AGROLOGIST'S REPORT

3401 CATHERWOOD ROAD. REVELSTOKE. BC.

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By: **Wayne A. Blashill, PAg.**
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June 25, 2018.

Signature: Wayne Blashill, PAg

WB

INTRODUCTION

This Agrologist's Report has been compiled to determine the agricultural capability and arability of a property at 3401 Catherwood Road in Revelstoke, BC. The property is within the Agricultural Land Reserve. The legal description of the property is:

Lot 1, Sec 11, Twp 23, R2, W6M, Kootenay District. Plan 7126 Except part included in Plan 7169.

The owners full name and contact information is:

Stephen Michael Revell
3401 Catherwood Road
Revelstoke, BC. V0E 2S0

Agrologist Background

Mr. Blashill, PAg has worked on several ALC applications. Mr. Blashill has a soil science background, which is essential in assessing land-based activity within the ALR. Soils experience is required: to estimate the depth & extent of the topsoil resource, and to calculate climatic & land capability classes for agriculture. The Agrologist's opinion is based on that experience, an understanding of the climatic conditions in the area, the site & soil observations along with the operational constraints & details of the land from the owner.

METHODS

The site was inspected on May 22, 2018. Five (5) soil pits were excavated by hand on the 7.8-acre parcel. The soil pits were placed to sample the range of soils at the site. Appendix A contains the photographs of each soil test pit. The BC Ministry of Forests FS882 field form was used to record the data. The soil pit locations are depicted in Figure 1. Appendix B contains the original soil description data collected. The pits are labelled TP1 thru TP5.

The soil horizons were described to determine the agricultural capability, depth of soil and surface gravel content. Soil colour (Macbeth, 1992), roots, % coarse fragments, texture are among the factors used to differentiate soil horizons and topsoil depth & extent. A total of 5 hours was spent at the property.

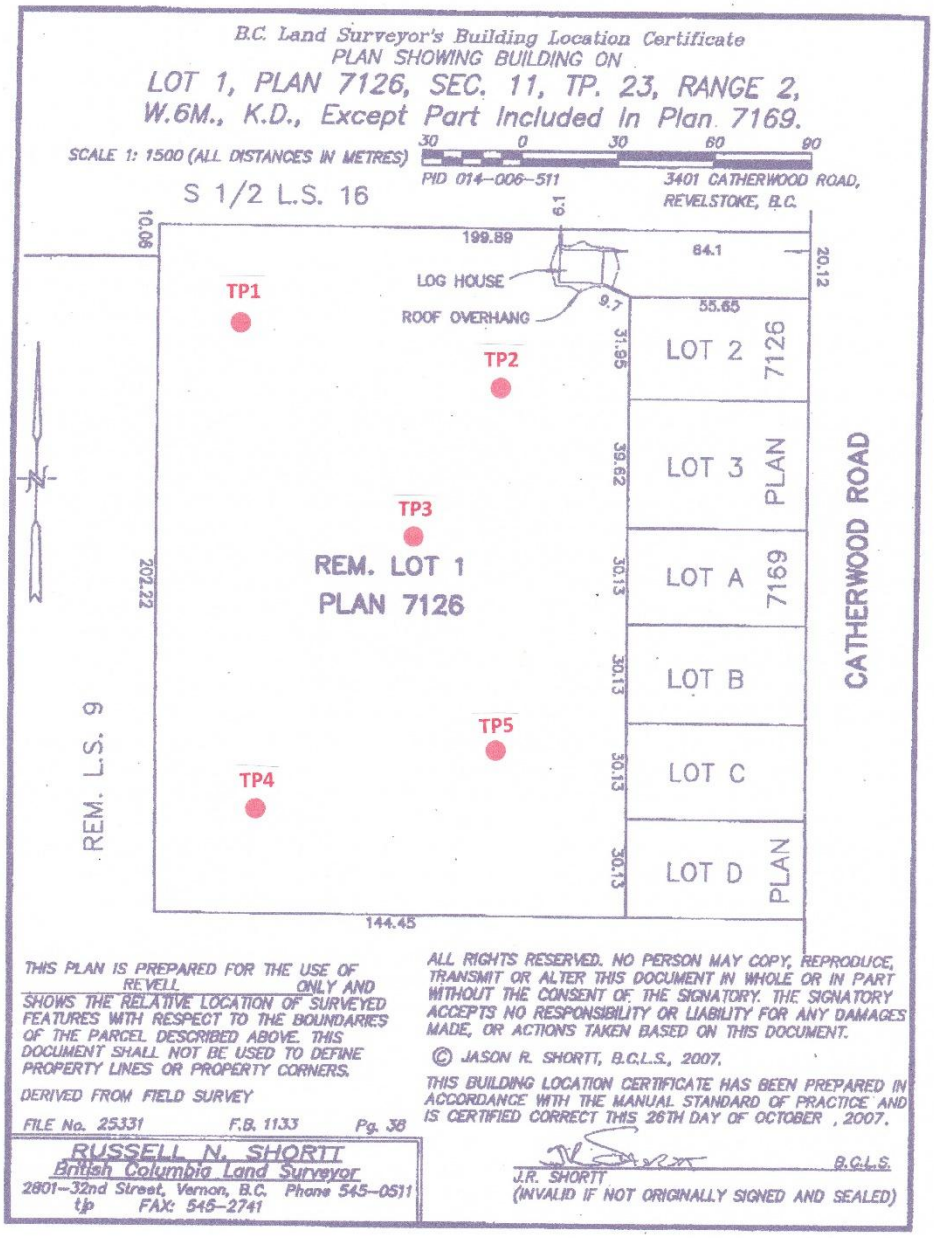

Figure 1. Soil Test Pit locations at the subject property.

