah, PhD, MES, P.Ag
Professional Agrologist



TABLE 6. SOIL MOISTURE BALANCE AND CLIMATIC CAPABILITY RATINGS (UPPER 50 CM).

SITE & SOIL HORIZON	SOIL MOISTURE BALANCE						CLIMATE CAPABILITY RATING			
	TOTAL DEPTH	MATRIX TEXTURE	MATRIX AWSC ¹	MATRIX FRACTION ²	CF ADJUSTED AWSC ³	INTERVAL AWSC ⁴	CLIMATE MOISTURE DEFICIT ⁵	SOIL MOISTURE BALANCE ⁶	UNIMPROVED MOISTURE SUBCLASS ⁷	IMPROVED MOISTURE SUBCLASS ⁷
SP6	cm	FIELD	mm/cm	FIELD	mm/cm	mm	mm	mm		
Ah	8	Silt loam	2.1	0.95	2.00	15.96				
Bmh	22	Sandy clay loam	1.2	0.70	0.84	18.48				
Bm	21	Sandy clay loam	1.2	0.40	0.48	10.08				
						44.52	-433.00	-388.48	6A	2A
SP8										
Ah	15	Loam	1.7	1.00	1.70	25.5				
Bf	35	Sandy clay loam	1.2	0.90	1.08	37.8				
						63.30	-433.00	-369.70	6A	2A

lab/field Lab Data or Field Estimate

CF Coarse Fragments > 2.0 mm

¹ Based on MOE Manual 1 Land Capability Classification for Agriculture in British Columbia, Section 9.4, pp. 46

² Based on Field Estimation of Coarse Frags (%) (100%-Estimated% = Amount capable of storing H₂O)

³ AWSC of fraction <2.0 mm = Matrix AWSC x Matrix Fraction

⁴ AWSC of horizon/interval = Depth x Adjusted AWSC

⁵ Historic average soil moisture deficit (May 1 to Sept 30) for Saturna Island provided by Farm West (<https://farmwest.com/climate/calculators/evapotranspiration/>)

⁶ Upper 50 cm soil texture based AWSC (Climate Moisture Balance) + (Interval AWSC) = Deficit (negative) or Surplus (positive)

⁷ Based on Land Capability Classification for Agriculture, MOE Manual 1

TABLE 7. OBSERVED SOILS CHARACTERISTICS AND REVISED LCA RATINGS BASED ON FIELD AND DESKTOP ASSESSMENT.

Soil polygon (~ ha/% of total assessment area)	Predominant soil association(s)	Texture and coarse fragment content* in upper 25 cm	Distinguishing characteristics	Unimproved LCA rating**	Best improved LCA rating ***
Polygon A 10.8 ha (26.7 acres); ~18.2% of the Exclusion Property	Beddis and Saturna	Variable; between 10 to 20% coarse gravels and cobbles	11 to 15% complex slopes; near surface bedrock (25 to 50 cm depth)	6A 5R 4T 3P	2A 5R 4T 3P
Polygon B 28.6 ha (70.7 acres); ~48.3% of the Exclusion Property	Beddis and Saturna	Variable; between 10 to 20% coarse gravels and cobbles	16 to 30% complex slopes; near surface bedrock (25 to 50 cm depth)	6A 5RT 3P	2A 5RT 3P
Polygon C 19.8 ha (48.9 acres); ~33.5% of the Exclusion Property ~11.8 ha (29.2 acres); 13.0% of the Inclusion Property	Saturna and Bedrock	Between 21 to 40% coarse gravels and cobbles; colluvium	31 to 60% complex slopes; near surface bedrock (<25 cm depth)	6ART 4P	2A 6RT 4P
Polygon D 55.7 ha (137.6 acres); ~61.4% of the Inclusion Property	Bedrock	Between 21 to 40% coarse gravels and cobbles; colluvium	Steep bedrock cliffs	7RT 4P	7RT 4P
Polygon E 6.5 ha (16.1 acres); ~7.2% of the Inclusion Property	Qualicum and Saturna	Variable; between 10 to 20% coarse gravels and cobbles	16 to 30% complex slopes	6A 5T 3P	2A 5T 3P
Polygon F 16.7 ha (41.3 acres); ~18.4% of the Inclusion Property	Saturna and Qualicum; localized Tolmie and hydric soils	Variable; between 10 to 20% coarse gravels and cobbles	11 to 15% simple slopes; occasionally areas of poor drainage	6A 3PT 2W	3PT 2W

* Coarse fragment content, as defined by the for the purpose of the BC Ministry of the Environment for LCA assessments, include coarse gravels, cobbles and stones

** When reporting LCA ratings, the syntax only includes the most severe limitation reported which is **bolded** in this table for the purposes of the report.

Source: https://www.alc.gov.bc.ca/assets/alc/assets/library/agricultural-capability/land_capability_classification_for_agriculture_in_bc_1983.pdf

† The improved LCA Class ratings account for improvements that do not involve the importation of fill or soil.



APPENDIX A

Maps and Figures



FIGURE 1. AERIAL VIEW OF THE EXCLUSION PROPERTY AND THE INCLUSION PROPERTY ON SATURNA ISLAND, BC. PARCEL BOUNDARIES ARE SHOWN IN ORANGE. THE LIGHT GREEN SHADED AREA IN THE EXCLUSION PROPERTY VISUALIZES THE LOCATION OF THE CURRENT AGRICULTURAL LAND RESERVE (ALR).

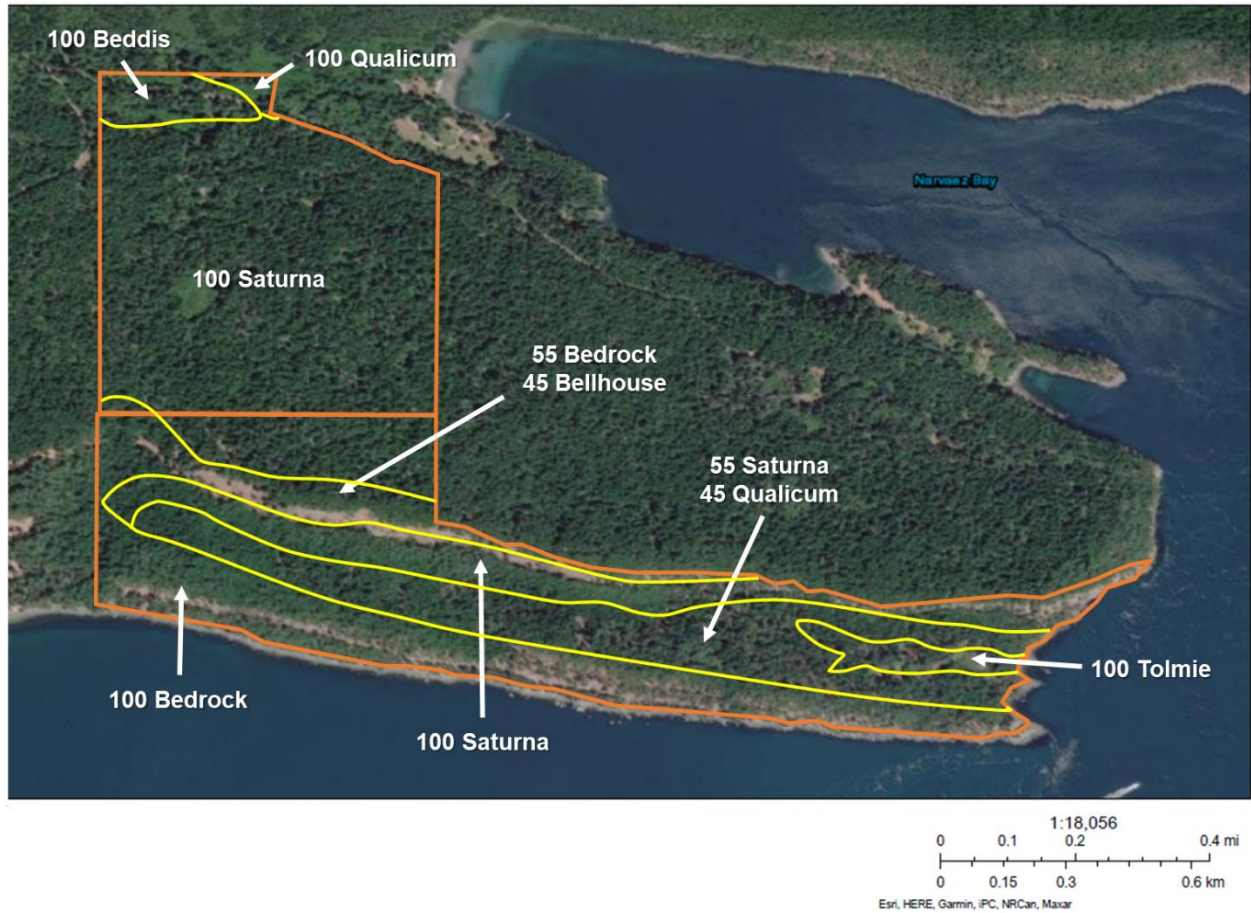


FIGURE 2. MAP SHOWING THE PROVINCIALLY MAPPED SOIL POLYGONS (IN YELLOW) AVAILABLE FROM THE BRITISH COLUMBIA SOIL INFORMATION FINDER TOOL (SIFT) ONLINE APPLICATION. PARCEL BOUNDARIES OF THE EXCLUSION PROPERTY AND INCLUSION PROPERTY ARE SHOWN IN ORANGE. BASE IMAGERY PROVIDED BY ESRI AND DATED 2002.

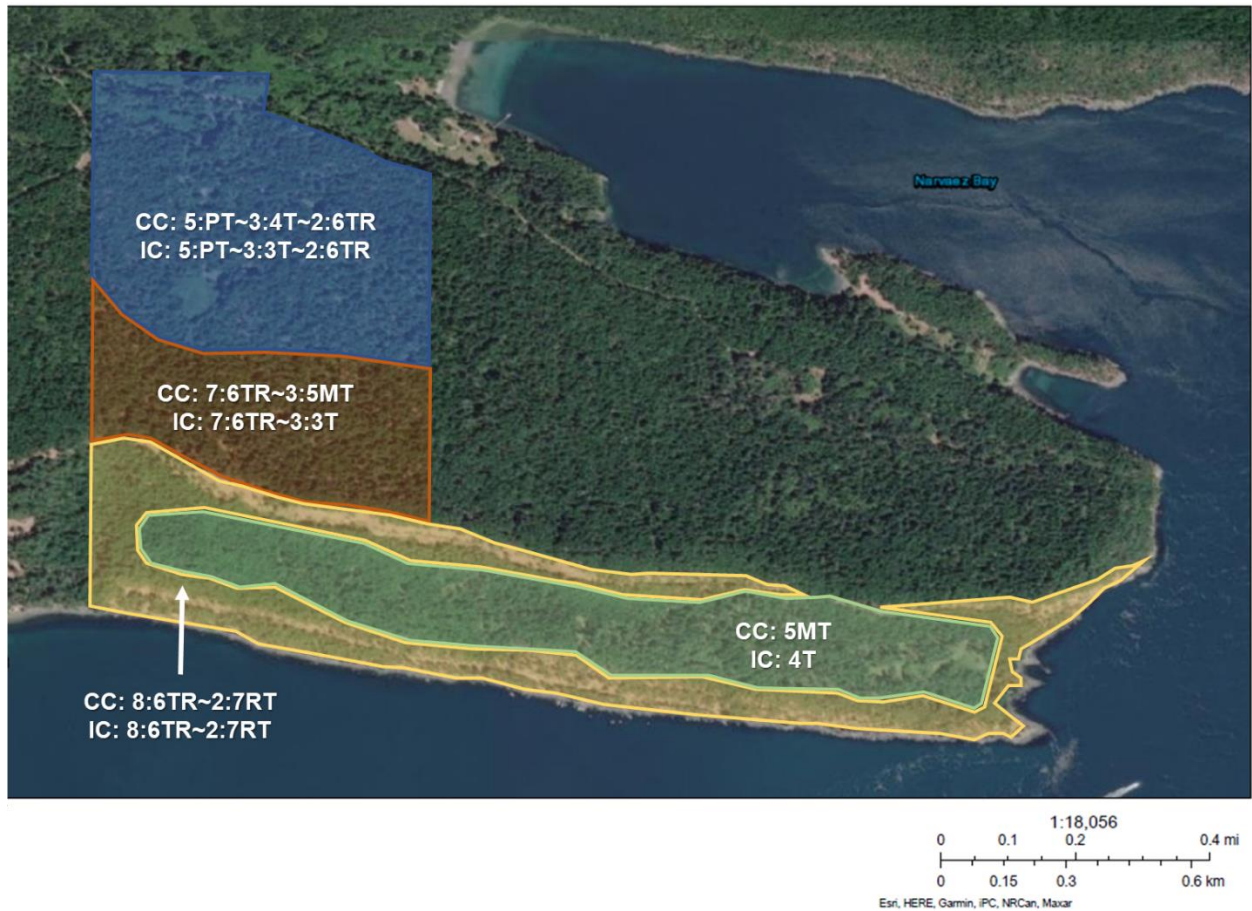


FIGURE 3. MAP SHOWING THE PROVINCIALY MAPPED LAND CAPABILITY FOR AGRICULTURE (COLOUR SHADED) AVAILABLE FROM THE BRITISH COLUMBIA SOIL INFORMATION FINDER TOOL (SIFT) ONLINE APPLICATION. PARCEL BOUNDARIES OF THE EXCLUSION PROPERTY AND INCLUSION PROPERTY ARE SHOWN IN ORANGE. BASE IMAGERY PROVIDED BY ESRI AND DATED 2002.

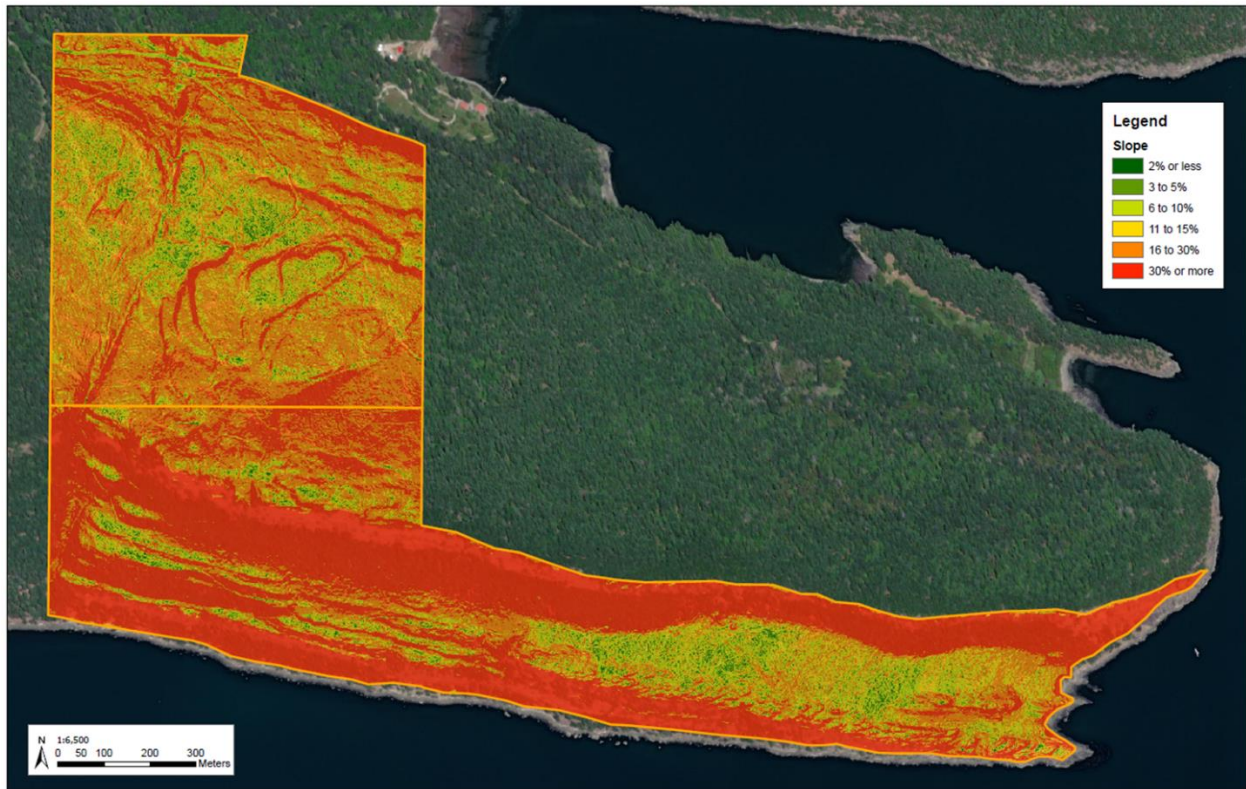


FIGURE 4. SLOPE MAP (% GRADIENT) PRODUCED BY MADRONE ENVIRONMENTAL SERVICES DERIVED FROM LIDAR IMAGERY. PARCEL BOUNDARIES OF THE EXCLUSION PROPERTY AND INCLUSION PROPERTY ARE SHOWN IN ORANGE.



FIGURE 5. MAP SHOWING THE LOCATIONS OF DETAILED SOIL PITS (DENOATED AS SP) AND SCRATCH PITS (DENOATED AS SCR) AS PART OF MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILTY FOR AGRICULTURE ASSESSMENT (MARCH 22 AND 23, 2023). PARCEL BOUNDARIES OF THE EXCLUSION PROPERTY AND INCLUSION PROPERTY ARE SHOWN IN ORANGE. BASE IMAGERY PROVIDED BY ESRI AND DATED 2002.



FIGURE 6. LOCATIONS OF THE PROPOSED AGRICULTURAL LAND RESERVE (ALR) EXCLUSION AND ALR INCLUSION AREAS (SHOWN AS DASHED LINES). THE LIGHT GREEN SHADED AREA IN THE EXCLUSION PROPERTY VISUALIZES THE LOCATION OF THE CURRENT ALR. THE LANDOWNER OF THE PROPERTIES IS PROPOSING AN EXCLUSION AND INCLUSION PLAN THAT WOULD RESULT IN 'NO NET LOSS' OF ALR LAND. A PROPOSED HOMEPLATE FOOTPRINT ON THE INCLUSION PROPERTY IS HIGHLIGHTED IN RED. BASE IMAGERY PROVIDED BY ESRI AND DATED 2002.