RESULTS

It was determined from field inspection that the landform is generally a silty sandy glacial fluvial undulating blanket ($sF^{G}bu) Howes & Kenk (1988). The landform is uniform across the acreage.

Soils

Table 1 is part of the soil description from TP1. Table 2 for TP5. The entire test pit descriptions can be found in Appendix B. The soil at TP1 is an Orthic Humic Gleysol (NRC, 1998). It has an Ah >10cm, Bg horizon plus prominent and distinct mottles within 50cm of the mineral soil surface. The soil at TP5 is a Gleyed Humic Regosol. It has an Ah>10cm, but with only faint mottles within 50cm of the mineral surface.

Table 1. Soil description for pit TP1. Orthic Humic Gleysol on a glacial fluvial blanket.

HORIZON	DEPTH (cm)	SOIL COLOUR	MOTTLES COLOUR	MOTTLES CONTRAST	SOIL TEXTURE	COARSE FRAGMENTS (%)
LFH	3-0	--	--	--	--	
Ah1	0-18	10YR3/1	--	--	loam	0
Ah2	18-28	10YR3.5/1	--	--	sandy loam	0
Bg	28-46	2.5Y3/1	7.5YR3/3	prominent	sand	0
Cg1	46-78	2.5Y3/2	10YR3/6	distinct	sand	0
Cg2	78-100	2.5Y3/2	--	faint	sand	0

Table 2. Soil description for pit TP5. Gleyed Humic Regosol on a glacial fluvial blanket.

HORIZON	DEPTH (cm)	SOIL COLOUR	MOTTLES COLOUR	MOTTLES CONTRAST	SOIL TEXTURE	COARSE FRAGMENTS (%)
LFH	3-0	--	--	--	--	
Ah	0-23	10YR2/1	--	--	sandy loam	0
Cgj	23-57	2.5Y4/1	--	faint	loamy sand	0
Cg1	57-82	2.5Y4/1	10YR5/4	distinct	sand	0
Cg2	82-100	2.5Y4/2	10YR5/5	distinct	sand	0

Soil Drainage

The soils all have mottles indicating periods of fluctuating water table or seepage water. Seepage water is the mostly likely source, due to the steep adjacent mountain-side to the east. Rainfall and snowmelt move downslope through the soil and seep out onto the valley flat. The remnant forest vegetation also indicates a moist seepage soil with cedar, hemlock, devil's club and lady-fern.

Colours such as red and reddish brown are encouraged under oxidized conditions, while the subdued shades of grays and blues predominate if insufficient O_2 is present. The mottled condition indicates a zone of alternate acceptable and poor aeration, a condition not conducive to proper plant growth (Brady, 1974).

Soil Chemistry

The soil chemistry sample is used to determine the fertility of the topsoil (Tables 3). Appendix B has the complete analysis page from Exova (2018). The data is used to characterize the nutritional status of the soil.

Table 3. Soil chemistry analysis for the Ah1 horizon from TP1.

SAMPLE	pH	%OM	NO_3^- (ppm)	CEC (meq/100g.)	P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	EC (dS/m)
Ah1 (0-18)	5.8	4.7	<2	12.0	20	78	380	30	0.07

The bar graph from the Exova analysis for TP1 shows phosphorus, calcium and iron as acceptable. Potassium, sulfate-S, copper, zinc and manganese are marginal. Nitrate-N, magnesium, boron and chlorine are deficient. The pH is slightly acidic, the EC is okay and the %OM is normal. The overall nutritional status of the topsoil is considered moderate.

Climatic Capability

The nearest climate station is Revelstoke at 456 m in elevation (RAB, 1972). The climatic capability for agriculture is represented by the symbol:

3A
(1aF)

Aridity Class 3A could be improved through irrigation to Class 1. But, there is no water source for irrigation. Climatic subclass (F) means minimum temperatures near freezing will adversely affect plant growth during the growing season. There can be early fall frosts in these West Columbia mountain valleys. Cold, dense air flows down the mountain sides like a fluid and pools on the valley floor. These frosts limit the production of commercial crops. The Revell land location would be subject to early frost.

The climate subclass (1a) has a freeze free period of 120 to 150 days and growing degree days (above 5^oC) of 1505 to 1779. The rating (1a) indicates the *theoretical* crops that can be grown. Crops include: hardy apples, berries, a wide range of vegetables, tomatoes, cereal grains and forage crops.

However, the (1a) rating is considered borderline in the Revelstoke area, because local growers need greenhouses for tomato production. Tomatoes must be able to be field grown to qualify for the (1a) climate subclass. The main commercial crop currently grown in the Revelstoke valley is hay and forage for livestock.

Agricultural Capability

The climatic capability predicts the *theoretical* crops that you can grow. The agricultural land capability rating determines the soil limitations & constraints that will be encountered in growing those crops (Kenk, 1983).