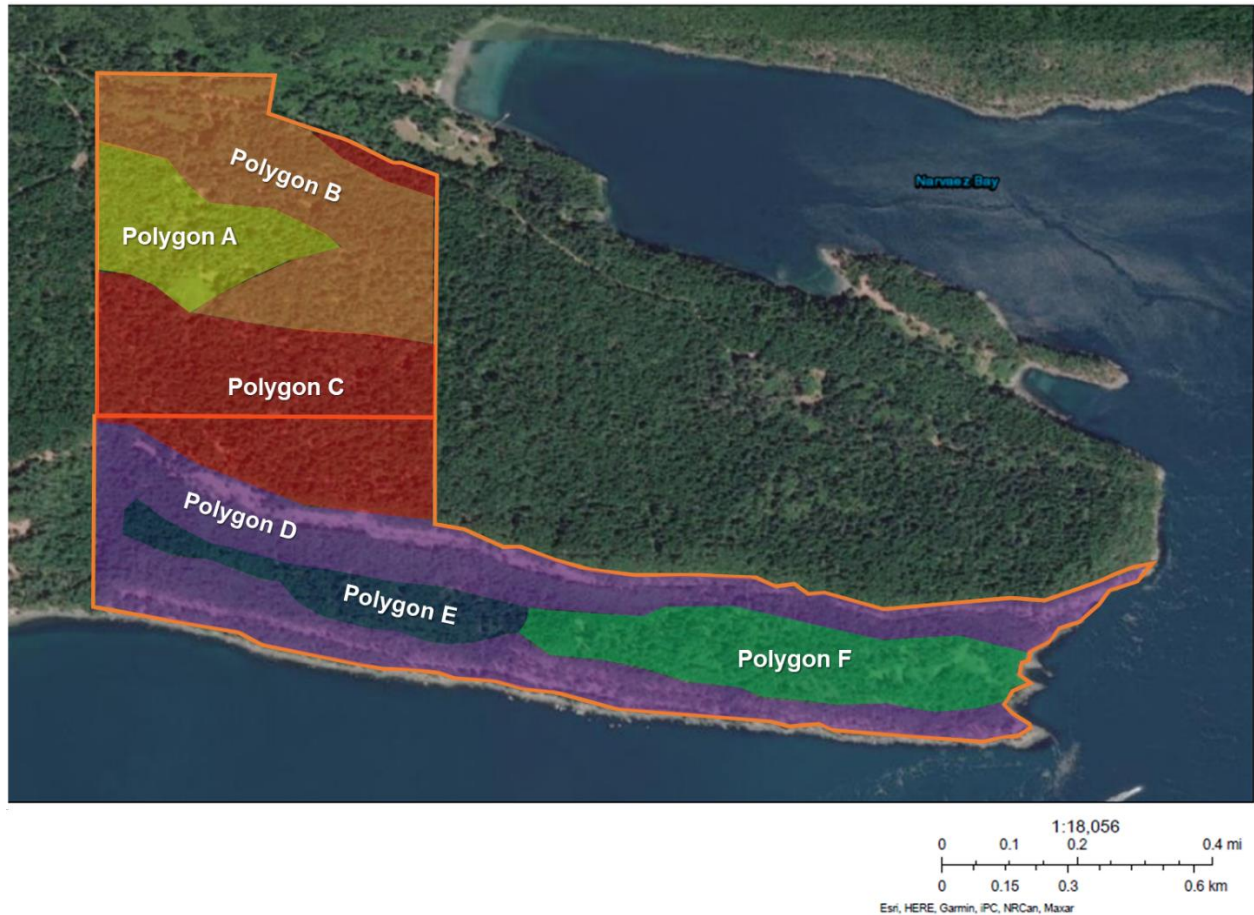


FIGURE 7. DELINEATED LAND CAPABILITY POLYGONS BASED ON SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT (MARCH 22 AND 23, 2023). PARCEL BOUNDARIES OF THE EXCLUSION PROPERTY AND INCLUSION PROPERTY ARE SHOWN IN ORANGE. BASE IMAGERY PROVIDED BY ESRI AND DATED 2002.

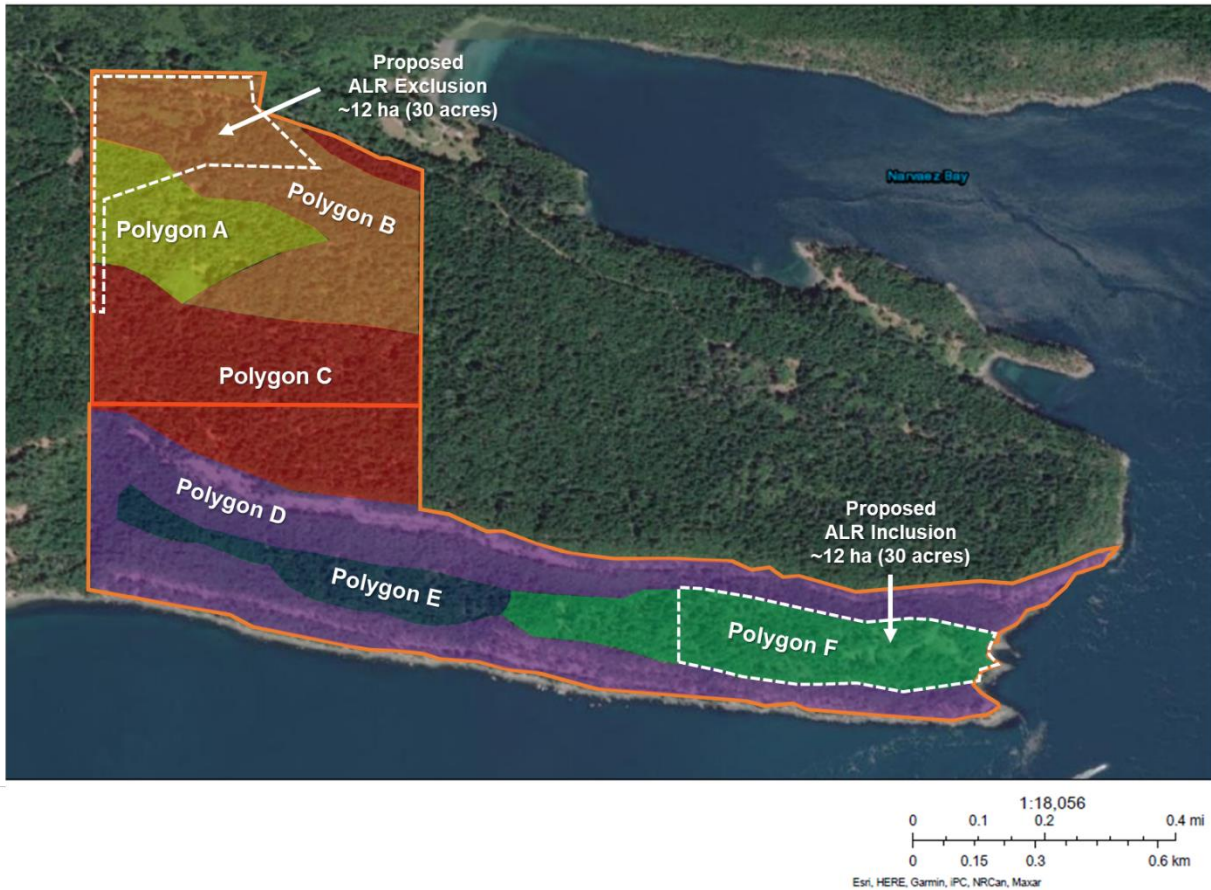


FIGURE 8. DELINEATED LAND CAPABILITY POLYGONS BASED ON SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT (MARCH 22 AND 23, 2023) WITH PROPOSED AGRICULTURAL LAND RESERVE (ALR) EXCLUSION AND ALR INCLUSION AREAS OVERLAIN. PARCEL BOUNDARIES OF THE EXCLUSION PROPERTY AND INCLUSION PROPERTY ARE SHOWN IN ORANGE. BASE IMAGERY PROVIDED BY ESRI AND DATED 2002.



APPENDIX B

Soil Profile Descriptions

Soil Pit 1 (SP1)		
Soil Association: Qualicum		
Classification: Gleyed Dystric Brunisol		
Horizon	Depth (cm)	Description
Ah	0 to 5	Silt loam texture; moderate, fine granular; friable; 5% coarse fragment content; moderately well drained; Plentiful fine to medium roots; no mottling; 7.5YR 2.5/2.
Bmh	5 to 20	Sandy clay loam texture; strong, fine subangular blocky; very friable; 20% coarse fragment content (20% fine gravel); Imperfectly drained; few fine roots; no mottles; 7.5YR 3/3.
Bmg	20 to 38	Sandy clay texture; weak, fine subangular blocky; wet: non-plastic, slightly sticky; 30% coarse fragment content (30% fine gravel); Imperfectly drained; few fine roots; few faint, diffuse mottles; 10YR 5/4.
Bg	38+	Underwater and unable to assess. Assumed Bg based on mottles in soil excavated pulled out.
Notes: Inclusion Property under short grass and moss in second growth forest. Along an underground spring/stream. Water table observed at 38 cm.		



Soil Pit 2 (SP2)		
Soil Association: Saturna		
Classification: Orthic Dystric Brunisol		
Horizon	Depth (cm)	Description
Ah	0 to 5	Loam texture; moderate, fine granular; Friable; 5% coarse fragment content; well drained; Plentiful fine to medium roots; no mottling; 7.5YR 2.5/2.
Bmh	5 to 25	Sandy clay loam texture; primary: weak, medium subangular blocky, secondary: weak fine granular; very friable; 15% coarse fragment content (10% fine gravel, 5% coarse gravel); moderately well drained; many fine roots; no mottles; 7.5YR 3/2.
Bm	25 to 60	Sandy loam texture; weak, fine blocky; friable; 60% coarse fragment content (40% coarse gravel, 20% fine gravel); well drained; many fine to medium roots; no mottles; 10YR 4/3.
BC	60 to 90	Sandy loam texture; weak, fine blocky to structureless; friable; 80% coarse fragment content (fine gravel to cobble); rapidly drained; no roots; no mottles; 2.5Y 4/3.
Notes: Inclusion Property south of SP1, on slightly higher ground under moss, grass and a second growth forest. Seepage observed at 90 cm.		