It was determined that the principle soil limitation at the property was excess water (W). The definitions are as follows:

> CLASS 4W
> *"Frequent or continuous occurrence of excess water during the growing period causing moderate crop damage and occasional crop loss. Water level is near the soil surface during most of the winter and/or until late spring preventing seeding in some years, or the soil is very poorly drained."*
>
> CLASS 5W
> *"Frequent or continuous occurrence of excess water during the growing period making the land suitable for only perennial forage crops and/or improved pasture. The soil is very poorly drained, commonly with shallow organic surface layers."* (Note: the full definition is on page 30 in Kenk, 1983)

The 4W seems to be the best fit given the soil mottles, imperfect drainage and site factors. These soils do not have surface organic layers. But, since local farmers are growing only perennial forage crops, it also fits part of the 5W definition. Excess water reduces the range of crops that can be grown. These Gleysol soils preclude the planting of most agronomic species, especially root crops. That would explain why adjacent farms only grow hay.

There are no improved ratings for the 4W or 5W soil limitations. It is not considered feasible to drain this property. A perimeter drainage ditch would drain the adjacent properties as much as the subject parcel, negating the improvement. Moreover, there is no outlet for the drained water.

Crop Valuation

A beef producer in the Revelstoke valley was contacted about the economic value of hay production in the Airport Way area (Graham, 2018). A good soil without irrigation will produce about 2 tons/acre of hay. The total income for the subject property would be:

[(7.2 acres) x (2 ton/acre) x ($150/ton) = $2,160 per year]

This would not be enough income to qualify for Farm Assessment status. The land still needs to be logged, cultivated and seeded to get the entire parcel into hay. Subtract the cost of haying and delivery each year. The net result would be zero income for the farmer. Given the fact that hay is the only crop that can be grown in this area and given

the probable negative value of the crop. It is not surprising that the parcel currently does not have Farm Assessment status.

The rancher also stated that high summer rainfall in the area can further reduce yield. If it rains too much, haying is delayed and bales in the field can be ruined. A wet summer would exacerbate the wet soils that already exist at the site. Recall that the 4W soil on its own can result in crop damage and occasional crop loss.

DISCUSSION

It is the Agrologist's opinion that the agricultural capability for the subject property is borderline between Class 4W and 5W. It has characteristics of both. The Gleysol and Gleyed subgroup soils at the site, limit the range of crops that can be grown. Hay is the only crop that can be grown here. Hay sales would not be enough to maintain Farm Assessment status and would not be economically viable.

There is an access problem on the north side of the house. Farm machinery and equipment operators may find the driveway narrow.

The owner intends to use the property as a vacation rental. It is the Agrologist's opinion that there would be none to negligible impact of the vacation rental on the ability to hay this acreage.

It has been said that farmers on land of this type could build greenhouses or facilities for poultry production. There would have to be a local market for that to be feasible and it would require significant investment. Revelstoke is just a small community. Asking a landowner to build those types of structures would incur a large financial burden, with no expectation of income.

OVERALL CONCLUSION

The overall condition of the soil, the amount of water impacting the site and the climate means this site is not suitable for any agricultural use other than for hay cropping which would not, in any event, be economically viable.

REFERENCES

Brady, N.C. 1974. *The Nature and Properties of Soils*. MacMillan Publishing Co. New York. Page 265.

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Howes, D.E. and E. Kenk. 1988. Terrain Classification System for British Columbia. MOE. Manual 10. Ministry of Environment. Victoria.

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RAB. 1972. Climatic Capability Classification for Agriculture in BC. Resource Analysis Branch. Province of BC. Victoria. Pages 6, 8, 12.

APPENDIX A

Photo Diary

Photo#1. Soil pit TP1. Orthic Humic Gleysol (Ah, prominent & distinct mottles above 50cm) on a glacial-fluvial blanket.

Photo#2. Soil pit TP2. Gleyed Humic Regosol (Ah, only faint mottles above 50cm) on a glacial-fluvial blanket.

Photo#3. Soil pit TP3. Rego Humic Gleysol (Ah, distinct mottles above 50cm) on a glacial-fluvial blanket.

Photo#4. Soil pit TP4. Rego Humic Gleysol (Ah, distinct & prominent mottles above 50cm) on a glacial-fluvial blanket.

Photo#5. Soil pit TP5. Gleyed Humic Regosol (Ah, only faint mottles above 50cm) on a glacial-fluvial blanket.

Photo#6. Hayfield on the north part of the property with moderate forage.

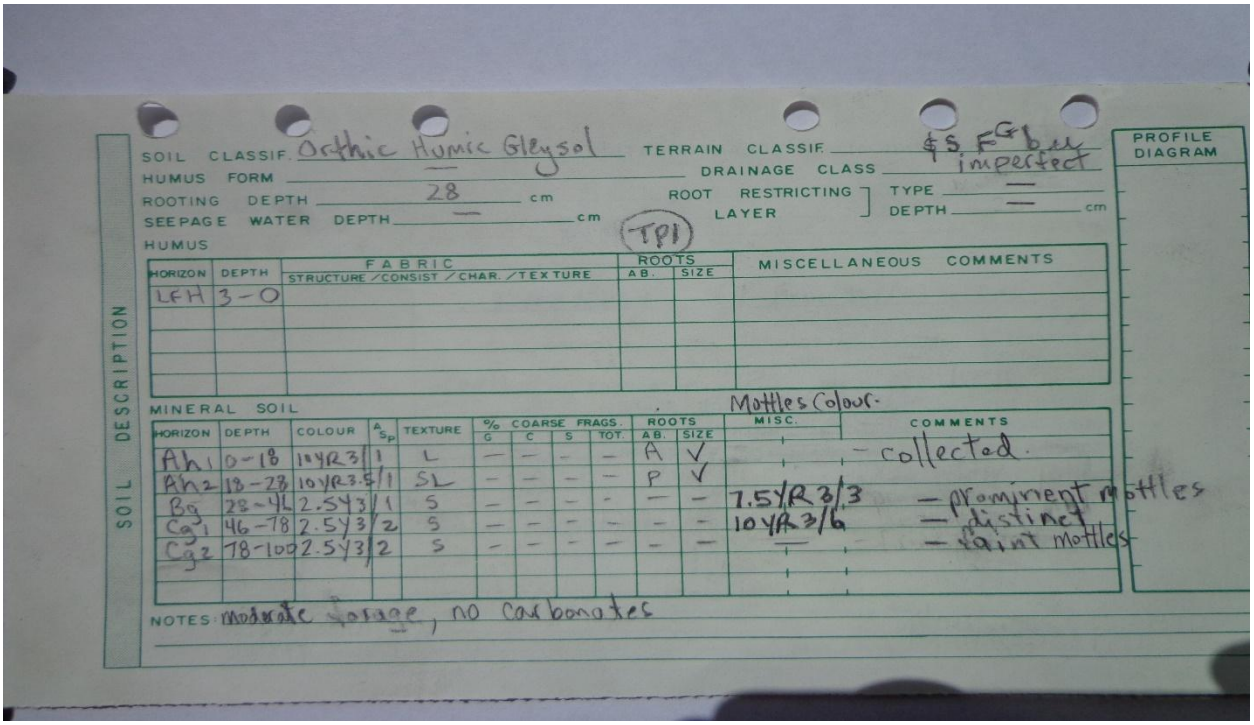
Photo#7. Shrubby vegetation in the moist meadows on the south part of the property.

APPENDIX B

FS882 Field Forms

Soil Chemistry Analysis

Agrologist Resume



SOIL DESCRIPTION

SOIL CLASSIF. Orthic Humic Gleysol — TERRAIN CLASSIF. S S F G bu
HUMUS FORM — DRAINAGE CLASS imperfect
ROOTING DEPTH 28 cm — ROOT RESTRICTING LAYER — TYPE — DEPTH — cm
SEEPAGE WATER DEPTH — cm
HUMUS