Soil Pit 3 (SP3)		
Soil Association: Saturna		
Classification: Orthic Dystric Brunisol		
Horizon	Depth (cm)	Description
Ah	0 to 5	Loam texture; moderate, fine granular; friable; 5% coarse fragment content; well drained; Plentiful fine to medium roots; no mottling; 7.5YR 2.5/2.
Bm ₁	5 to 35	Sandy loam texture; moderate, medium subangular blocky; friable; 20% coarse fragment content (15% fine gravel, 5% coarse gravel); well drained; few fine to medium roots; no mottles; 7.5YR 4/3.
Bm ₂	35 to 76	Sandy clay loam texture; weak, fine angular blocky; very friable; 50% coarse fragment content (40% coarse gravel, 20% cobble); moderately well drained; few medium roots; no mottles; 10YR 4/4.
BC	76 to 91	Sandy clay loam texture; weak, fine angular blocky; very friable; 50% coarse fragment content (40% coarse gravel, 20% cobble); moderately well drained; few medium roots; fine, weak, diffuse mottles; 10YR 4/4.
Notes: Inclusion Property south of the base of the cliff. Under grassy meadow in a second growth forest.		



Soil Pit 4 (SP4)		
Soil Association: Saturna		
Classification: Orthic Dystric Brunisol		
Horizon	Depth (cm)	Description
Ah	0 to 8	Loam texture; moderate, fine granular; Friable; 5% coarse fragment content; well drained; Plentiful fine to medium roots; no mottling; 7.5YR 2.5/2.
Bm ₁	8 to 32	Sand texture; structureless; very friable; 60% coarse fragment content (60% fine gravel); rapidly drained; abundant fine to medium roots; no mottles; 10YR 3/3.
Bm ₂	32 to 71	Sand texture; structureless; very friable; 40% coarse fragment content (30% fine gravel, 5% coarse gravel, 5% cobble); rapidly drained; few fine to medium roots; no mottles; 10YR 3/3.
BC	71 to 85	Sand texture; Structureless; very friable; 70% coarse fragment content (40% fine gravel, 20% coarse gravel, 20% cobble; 10% stone); rapidly drained; few coarse roots; no mottles; 10YR 3/3.
Notes: Inclusion Property below grass and second growth forest. Seepage observed at 75 cm.		



Soil Pit 5 (SP5)		
Soil Association: Tolmie		
Classification: Orthic Humic Gleysol		
Horizon	Depth (cm)	Description
Ah	0 to 26	Silt loam texture; moderate, fine granular; firm; 20% coarse fragment content (fine gravel to boulder); moderately well drained; abundant fine to medium roots; no mottling; 7.5YR 2.5/1.
Bgj	26 to 75	Sandy clay loam texture; weak, fine subangular blocky; friable; 35% coarse fragment content (20% fine gravel; 10% coarse gravel; and 5% cobbles); moderately well drained; few fine to medium roots; few weak, diffuse, small mottles; 10YR 4/3.
Notes: Inclusion Property in an alder meadow in an underground spring/creek. Seepage observed at 51 cm.		



Soil Pit 6 (SP6)		
Soil Association: Saturna		
Classification: Orthic Dystric Brunisol		
Horizon	Depth (cm)	Description
Ah	0 to 8	Silt loam texture; moderate, fine granular; Friable; 5% coarse fragment content; well drained; Plentiful fine to medium roots; no mottling; 7.5YR 2.5/2.
Bmh	8 to 30	Sandy clay loam texture; weak, medium subangular blocky; firm; 70% coarse fragment content (40% fine gravel, 30% coarse gravel); well drained; Abundant fine to medium roots; no mottles; 10YR 3/4.
Bm	30 to 52	Sandy clay loam texture; structureless; very friable; 80% coarse fragment content (40% coarse gravel, 20% fine gravel, 20% cobble); well drained; few medium roots; no mottles; 10YR 5/4.
BC	52 to 75	Clay loam texture; Structureless; very friable; 80% coarse fragment content (40% coarse gravel, 20% fine gravel, 20% cobble); well drained; no roots; no mottles; 10YR 5/4.
Notes: Inclusion Property south of low meadow on a ridge. Low grass under second growth forest. Seepage observed at 52 cm.		



Soil Pit 7 (SP7)		
Soil Association: Beddis		
Classification: Orthic Humo-Ferric Podzol		
Horizon	Depth (cm)	Description
LFH	6 to 0	Moss over humic forest floor.
Bf	0 to 34	Sandy clay loam texture; large, strong angular; firm; 10% coarse fragment content (10% coarse gravel); Moderately well drained; Abundant fine to coarse roots; no mottling; 7.5YR 4/6.
BC	34 to 56	Sandy clay loam texture; structureless; firm; 60% coarse fragment content (50% cobble [broken bedrock];10% coarse gravel); well drained; abundant fine to coarse roots; no mottling; 2.5Y 4/4.
R	56 to 70	Sandstone bedrock broken by excavation.

Notes: Exclusion Property along the west edge of the parcel under salal, moss and a second growth fir forest.



Soil Pit 8 (SP8)		
Soil Association: Beddis		
Classification: Orthic Humo-Ferric Podzol		
Horizon	Depth (cm)	Description
LFH	1 to 0	Moss over humic forest floor.
Ah	0 to 15	Loam texture; fine moderate granular; firm; no coarse fragment content; well drained; few fine to medium roots; no mottling; 7.5YR 2.5/2.
Bf	15 to 57	Sandy clay loam texture; medium, weak subangular blocky; friable; 25% coarse fragment content (15% fine gravel, 10% coarse gravel); Moderately well drained; Abundant fine to coarse roots; no mottling; 7.5YR 4/6.
BC	57 to 100	Sandy clay loam texture; structureless; firm; 60% coarse fragment content (50% cobble [angular broken bedrock];10% coarse gravel); well drained; Abundant fine to coarse roots; no mottling; 2.5Y 4/4.
Notes: Exclusion Property along the west edge of the parcel near the road to the north under salal, moss and a second growth fir and sparse cedar forest.		



Soil Pit 9 (SP9)		
Soil Association: Beddis		
Classification: Orthic Humo-Ferric Podzol		
Horizon	Depth (cm)	Description
LFH	4 to 0	Moss and coniferous litter.
Ah	0 to 7	Loam texture; fine moderate granular; firm; no coarse fragment content; well drained; few fine to medium roots; no mottling; 7.5YR 2.5/2.
Bf	7 to 52	Silt loam texture; medium, weak subangular blocky; friable; 10% coarse fragment content (10% fine gravel); imperfectly drained; Plentiful fine to coarse roots; no mottling; 5YR 3/4.
BC	52 to 80	Sand texture; structureless; very friable; 80% coarse fragment content (70% cobble [angular broken bedrock];10% coarse gravel); well drained; no roots; no mottling; 10YR 4/6.
Notes: Exclusion Property on the northeastern side on the parcel under a second growth fir and sparse cedar forest, with salal and moss.		



Soil Pit 10 (SP10)		
Soil Association: Beddis		
Classification: Orthic Humo-Ferric Podzol		
Horizon	Depth (cm)	Description
LFH	10 to 0	Moss over think forest floor of coniferous litter
Bf	0 to 19	Sandy loam texture; fine, weak angular blocky; friable; 15% coarse fragment content (10% fine and coarse gravel, 5% cobble); rapidly drained; Plentiful fine to coarse roots; no mottling; 10YR 4/4.
BC	19 to 80	Loamy sand texture; structureless; firm; 80% coarse fragment content (70% cobble [broken bedrock];10% gravel); rapidly drained; few medium to coarse roots; no mottling; 10YR 4/6.
Notes: Northeastern side of the Exclusion Property by Narvaez Bay Road under second growth fir and sparse cedar forest, with salal and moss.		



Scratch Pit 1 (SCR1)		
Soil Association: Saturna		
Classification: Orthic Dystric Brunisol		
Horizon	Depth (cm)	Description
Ah	0 to 3	Loam texture; moderate, fine granular; friable; 5% coarse fragment content; well drained; plentiful fine to medium roots; no mottling; 7.5YR 2.5/2.
Bm	3 to 34	Sandy loam texture; Strong, medium subangular blocky; very friable; 10% coarse fragment content (5% fine gravel, 5% coarse gravel); moderately well drained; few fine roots; no mottles; 7.5YR 3/2.
Notes: Inclusion Property in an alder meadow on the eastern side of the parcel proximal to the coast.		



Scratch Pit 2 (SCR2)		
Soil Association: Unidentified hydric soils		
Classification: Cumulic Regosol		
Horizon	Depth (cm)	Description
Om	0 to 25	Mesic organic matter; Von Post of 8; 80% coarse fragment content (colluvium angular cobble); abundant small to medium roots.
Notes: Inclusion Property on the cliff toe slope. 50% slope among large colluvium boulders under second growth fir and cedar forest.		



Scratch Pit 3 (SCR3)		
Soil Association: Unidentified hydric soils with underlying Tolmie soils		
Classification: Humic Gleysol		
Horizon	Depth (cm)	Description
Oh	0 to 19	Humic Organic Matter; Von Post of 9; 0% coarse fragment content; abundant small to medium roots.
Bg	19 to 31	Sandy clay loam texture; moderate, medium subangular blocky; wet: non-plastic, slightly sticky; 50% coarse fragment content (fine gravel to cobble); imperfectly drained; few medium distinct mottles; 1OYR 5/4.
Notes: Inclusion Property in the low-lying wetland running down the middle of the parcel. Seepage observed at 5 cm.		



Scratch Pit 4 (SCR4)		
Soil Association: Unidentified hydric soils		
Classification: Humisol		
Horizon	Depth (cm)	Description
Oh	0 to 35	Humic Organic Matter; Von Post of 10; 0% coarse fragment content; abundant small to medium roots.
Notes: Inclusion Property in the low-lying wetland running down the middle of the parcel. Seepage observed at surface.		