TP1

PROFILE DIAGRAM

HORIZON	DEPTH	FABRIC STRUCTURE / CONSIST / CHAR. / TEXTURE	ROOTS AB.	ROOTS SIZE	MISCELLANEOUS COMMENTS
LFH	3-0				

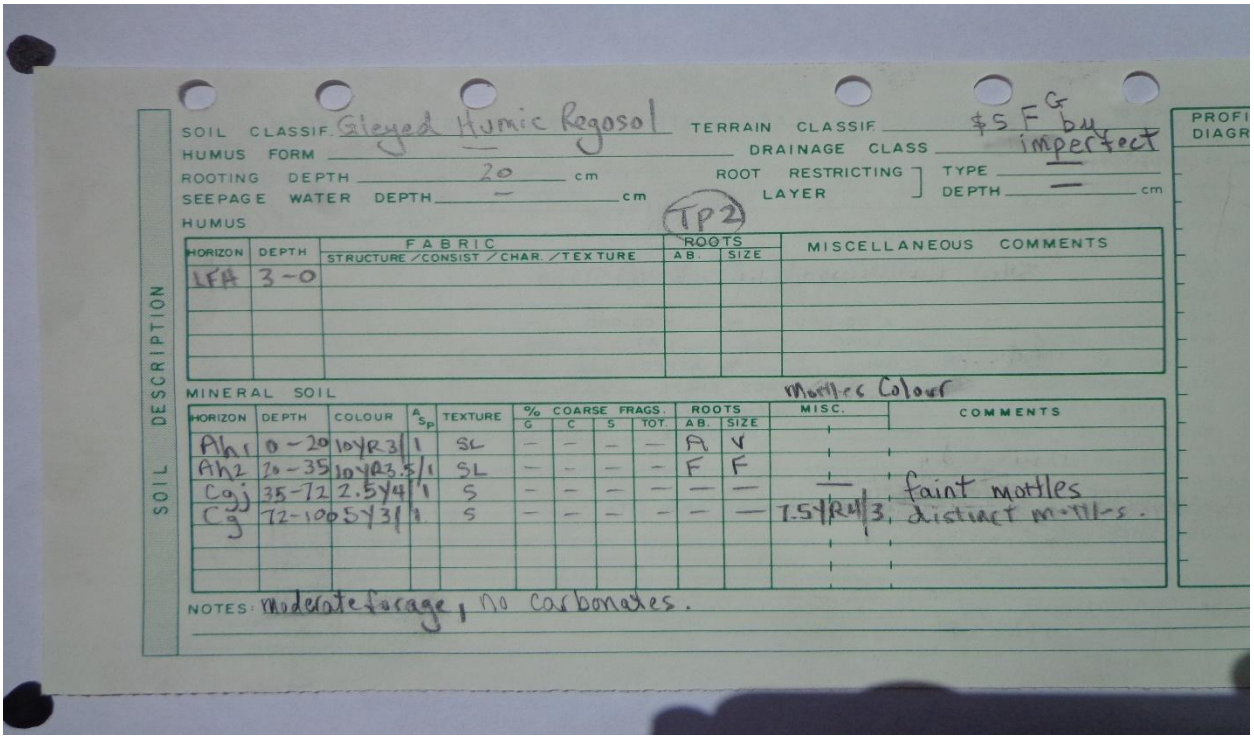
MINERAL SOIL

Mottles Colour.

HORIZON	DEPTH	COLOUR	A_{Sp}	TEXTURE	% COARSE FRAGS G	C	S	TOT.	ROOTS AB.	SIZE	MISC.	COMMENTS
Ah_1	0-18	10YR3/1	1	L	—	—	—	—	A	V		collected.
Ah_2	18-28	10YR3.5/1	1	SL	—	—	—	—	P	V		
Bg	28-46	2.5Y3/1	1	S	—	—	—	—	—	—	7.5YR3/3	— prominent mottles
Cg_1	46-78	2.5Y3/2	2	S	—	—	—	—	—	—	10YR3/6	— distinct
Cg_2	78-100	2.5Y3/2	2	S	—	—	—	—	—	—		— faint mottles

NOTES: moderate forage, no carbonates

FS882 Soil Description Field Card for soil pit TP1.



SOIL DESCRIPTION

SOIL CLASSIF. Gleyed Humic Regosol — TERRAIN CLASSIF. S S F G bu
HUMUS FORM — DRAINAGE CLASS imperfect
ROOTING DEPTH 20 cm — ROOT RESTRICTING LAYER — TYPE — DEPTH — cm
SEEPAGE WATER DEPTH — cm
HUMUS

TP2

PROFI DIAGR

HORIZON	DEPTH	FABRIC STRUCTURE / CONSIST / CHAR. / TEXTURE	ROOTS AB.	ROOTS SIZE	MISCELLANEOUS COMMENTS
LFH	3-0				

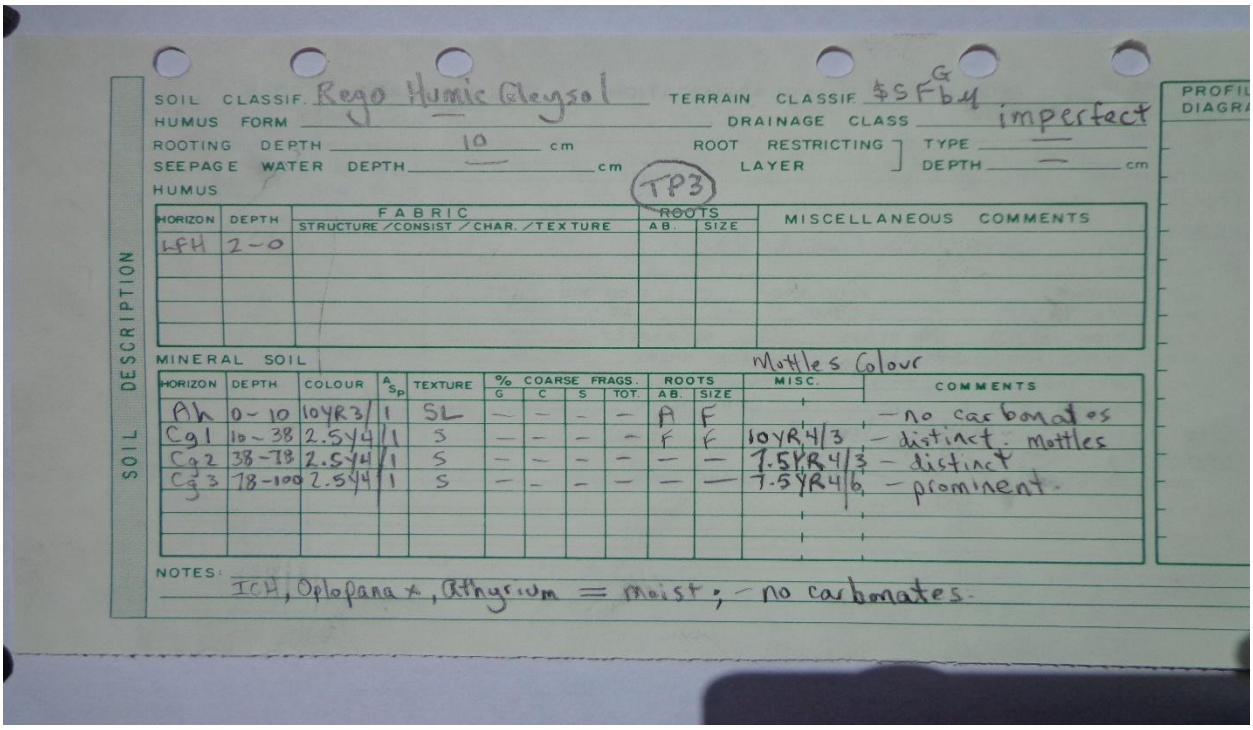
MINERAL SOIL

Mottles Colour

HORIZON	DEPTH	COLOUR	A_{Sp}	TEXTURE	% COARSE FRAGS G	C	S	TOT.	ROOTS AB.	SIZE	MISC.	COMMENTS
Ah_1	0-20	10YR3/1	1	SL	—	—	—	—	A	V		
Ah_2	20-35	10YR3.5/1	1	SL	—	—	—	—	F	F		
Cg_1	35-72	2.5Y4/1	1	S	—	—	—	—	—	—		faint mottles
Cg	72-100	5Y3/1	1	S	—	—	—	—	—	—	7.5YR4/3	distinct mottles.

NOTES: moderate forage, no carbonates.

FS882 Soil Description Field Card for soil pit TP2.



SOIL CLASSIF. Rego Humic Gleysol TERRAIN CLASSIF. $SFGbu
HUMUS FORM — DRAINAGE CLASS imperfect
ROOTING DEPTH 10 cm ROOT RESTRICTING LAYER TYPE — DEPTH — cm
SEEPAGE WATER DEPTH — cm
HUMUS
TP3

SOIL DESCRIPTION

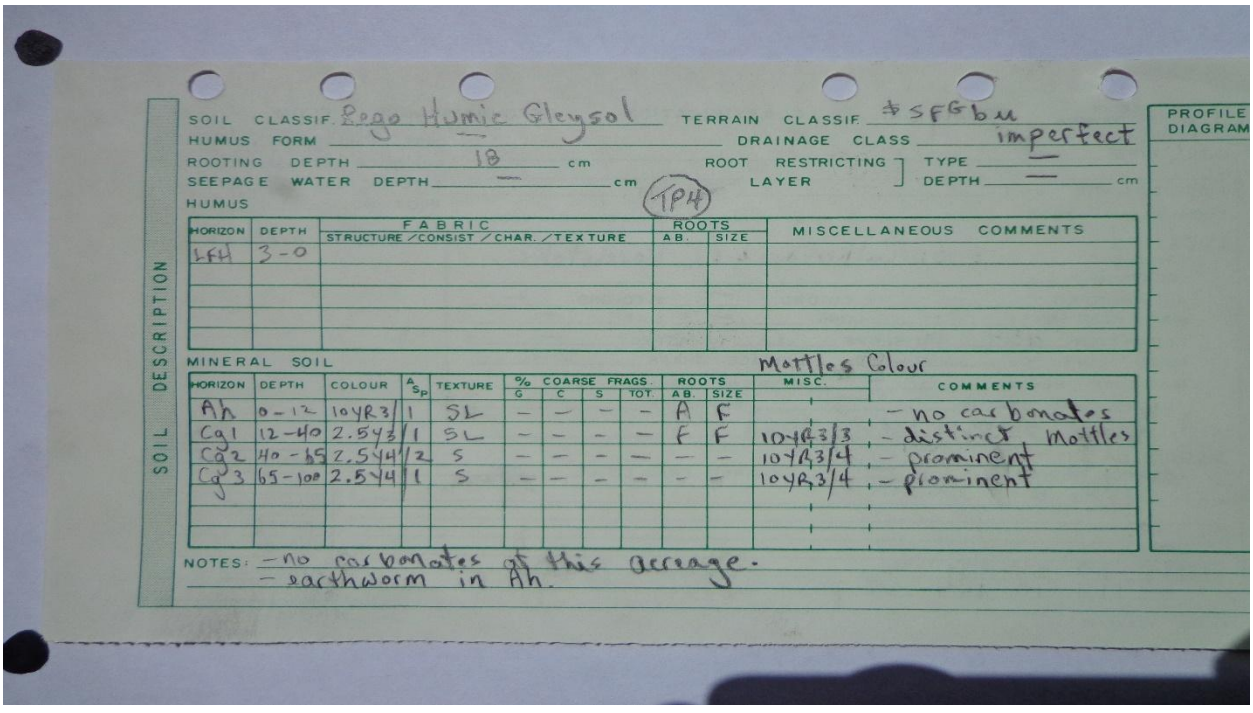
HORIZON	DEPTH	FABRIC STRUCTURE/CONSIST/CHAR./TEXTURE	ROOTS AB.	ROOTS SIZE	MISCELLANEOUS COMMENTS
LFH	2-0				

MINERAL SOIL — Mottles Colour

HORIZON	DEPTH	COLOUR	A_{sp}	TEXTURE	% COARSE FRAGS G	C	S	TOT.	ROOTS AB.	SIZE	MISC.	COMMENTS
Ah	0-10	10YR3/1		SL	—	—	—	—	A	F		- no carbonates
Cg1	10-38	2.5Y4/1		S	—	—	—	—	F	F	10YR4/3	- distinct. Mottles
Cg2	38-78	2.5Y4/1		S	—	—	—	—	—	—	7.5YR4/3	- distinct
Cg3	78-100	2.5Y4/1		S	—	—	—	—	—	—	7.5YR4/6	- prominent.

NOTES: ICH, Oplopana *, Athyrium = moist; - no carbonates.