Scratch Pit 5 (SCR5)		
Soil Association: Unidentified hydric soils with underlying Tolmie soils		
Classification: Humic Gleysol		
Horizon	Depth (cm)	Description
Oh	0 to 20	Humic organic matter; Von Post of 9; 0% coarse fragment content; abundant small to medium roots.
Bg	20 to 31	Sandy clay loam texture; moderate, medium subangular blocky; wet: non-plastic, slightly sticky; 50% coarse fragment content (fine gravel to cobble); imperfectly drained; few medium distinct mottles; 10YR 5/4.
Notes: Inclusion Property in the low-lying wetland running down the middle of the parcel. Seepage observed at 5 cm.		



Scratch Pit 6 (SCR6)		
Soil Association: Qualicum		
Classification: Gleyed Dystric Brunisol		
Horizon	Depth (cm)	Description
Ah	0 to 14	Loam texture; moderate, fine granular; Friable; 0% coarse fragment content; well drained; plentiful fine to medium roots; no mottling; 7.5YR 2.5/1.
Bm	14 to 29	Sandy loam texture; weak, medium subangular blocky; friable; 15% coarse fragment; rapidly drained; few fine to medium roots; no mottles; 7.5YR 4/3.
Notes: Exclusion Property. Soil characteristics similar to SP6.		



Scratch Pit 7 (SCR7)		
Soil Association: Beddis		
Classification: Orthic Humo-Ferric Podzol		
Horizon	Depth (cm)	Description
LFH	5 to 0	Moss (5 to 3 cm) over humic material (3 to 0 cm) forest floor.
Bf	0 to 25	Sandy clay loam texture; medium, weak subangular blocky; friable; 25% coarse fragment content (15% fine gravel, 10% coarse gravel); Moderately well drained; Abundant fine to coarse roots; no mottling; 7.5YR 4/6.
Notes: Exclusion Property. Soil characteristics similar to SP7.		



Scratch Pit 8 (SCR8)		
Soil Association: Beddis		
Classification: Orthic Humo-Ferric Podzol		
Horizon	Depth (cm)	Description
Ah	0 to 11	Loam texture; fine moderate granular; firm; 15% coarse fragment content (fine gravel and coarse gravel); well drained; few fine to medium roots; no mottling; 7.5YR 2.5/2.
Bf	11 to 30	Sandy clay loam texture; medium, weak subangular blocky; friable; 40% coarse fragment content (15% fine gravel, 15% coarse gravel, 10% cobble); Moderately well drained; Abundant fine to coarse roots; no mottling; 7.5YR 4/6.
Notes: Exclusion Property. Soil characteristics similar to SP8.		



Scratch Pit 9 (SCR9)		
Soil Association: Beddis		
Classification: Orthic Humo-Ferric Podzol		
Horizon	Depth (cm)	Description
Ah	0 to 6	Loam texture; fine moderate granular; firm; 15% coarse fragment content (fine gravel and coarse gravel); well drained; few fine to medium roots; no mottling; 7.5YR 2.5/2.
Bf	6 to 25	Sandy clay loam texture; medium, weak subangular blocky; friable; 40% coarse fragment content (15% fine gravel, 15% coarse gravel, 10% cobble); Moderately well drained; Abundant fine to coarse roots; no mottling; 7.5YR 4/6.
Notes: Exclusion Property. Soil characteristics similar to SP8.		



Scratch Pit 10 (SCR10)		
Soil Association: Saturna		
Classification: Orthic Dystric Brunisol		
Horizon	Depth (cm)	Description
LFH	3 to 0	Moss and mycelium (3 to 1 cm) over Humic material (1 to 0 cm) forest floor.
Bm	0 to 27	Sandy loam texture; weak, small subangular blocky; friable; 30% coarse fragment (fine gravel to cobble); rapidly drained; plentiful fine to medium roots; no mottles; 10YR 5/4.
R	27 - 42	Broken sandstone bedrock on roadcut

Notes: Exclusion Property. Soil characteristics similar to SP6.



Scratch Pit 11 (SCR11)		
Soil Association: N/A		
Classification: Regosol		
Horizon	Depth (cm)	Description
Ah	0 to 15	Loam texture; moderate, fine granular; Friable; 5% coarse fragment content; well drained; abundant fine to very fine roots; no mottling; 7.5YR 2.5/1.
R	15+	Sandstone bedrock
Notes: Exclusion Property. Shallow bedrock encountered.		



Scratch Pit 12 (SCR12)		
Soil Association: Beddis		
Classification: Orthic Dystric Brunisol		
Horizon	Depth (cm)	Description
Ah	0 to 4	Loam texture; moderate, fine granular; firm; 20% coarse fragment content (fine gravel and coarse gravel); well drained; Plentiful fine to medium roots; no mottling; 7.5YR 2.5/3.
Bf	4 to 25	Sandy clay loam texture; moderate, medium subangular blocky; firm; 15% coarse fragment (fine gravel and coarse gravel); rapidly drained; few fine to medium roots; no mottles; 7.5YR 4/4.
Bm	25 to 40	Sandy loam texture; small, moderate subangular blocky; friable; 25% coarse fragment; rapidly drained; few medium roots; no mottles; 10YR 3/6.
R	40+	Sandstone bedrock
Notes: Exclusion Property. Soil characteristics similar to SP8.		



Scratch Pit 13 (SCR13)		
Soil Association: Saturna		
Classification: Orthic Dystric Brunisol		
Horizon	Depth (cm)	Description
Ah	0 to 7	Loam texture; moderate, fine granular; friable; 0% coarse fragment content; well drained; Plentiful fine to medium roots; no mottling; 7.5YR 2.5/3.
Bm	7 to 40	Sandy loam texture; weak, medium subangular blocky; friable; 5% coarse fragment; rapidly drained; few fine to medium roots; no mottles; 7.5YR 4/3.
Notes: Exclusion Property. Soil characteristics similar to SP6.		





APPENDIX C

Site Photos



PHOTO 1. VIEW OF THE MIXED FOREST AND ALDER MEADOW IN THE AREA ON THE INCLUSION PROPERTY PROPOSED BY THE LANDOWNER TO BE INCLUDED INTO THE AGRICULTURAL LAND RESERVE (ALR). PHOTO LOCATION IS PROXIMAL TO SOIL PIT 2 (SP2) ASSOCIATED WITH MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. PHOTO DATED MARCH 22, 2023.



PHOTO 2. VIEW OF THE MIXED FOREST AND ALDER MEADOW IN THE AREA ON THE INCLUSION PROPERTY PROPOSED BY THE LANDOWNER TO BE INCLUDED INTO THE AGRICULTURAL LAND RESERVE (ALR). PHOTO LOCATION IS PROXIMAL TO SOIL PIT 2 (SP2) ASSOCIATED WITH MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. PHOTO DATED MARCH 22, 2023.



PHOTO 3. VIEW OF THE MIXED FOREST AND ALDER MEADOW IN THE AREA ON THE INCLUSION PROPERTY PROPOSED BY THE LANDOWNER TO BE INCLUDED INTO THE AGRICULTURAL LAND RESERVE (ALR). PHOTO LOCATION IS PROXIMAL TO SOIL PIT 5 (SP5) ASSOCIATED WITH MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. PHOTO DATED MARCH 22, 2023.



PHOTO 4. VIEW OF THE MIXED FOREST AND ALDER MEADOW IN THE AREA ON THE INCLUSION PROPERTY PROPOSED BY THE LANDOWNER TO BE INCLUDED INTO THE AGRICULTURAL LAND RESERVE (ALR). PHOTO LOCATION IS PROXIMAL TO SCRATCH PIT 6 (SCR6) ASSOCIATED WITH MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. PHOTO DATED MARCH 22, 2023.



PHOTO 5. VIEW OF THE MIXED FOREST AND ALDER MEADOW IN THE AREA ON THE INCLUSION PROPERTY PROPOSED BY THE LANDOWNER TO BE INCLUDED INTO THE AGRICULTURAL LAND RESERVE (ALR). PHOTO LOCATION IS PROXIMAL TO SOIL PIT 1 (SP1) ASSOCIATED WITH MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. PHOTO DATED MARCH 22, 2023.



PHOTO 6. VIEW OF LOCALIZED MARSH AREA ON THE INCLUSION PROPERTY PROPOSED BY THE LANDOWNER TO BE INCLUDED INTO THE AGRICULTURAL LAND RESERVE (ALR). SEVERAL OF THESE LOCALIZED WETLAND AREAS WERE OBSERVED DURING MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. PHOTO DATED MARCH 22, 2023.



PHOTO 7. VIEW OF COLLUVIUM AT THE BASE OF BEDROCK CLIFF ON THE INCLUSION PROPERTY. THIS AREA IS NOT WITHIN THE AREA PROPOSED BY THE LANDOWNER TO BE INCLUDED IN AGRICULTURAL LAND RESERVE (ALR). PHOTO LOCATION IS PROXIMAL TO SCRATCH PIT 2 (SCR2) ASSOCIATED WITH MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. PHOTO DATED MARCH 22, 2023.



PHOTO 8. VIEW OF THE MIXED FOREST ON THE AREA OF THE EXCLUSION PROPERTY PROPOSED BY THE LANDOWNER TO BE EXCLUDED FROM THE AGRICULTURAL LAND RESERVE (ALR). PHOTO LOCATION IS PROXIMAL TO SCRATCH PIT 7 (SCR7) ASSOCIATED WITH MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. THIS AREA IS CHARACTERIZED BY COMPLICATED SLOPES OF 16 TO 30% GRADIENT. PHOTO DATED MARCH 23, 2023.



PHOTO 9. VIEW OF THE MIXED FOREST ON THE AREA OF THE EXCLUSION PROPERTY PROPOSED BY THE LANDOWNER TO BE EXCLUDED FROM THE AGRICULTURAL LAND RESERVE (ALR). PHOTO LOCATION IS PROXIMAL TO SCRATCH PIT 8 (SCR8) ASSOCIATED WITH MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. THIS AREA IS CHARACTERIZED BY COMPLICATED SLOPES OF >30% GRADIENT. PHOTO DATED MARCH 23, 2023.