FS882 Soil Description Field Card for soil pit TP3.



SOIL CLASSIF. Rego Humic Gleysol TERRAIN CLASSIF. $SFGbu
HUMUS FORM — DRAINAGE CLASS imperfect
ROOTING DEPTH 18 cm ROOT RESTRICTING LAYER TYPE — DEPTH — cm
SEEPAGE WATER DEPTH — cm
HUMUS
TP4

SOIL DESCRIPTION

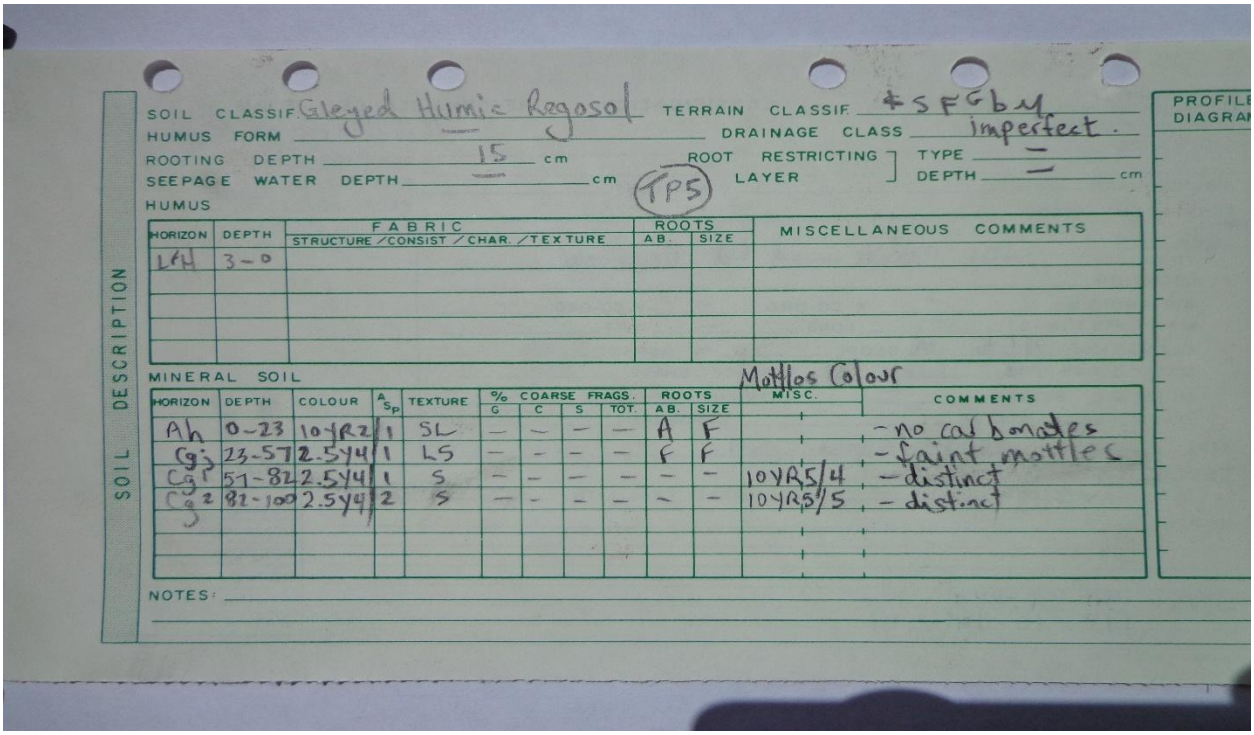
HORIZON	DEPTH	FABRIC STRUCTURE/CONSIST/CHAR./TEXTURE	ROOTS AB.	ROOTS SIZE	MISCELLANEOUS COMMENTS
LFH	3-0				

MINERAL SOIL — Mottles Colour

HORIZON	DEPTH	COLOUR	A_{sp}	TEXTURE	% COARSE FRAGS G	C	S	TOT.	ROOTS AB.	SIZE	MISC.	COMMENTS
Ah	0-12	10YR3/1		SL	—	—	—	—	A	F		- no carbonates
Cg1	12-40	2.5Y3/1		SL	—	—	—	—	F	F	10YR3/3	- distinct Mottles
Cg2	40-65	2.5Y4/1	2	S	—	—	—	—	—	—	10YR3/4	- prominent
Cg3	65-100	2.5Y4/1		S	—	—	—	—	—	—	10YR3/4	- prominent

NOTES: - no carbonates of this acreage.
- earthworm in Ah.

FS882 Soil Description Field Card for soil pit TP4.



SOIL DESCRIPTION

SOIL CLASSIF. Gleyed Humic Regosol TERRAIN CLASSIF. ±SFGbM

HUMUS FORM — DRAINAGE CLASS imperfect.

ROOTING DEPTH 15 cm ROOT RESTRICTING LAYER TYPE — DEPTH — cm

SEEPAGE WATER DEPTH — cm (TP5)

HUMUS

HORIZON	DEPTH	FABRIC STRUCTURE/CONSIST/CHAR./TEXTURE	ROOTS AB.	ROOTS SIZE	MISCELLANEOUS COMMENTS
LFH	3-0				

MINERAL SOIL

Mottles Colour

HORIZON	DEPTH	COLOUR	A_{Sp}	TEXTURE	% COARSE FRAGS. G	C	S	TOT.	ROOTS AB.	SIZE	MISC.	COMMENTS
Ah	0-23	10YR2/1	1	SL	—	—	—	—	A	F		- no carbonates
Cg_1	23-57	2.5Y4/1	1	LS	—	—	—	—	F	F		- faint mottles
Cg_1	57-82	2.5Y4/1	1	S	—	—	—	—	—	—	10YR5/4	- distinct
Cg_2	82-100	2.5Y4/1	2	S	—	—	—	—	—	—	10YR5/5	- distinct

NOTES:

FS882 Soil Description Field Card for soil pit TP5.

Exova
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W: www.exova.com

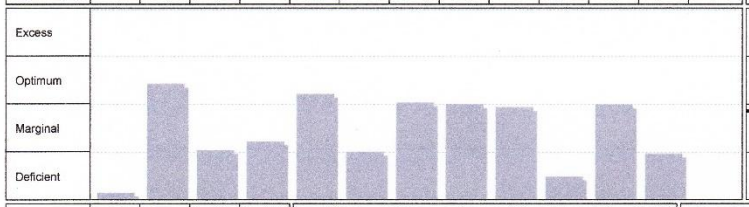
Exova

Farm Soil Analysis

Bill To:	Cash Account	Grower Name:	3401 Catherwood Road	Lot Number:	1273028
Report To:	Cash Account	Client's Sample Id:		Report Number:	2289816
		Field Id:	TP1 Ah1 (0-18)	Date Received:	May 24, 2018
	11519 Quinpool Road	Acres:		Disposal Date:	Jun 23, 2018
	Summerland, BC., Canada	Legal Location:		Report Date:	May 29, 2018
	V0H 1Z5	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	112534				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 18"	<2	20	78	2	380	30	56.6	0.8	1	<0.2	2.2	4	



Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
5.8	0.07	4.7	6107907

Alkaline	*Extreme*	*High*	
Neutral	*Very High*	*Normal*	←
Acidic	*High*	*Low*	←
Very Acidic	*Good*	*Very Low*	←

Total lbs/acre	12	120	469	12
Estimated lbs/acre	13	81	157	13

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a
Lime 1 T/ac Buffer pH 6.7 Est. N Release n/a K/Mg Ratio n/a

BS 44 % CEC 12 meq/100 g
Ca 35 % Mg 4.7 % Na <2.4 % K 3.7 %
TEC 5.3 meq/100 g Na <30 ppm

*Nitrate-N **Sulfate-S n/a = not analysed

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Hay - Legume				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.2	96	19	69	15	3.5	12	20	86	17
Average	2.8	72	12	58	11	2.6	9	14	76	16
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.2	0 / 159	0 / 47	0 / 202	0 / 20	3.5	0 / 207	0 / 53	0 / 194	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	2.0	0.0

Add Boron or try a test strip.
Magnesium %BS is low.

Parts of the field may be Zinc deficient.
Add Boron or try a test strip.
Magnesium %BS is low.

Comments:.

Recommendations are based on general research consensus. They should not replace responsible judgement.

RESUME

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RELEVANT EXPERIENCE

Vineyard Soil Survey.

Agriculture Canada. Summerland Research Station. **Consultant.** 2010-2013. Soil survey on 325 vineyards in the Okanagan and Similkameen to verify soil mapping completed in 1980's. They wanted to correlate the soil name, texture and % coarse fragments with grape variety and management practices to determine factors in producing award winning wines. Contact: Scott Smith (250) 494 7711.

Soil Arability Mapping.

Burns Lake Cattleman's Association, Westland Resource Consultants, Herb Luttmerding. **Consultant.** 1998-2007. Soil survey and mapping from Smithers to Valemount and MacKenzie to Hixon in the BC Central Interior. Soil name, agricultural capability and arability were determined on approx. 186,000 ha over 10 years. Arable land was placed into the ALR for future farming.

Agrologist Reports.

Vineyard, orchard owners and other landowners. **Consultant.** 1998-2016. Complete a variety of reports for ALC applications for subdivision, alternate use, swaps and exclusion. Climate station, site and soils description data is used to determine climatic and agricultural capability. The amount of arable land is estimated. Find creative solutions for landowners to meet their environmental and legal obligations, while continuing to operate their farms and business's.

Revelstoke Soils Description & ID Course.

Columbia Mountains Institute of Applied Ecology (CMI). Revelstoke soils tour. **Instructor.** 2017. Instruct students in soils description and classification. Field techniques for soil texture, colour and % coarse fragments etc. were demonstrated. Soils data was applied to agriculture, forestry, mining, oil & gas activities. Contact: Hailey Ross (250) 837 9311.

EDUCATION

Bachelor of Science. Biology/Ecology. University of Victoria. 1977. Pertinent courses: plant physiology, plant anatomy, ecology, botany, biostatistics, geomorphology, population ecology, organic chemistry.

MSc. Candidate. Soil Science Department. University of British Columbia. 1982-1984. Pertinent courses: soil chemistry, soil physics, soil classification, biometeorology, forest soils, tree nutrition, soil and water conservation.

British Columbia Institute of Agrologists. Professional Agrologist in good standing. Past Branch President and Vice-President. Okanagan Branch. 1998-2018.