PHOTO 10. VIEW OF THE MIXED FOREST ON THE AREA OF THE EXCLUSION PROPERTY PROPOSED BY THE LANDOWNER TO BE EXCLUDED FROM THE AGRICULTURAL LAND RESERVE (ALR). PHOTO LOCATION IS PROXIMAL TO SOIL PIT 8 (SP8) ASSOCIATED WITH MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. THIS AREA IS CHARACTERIZED BY COMPLICATED SLOPES OF >30% GRADIENT. PHOTO DATED MARCH 23, 2023.



PHOTO 11. VIEW OF THE MIXED FOREST ON THE AREA OF THE EXCLUSION PROPERTY PROPOSED BY THE LANDOWNER TO BE EXCLUDED FROM THE AGRICULTURAL LAND RESERVE (ALR). PHOTO LOCATION IS PROXIMAL TO SOIL PIT 9 (SP9) ASSOCIATED WITH MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. THIS AREA IS CHARACTERIZED BY COMPLICATED SLOPES OF >30% GRADIENT. PHOTO DATED MARCH 23, 2023.



PHOTO 12. VIEW OF THE MIXED FOREST ON THE AREA OF THE EXCLUSION PROPERTY PROPOSED BY THE LANDOWNER TO BE EXCLUDED FROM THE AGRICULTURAL LAND RESERVE (ALR). PHOTO LOCATION IS PROXIMAL TO SOIL PIT 10 (SP10) ASSOCIATED WITH MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. THIS AREA IS CHARACTERIZED BY COMPLICATED SLOPES OF >30% GRADIENT. PHOTO DATED MARCH 23, 2023.



PHOTO 13. VIEW OF THE MIXED FOREST ON THE AREA OF THE EXCLUSION PROPERTY PROPOSED BY THE LANDOWNER TO BE EXCLUDED FROM THE AGRICULTURAL LAND RESERVE (ALR). PHOTO LOCATION IS PROXIMAL TO SOIL PIT 10 (SP10) ASSOCIATED WITH MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. THIS AREA IS CHARACTERIZED BY COMPLICATED SLOPES OF >30% GRADIENT. PHOTO DATED MARCH 23, 2023.



PHOTO 14. VIEW OF THE MIXED FOREST ON THE AREA OF THE EXCLUSION PROPERTY PROPOSED BY THE LANDOWNER TO BE EXCLUDED FROM THE AGRICULTURAL LAND RESERVE (ALR). PHOTO LOCATION IS PROXIMAL TO SCRATCH PIT 13 (SCR13) ASSOCIATED WITH MADRONE ENVIRONMENTAL SERVICES' LAND CAPABILITY FOR AGRICULTURE ASSESSMENT. THIS AREA IS CHARACTERIZED BY COMPLICATED SLOPES OF >30% GRADIENT. PHOTO DATED MARCH 23, 2023.



APPENDIX D

Land Capability for Agriculture, Soil Associations and Soil Types

Land Capability for Agriculture Overview

The *Land Capability Classification for Agriculture in BC*¹⁷ is a classification system that groups agricultural land into classes that reflect potential and limitations to agriculture. The classes are differentiated based on soil properties and climate conditions. The system considers the range of possible crops and the type and intensity of management practices required to maintain soil resources, but it does not consider suitability of land for specific crops, crop productivity, specific management inputs or the feasibility of implementing improvements. There are two land capability hierarchies, one for mineral soils and one for organic soils. Each hierarchy groups the land into seven classes that describe the range of suited crops and required management inputs. The organic soil class definitions are equivalent in relative capabilities and limitations for agricultural use to those defined for mineral soils.

The range of suited crops decreases from Class 1 to Class 7 and/or the management inputs increase from Class 1 to Class 7. For example, Class 1 lands can support the broadest range of crops with minimal management units. Lands in Classes 1 to 4 are considered capable of sustained agricultural production of common crops. Class 5 lands are considered good for perennial forage or specially-adapted crops. Class 6 lands are good for grazing livestock and Class 7 lands are not considered capable of supporting agricultural production.

LCA Classes are subdivided into subclasses based on the degree and kind of limitation to agriculture. Subclasses indicate the type and intensity of management input required to maintain sustained agricultural production and specify the limitation. For example, lands rated Class 2W have an excess water limitation that can be improved by managing water on the site. There are fewer subclasses for organic soils than for mineral soils (see below).

Most lands are rated for unimproved and improved conditions. Unimproved ratings are calculated based on site conditions at the time of the assessments, without irrigation. Past improvements are assessed as part of the unimproved rating. Forested lands are assessed assuming they are cleared. Improved ratings are assigned assuming that existing limitations have been alleviated. Generally, improvement practices taken into account are drainage, irrigation, diking, stone removal, salinity alleviation, intensive fertilization and adding soil amendments.

¹⁷ BC Ministry of Environment and Ministry of Agriculture and Food (1983). Land Capability Classification for Agriculture in British Columbia MOE Manual 1. https://www.alc.gov.bc.ca/assets/alc/assets/about-the-alc/alr-and-maps/agricultural-land/land_capability_classification_for_agriculture_in_bc.pdf. Accessed May 2, 2023.

LCA Classes and Characteristics for Mineral and Organic Soils

Class	Description	Characteristics
1	No or very slight limitations that restrict agricultural use	<ul style="list-style-type: none"> • Level or nearly level • Deep soils are well to imperfectly drained and hold moisture well • Managed and cropped easily • Productive
2	Minor limitations that require ongoing management or slightly restrict the range of crops, or both	<ul style="list-style-type: none"> • Require minor continuous management • Have lower crop yields or support a slightly smaller range of crops than Class 1 lands • Deep soils that hold moisture well • Managed and cropped easily
3	Limitations that require moderately intensive management practices or moderately restrict the range of crops, or both	<ul style="list-style-type: none"> • More severe limitations than Class 2 land • Management practices more difficult to apply and maintain • Limitations may: <ul style="list-style-type: none"> ○ Restrict choice of suitable crops ○ Affect timing and ease of tilling, planting or harvesting ○ Affect methods of soil conservation
4	Limitations that require special management practices or severely restrict the range of crops, or both	<ul style="list-style-type: none"> • May be suitable for only a few crops or may have low yield or a high risk of crop failure • Soil conditions are such that special development and management conditions are required • Limitations may: <ul style="list-style-type: none"> ○ Affect timing and ease of tilling, planting or harvesting ○ Affect methods of soil conservation
5	Limitations that restrict capability to produce perennial forage crops or other specially adapted crops (e.g. cranberries)	<ul style="list-style-type: none"> • Can be cultivated, provided intensive management is employed or crop is adapted to the particular conditions of the land • Cultivated crops may be grown where adverse climate is the main limitation, crop failure can be expected under average conditions
6	Not arable, but capable of producing native and/or uncultivated perennial forage crops	<ul style="list-style-type: none"> • Provides sustained natural grazing for domestic livestock • Not arable in present condition • Limitations include severe climate, unsuitable terrain or poor soil • Difficult to improve, although draining, dyking and/or irrigation can remove some limitations
7	No capability for arable culture or sustained natural grazing	<ul style="list-style-type: none"> • All lands not in Class 1 to 6 • Includes rockland, non-soil areas, small water-bodies

LCA Subclasses

LCA Classes, except Class 1 which has no limitations, can be divided into subclasses depending upon the type and degree of limitation to agricultural use. There are twelve LCA subclasses to describe mineral soils and nine LCA subclasses to describe organic soils, as summarized below. Mineral soils contain less than 17% organic carbon; except for an organic surface layer¹⁸.

LCA Subclasses for Mineral Soils

LCA Subclass	Map Symbol	Description	Improvement
Soil moisture deficiency	A	Crops are adversely affected by drought either through insufficient precipitation or low water holding capacity of the soil.	Improvable through irrigation.
Adverse climate	C	Used on a subregional or local basis, from climate maps, to indicate thermal limitations including freezing, insufficient heat units and/or extreme winter temperatures.	N/A
Undesirable soil structure and/or low perviousness.	D	This subclass is used for soils difficult to till, requiring special management for seedbed preparation and soils with trafficability problems for common farm implements. Also included are soils which have insufficient aeration, absorb and distribute water slowly, or have the depth of rooting zone restricted by conditions other than wetness (high water table) or consolidated bedrock or permafrost.	Can be improved to varying degrees by amelioration of soil texture, deep ploughing or blading to break-up root restricting layers. Soil can also be amended with compost to improve structure.
Erosion	E	Includes soils on which past damage from erosion limits agricultural use of the land because of the loss in productivity and the difficulty in farming land with gullies.	N/A; usually a continuing limitation.
Fertility	F	Limited by lack of available nutrients, low cation exchange capacity or nutrient holding ability, high or low pH, high amount of carbonates, presence of toxic elements or high fixation of plant nutrients.	Constant and careful use of fertilizers and/or other soil amendments
Inundation	I	Includes soils where flooding damages crops or restricts agricultural use.	Diking
Salinity	N	Includes soils adversely affected by soluble salts that restrict crop growth or the range of crops.	Specific to site and soil conditions
Stoniness	P	Applies to soils with sufficient coarse fragments, 2.5 cm diameter or larger, to significantly hinder tillage, planting and/or harvesting.	Remove cobbles and stones
Depth to bedrock and rockiness	R	Used for soils in which bedrock near the surface restricts rooting depth and tillage and/or the presence of rock outcrops restricts agricultural use.	N/A
Topography	T	Applies to soils where topography limits agricultural use, by slope steepness and/or complexity.	N/A
Excess Water	W	Applies to soils for which excess free water limits agricultural use.	Ditching, tilling, draining

¹⁸ Agriculture and Agri-Food Canada (1998). Canadian System of Soil Classification.

http://sis.agr.gc.ca/cansis/publications/manuals/1998-cssc-ed3/cssc3_manual.pdf. Accessed May 2, 2023.

LCA Subclass	Map Symbol	Description	Improvement
Permafrost	Z	Applies to soils that have a cryic (permanently frozen) layer.	N/A

LCA Subclasses for Organic Soils

LCA Subclass	Map Symbol	Description	Improvement
Wood in the profile	B	Layers of wood in the form of trunks, stumps, and branches occur in many organic soils; wood located within 50 cm of the surface can interfere with cultivation; buried wood may be well-decomposed or solid and large.	The amount of wood present is variable and difficult to remove or manage. Therefore the improved rating is equivalent to the unimproved rating
Climate	C	Used on a subregional or local basis, from climate maps, to indicate thermal limitations including freezing, insufficient heat units and/or extreme winter temperatures.	N/A
Depth of organic soil over bedrock and/or rockiness	H	The presence of bedrock near the surface restricts the depth of rooting and the feasibility of subsurface drainage, and / or the presence of rock outcrops restricts agricultural use.	Improvement of limitations due to bedrock near the surface and/or rockiness is not considered practical; therefore the improved rating is equivalent to the unimproved rating
Fertility	F	Limited by lack of available nutrients, low cation exchange capacity or nutrient holding ability, high or low pH, high amount of carbonates, presence of toxic elements or high fixation of plant nutrients.	Constant and careful use of fertilizers and/or other soil amendments
Inundation	I	Includes soils where flooding damages crops or restricts agricultural use.	Diking
Degree of decomposition - permeability	L	Degree of decomposition of the rooting zone probably of less importance to the overall capability than the lower part of the soil. The degree of decomposition of lower layers is important because of its effect on drainage, permeability, capillary rise of water and rate of subsidence.	Improvement of this limitation is not considered practical; therefore the improved rating is equivalent to the unimproved rating
Salinity	N	Includes soils adversely affected by soluble salts that restrict crop growth or the range of crops.	Specific to site and soil conditions
Excess Water	W	Applies to soils for which excess free water limits agricultural use (applicable to both mineral and organic soil).	Ditching, tilling, draining
Permafrost	Z	Applies to soils that have a cryic (permanently frozen) layer.	N/A

Soil Associations

Soils in British Columbia (where soil mapping has taken place) are grouped into distinct soil associations based on typical characteristics associated with particular pedogenic (soil-forming) factors. These associations are typically spatially limited to certain areas of the province. In this report, using the collected soil data, the main soil association for the Properties have been identified from *Soils of the Gulf Islands of British Columbia - Soils of North Pender, South Pender, Prevost, Mayne, Saturna, and lesser islands. Volume 2*¹⁹, as follows:

Saturna

Saturna soils (ST)

Saturna soils are well-drained soils that have developed on shallow deposits of channery, sandy loam textured, colluvial and glacial drift materials over sandstone bedrock within 100 cm of the surface. Coarse fragment content varies between 20 and 50%. The profile description and analyses of a selected Saturna soil are given in Appendixes 1 and 2.

Soil characteristics

Characteristic	Mean	Minimum	Maximum	No. of observations
Thickness of surface layer (cm)	48	12	97	239
Depth to bedrock (cm)	50	12	97	239
Depth to restricting layer (cm)	56	12	97	239
Depth to mottles (cm)	160	160	160	258
CF content surface layer (%)	42	20	50	97
Fine gravel (channery) content surface layer (%)	17	5	30	97
Coarse gravel (channery) content surface layer (%)	18	5	45	97
Cobble content (flaggy) surface layer (%)	8	0	50	97
CF content subsurface layer (%)	52	35	70	7
Fine gravel (channery) content subsurface layer (%)	26	15	35	7
Coarse gravel (channery) content subsurface layer (%)	17	5	30	7
Cobble content (flaggy) subsurface layer (%)	9	0	30	7

	Frequency of occurrence (%)	No. of observations
Texture of surface layer	SL(96), LS(3), L(1)	258
Texture of subsurface layer	SL(72), LS(14), L(14)	7
Drainage class	Well(99), moderately well(1)	258
Soil classification	O.DYB(87), O.HFP(11), E.DYB(2)	258
Type of restricting layer	Sandstone bedrock	
Perviousness	Rapid	

¹⁹ Agriculture Canada (1988). Soils of the Gulf Islands of British Columbia - Soils of North Pender, South Pender, Prevost, Mayne, Saturna, and lesser islands. Volume 2. Report No. 43 British Columbia Soil Survey. https://www.env.gov.bc.ca/esd/distdata/ecosystems/Soils_Reports/bc43-2_report.pdf. Accessed May 1, 2023.

Water regime

The Saturna soils are well-drained soils. They are moist from late fall to spring but droughty during summer months. During and shortly after wet periods, water may flow laterally through the saturated subsoil on top of the sloping bedrock.

Variability

Soil phase or variant	Frequency		Description of variability
	(no.)	(%)	
STb	4	2	Bouldery phase: >50% rock fragments >60 cm in diameter; colluvial toe-slope positions below rock ridges and escarpments; in conjunction with shallow lithic (l) and deep (d) phases
STd	19	7	Deep phase: depth to bedrock 100-160 cm; mean depth 132 cm (105-160 cm); also in conjunction with nongravelly (ng), bouldery (b), and very gravelly (vg) phases
STl	89	34	Shallow lithic phase: depth to bedrock 50-100 cm; mean depth 70 cm (50-97 cm); also in conjunction with nongravelly (ng), paralithic (pl), bouldery (b), and very gravelly (vg) phases and taxonomy change (t) variant
STng	18	7	Nongravelly phase: coarse fragment content in surface layer <20%; mean CF 8% (0-15%); in conjunction with deep (d), shallow lithic (l), and very shallow lithic (sl) phases
STpl	22	9	Paralithic phase: boundary between soil and solid bedrock consists of fractured sandstone rock; mean depth to fractured rock 45 cm (20-70 cm); mean thickness of fractured rock 46 cm (5-90 cm); in conjunction with very shallow lithic (sl) and shallow lithic (l) phases
STsl	148	57	Very shallow lithic phase: depth to bedrock 10-50 cm; mean depth 36 cm (12-50 cm); also in conjunction with nongravelly (ng), paralithic (pl), and very gravelly (vg) phases
STvg	142	55	Very gravelly phase: coarse fragment content in surface layer >50%; mean CF 59% (50-80%); in conjunction with deep (d), shallow lithic (l), and very shallow lithic (sl) phases

Note: There is also a very limited occurrence of the taxonomy change (t) variant for the Saturna soil, mainly used when a podzolic B horizon is present.

Qualicum

Qualicum soils (QU)

Qualicum soils are rapidly to moderately well-drained soils developed on deep (>150 cm) deposits of gravelly sandy loam to gravelly sand textured, glaciofluvial, fluvial, or marine deposits. Coarse fragment content throughout the profile is between 20 and 70%, but not exceeding 50% in the surface layer. The profile description and analyses of a selected Qualicum soil are given in Appendixes 1 and 2.

Soil characteristics

Characteristic	Mean	Minimum	Maximum	No. of
				observations
Thickness of surface layer (cm)	91	15	160	139
Depth to bedrock (cm)	160	160	160	90
Depth to restricting layer (cm)	160	160	160	90
Depth to mottles (cm)	155	100	160	128
CF content surface layer (%)	38	25	45	53
Fine gravel content surface layer (%)	19	5	40	53
Coarse gravel content surface layer (%)	13	0	20	53
Cobble content surface layer (%)	7	0	15	53
CF content subsurface layer (%)	32	5	70	33
Fine gravel content subsurface layer (%)	20	2	50	33
Coarse gravel content subsurface layer (%)	9	0	25	33
Cobble content subsurface layer (%)	4	0	40	33
				No. of
				observations
Texture of surface layer	LS(47), SL(37), S(12), L(4)			139
Texture of subsurface layer	LS(46), SL(30), S(24)			46
Drainage class	Rapid(42), well(41), moderately well(11), imperfect(5), poor(1)			139
Soil classification	O.DYB(80), O.SB(13), GL.SB(5), GL.DYB(1), O.HG(1)			139
Type of restricting layer	Absent			
Perviousness	Rapid			

Water regime

Qualicum soils are rapidly to moderately well-drained soils. They are moist from late fall to spring but quickly become very droughty during summer. The water table remains well below 100 cm throughout the year.

Variability

Soil phase or variant	Frequency (no.) (%)	Description of variability
QUa	25 18	Sombric variant: Ah or Ap horizon >10 cm; also in conjunction with deep (d), imperfectly drained (id), poorly drained (pd), shallow (s), and very gravelly (vg) phases
QUd	7 5	Deep phase: less deep (100-150 cm) than specified over similar materials but with <20% coarse fragment 150 cm; mean depth 111 cm (100-125 cm); mean CF subsoil 1% (0-5%); also in conjunction with sombric (a) variant and loam (lo) and very gravelly (vg) phases
QUid	6 4	Imperfectly drained phase: moisture regime wetter than specified (Gleyed subgroups) for soil; also in conjunction with sombric (a) variant and shallow lithic (l), shallow (s), and very shallow (vs) phases
QUl	16 12	Shallow lithic phase: bedrock at 50-100 cm; mean depth 84 cm (55-100 cm); also in conjunction with imperfectly drained (id), poorly drained (pd), shallow (s), and very gravelly (vg) phases
QUs	17 12	Shallow phase: less deep (50-100 cm) than specified over similar materials but with coarse fragment content <20%; mean depth 72 cm (50-90 cm); mean total CF 9% (0-35%); mean coarse gravels and cobbles 1% (0-5%); also in conjunction with sombric (a) variant and imperfectly drained (id) and very gravelly (vg) phases
QUvg	79 57	Very gravelly phase: coarse fragment content in surface layer >50%; mean CF 59% (50-75%); also in conjunction with sombric (a) and taxonomy change (t) variants and shallow lithic (l), deep (d), shallow (s), and loam (lo) phases
QUvs	4 3	Very shallow phase: less deep (30-50 cm) than specified over similar materials but with coarse fragment content <20%; mean depth 39 cm (30-45 cm); mean CF 2% (0-10%); also in conjunction with imperfectly drained (id) phase

Note: Other phases of the Qualicum soil with very limited occurrences are: bouldery (b), loam (lo), poorly drained (pd), and silt loam (si) phases and taxonomy change (t) variant.

Beddis

Beddis soils (BD)

Beddis soils are rapidly to moderately well-drained soils that have developed on deep (>150 cm), fluvial, marine, or eolian materials of sandy loam to sand texture. Coarse fragment content is <20%. The profile description and analyses of a selected Beddis soil are given in Appendixes 1 and 2.

Soil characteristics

Characteristic	Mean	Minimum	Maximum	No. of observations
Thickness of surface layer (cm)	111	20	160	22
Depth to bedrock (cm)	160	160	160	22
Depth to restricting layer (cm)	160	160	160	22
Depth to mottles (cm)	142	90	160	22
CF content surface layer (%)	9	0	20	28
Fine gravel content surface layer (%)	7	0	15	28
Coarse gravel content surface layer (%)	3	0	10	28
Cobble content surface layer (%)	0.1	0	3	28
CF content subsurface layer (%)	2	0	25	28
Fine gravel content subsurface layer (%)	2	0	15	28
Coarse gravel content subsurface layer (%)	1	0	10	28
Cobble content subsurface layer (%)	0	0	0	28

	Frequency of occurrence (%)	No. of observations
Texture of surface layer	SL(69), LS(29), L(2)	35
Texture of subsurface layer	S(28), LS(28), SL(28), L(16)	18
Drainage class	Well(52), moderately well(31), rapid(17)	35
Soil classification	O.DYB(69), O.SB(28), O.HFP(3)	35
Type of restricting layer	Absent	
Perviousness	Rapid to moderate	

Water regime

Beddis soils are rapidly to moderately well-drained with water tables remaining below 100 cm throughout the year. The soil remains moist during the winter months, but quickly becomes droughty in dry periods during the summer. The C horizon may occasionally have a massive structure of compact sand that is more slowly permeable than the overlying materials but not enough to create perched water table conditions.

Variability

Soil phase or variant	Frequency (no.) (%)	Description of variability
BDa	9 28	Sombic variant: Ah or Ap horizon >10 cm; also in conjunction with shallow lithic (1) phase

BDg	5	14	Gravelly phase: coarse fragment content in surface layer 20-50%; mean CF 33% (25-40%); also in conjunction with very shallow lithic (sl) phase
BDl	4	11	Shallow lithic phase: depth to bedrock 50-100 cm; mean depth 86 cm (57-100 cm); also in conjunction with sombric (a) variant
BDS	4	11	Shallow phase: less deep (50-100 cm) than specified, over similar materials but with >20% coarse fragments; mean depth 56 cm (50-60 cm); mean CF in subsoil 54% (45-60%)

Note: Other phases and variants of the Beddis soil with very limited occurrence are: loam (lo) and very shallow lithic (sl) phases and taxonomy change (t) variant.

Tolmie

Tolmie soils (TL)

Tolmie soils are poorly drained soils that have developed on deep (>100 cm), loam to silty clay textured, marine deposits that are usually stone free. Sandy loam, loamy sand, and gravelly materials occur in pockets or in a thin layer or layers throughout the soil profile. The profile description and analyses of a selected Tolmie soil are given in Appendixes 1 and 2.

Soil characteristics

Characteristic	Mean Minimum Maximum			No. of observations
	Mean	Minimum	Maximum	
Thickness of surface layer (cm)	42	7	160	139
Depth to bedrock (cm)	160	160	160	138
Depth to restricting layer (cm)	63	7	160	138
Depth to mottles (cm)	29	5	50	139
CF content surface layer (%)	4	0	20	127
Fine gravel content surface layer (%)	2	0	15	127
Coarse gravel content surface layer (%)	2	0	15	127
Cobble content surface layer (%)	0	0	10	127
CF content subsurface layer (%)	2	0	30	139
Fine gravel content subsurface layer (%)	1	0	25	139
Coarse gravel content subsurface layer (%)	0	0	10	139
Cobble content subsurface layer (%)	0	0	5	139

Characteristic	Frequency of occurrence (%)	No. of observations
Texture of surface layer	L(35), SIL(26), Peat(14), SICL(13), CL(7), SCL(2), SL(2), SIC(1)	139
Texture of 2nd layer	SICL(40), SL(19), SCL(13), CL(9), SIC(8), L(7), SIL(3), LS(1)	116
Texture of 3rd layer	SICL(43), SIC(22), SL(19), CL(7), L(5), LS(2), SCL(2)	58
Drainage class	Poor(94), very poor(6)	139
Soil classification	O.HG(89), HU.LG(7), O.G(3), R.HG(1)	139
Type of restricting layer	Fine-textured subsoil, commonly massive structured	
Perviousness	Slow	

Water regime

Tolmie soils are poorly drained soils that have distinct to prominent mottles within 50 cm of the surface. They are wet for long periods throughout the year with water tables within 30 cm of the surface from late November to early March. In spring, water tables drop quickly and remain below 50 cm from May to October. Water tables fluctuate rapidly in response to wetness and dryness. Perched water tables can occur temporarily on top of a massive-structured, fine-textured subsoil. The Tolmie soils receive runoff water from the surroundings as a result of their low landscape position.

Variability

Soil phase or variant	Frequency		Description of variability
	(no.)	(%)	
TLg	13	9	Gravelly phase: coarse fragment content in surface layer 20-50%; mean CF 27% (20-40%); also in conjunction with taxonomy change (t) variant
TLpt	20	14	Peaty phase: <40 cm of mesic or humic organic materials over mineral soil; mean thickness 20 cm (10-40 cm); also in conjunction with taxonomy change (t) variant
TLt	8	6	Taxonomy change variant: taxonomy differs from specified classification (Orthic Humic Gleysol); also in conjunction with gravelly (g) and peaty (pt) phases

Note: There is also a very limited occurrence of the shallow lithic (l) phase of the Tolmie soil.

Bellhouse**Bellhouse soils (BH)**

No simple Bellhouse (BH) map unit appears on the accompanying map sheets and, for this reason, there is no description of a Bellhouse map unit following the soil description.

Bellhouse soils are well-drained soils that have developed on shallow colluvial and glacial drift materials of channery, sandy loam texture over fractured or smooth, unweathered sandstone bedrock within 100 cm. Coarse fragment content varies between 20 and 50%. The soil has a dark-colored Ah horizon of at least 10 cm thick that is high in organic matter content. The profile description and analyses of a selected Bellhouse soil are given in Appendixes 1 and 2.

Soil characteristics

Characteristic	Mean	Minimum	Maximum	No. of observations
Thickness of surface layer (cm)	46	15	95	13
Depth to bedrock (cm)	49	15	95	16
Depth to restricting layer (cm)	49	15	95	15
Depth to mottles (cm)	160	160	160	18
CF content surface layer (%)	31	27	35	5
Fine gravel (channery) content surface layer (%)	18	10	25	5
Coarse gravel (channery) content surface layer (%)	11	5	20	5
Cobble (flaggy) content surface layer (%)	2	0	5	5
CF content subsurface layer (%)	30	30	30	2
Fine gravel (channery) content subsurface layer (%)	13	10	15	2
Coarse gravel (channery) content subsurface layer (%)	13	10	15	2
Cobble (flaggy) content subsurface layer (%)	5	0	10	2

	Frequency of occurrence (%)	No. of observations
Texture of surface layer	SL(83), L(17)	18
Texture of subsurface layer	SL(100)	2
Drainage class	Well(100)	18
Soil classification	O.SB(100)	18
Type of restricting layer	Sandstone bedrock	
Perviousness	Rapid to moderate	

Water regime

Bellhouse soils are well drained. They remain moist throughout the winter but are droughty from late spring to late fall. After infiltration, excess water drains freely and rapidly on top of the underlying sloping bedrock to lower areas.

Variability

Soil phase or variant	Frequency		Description of variability
	(no.)	(%)	
BHl	6	33	Shallow lithic phase: depth to bedrock 50-100 cm; mean depth 78 cm (60-95 cm); also in conjunction with loam (lo), paralithic (pl), nongravelly (ng), and very gravelly (vg) phases
BHlo	3	17	Loam phase: surface texture is loam; mean thickness 20 cm (10-40 cm); also in conjunction with nongravelly (ng), paralithic (pl), shallow lithic (l), and very shallow lithic (sl) phases
BHng	7	39	Nongravelly phase: coarse fragment content in surface layer <20%; mean CF 7% (0-15%); also in conjunction with loam (lo), paralithic (pl), shallow lithic (l), and very shallow lithic (sl) phases
BHsl	10	56	Very shallow lithic phase: depth to bedrock 10-50 cm; mean depth 32 cm (15-45 cm); also in conjunction with loam (lo), nongravelly (ng), paralithic (pl), and very gravelly (vg) phases
BHvg	6	33	Very gravelly phase: coarse fragment content in surface layer >50%; mean CF 59% (50-70%); also in conjunction with deep (d), shallow lithic (l), and very shallow lithic (sl) phases

Note: Other phases of the Bellhouse soil with limited occurrence are: deep (d) and paralithic (pl) phases.