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October 19, 2019

Cortes Community Housing Project
c/o Mr. Ian Scott
Ian Scott Planning Services
Sent via e-mail: Ian Scott <ianscottconsulting@gmail.com>

RE: PROPOSED REZONING FOR PHASE I OF - EAST 1/2 OF NW 1/4 SECTION 7, AND LOT 1, PLAN VIP71344, CORTES ISLAND

OUR FILE: 0921

Dear Sir:

The following report summarizes our site and soil evaluation and proposed on-site sewerage system design in support of the rezoning application for Phase I, Rainbow Ridge of the above noted property. It includes recommendations for the proposed level of treatment and treatment technology. It indicates proposed primary and reserve dispersal areas (drainfields) and discusses dispersal system technology, hydraulic and linear loading rates and a proposed treatment level for nitrogen to protect drinking water (wells) and to address concerns regarding nutrient loading to downstream water bodies i.e., Hague Lake.

BACKGROUND AND PROPOSED DEVELOPMENT

The parent property has an area of 20.6 hectares (51 acres). It is in Mansons Landing, near the centre of the community (east of Sutil Point Road and bounded to the north by Beasley Road and to the south by Cemetery Road). Several potential community housing projects are being considered for the property. The first project being planned (Phase 1) is a 20 - unit affordable housing project for families, seniors and other needy households. It is proposed to be located on the north-west portion of the property just south of the firehall and adjacent to the existing seniors housing site to the west.

SITE AND SOIL EVALUATION

A site and soil evaluation was carried out by the author at the parent property to evaluate the potential for onsite wastewater systems with dispersal of effluent to ground in accordance with the BC Sewerage System Regulation (SSR). 31 Machine dug test pits and evaluation of the soil profile were carried out on April 16 and 17, 2018 (TP1 to TP26) and on October 25, 2018 (TP27 to TP31). Test pits TP1 to TP6 and TP27 are within the proposed Phase I project – the subject property of this proposed re-zoning. APPENDIX 1 (attached) contains soil information within in the Phase I boundary.

The property is generally forested (2nd growth conifers and some deciduous species) with typical native understory vegetation and ground cover.

Land slope on the site and in the area of proposed septic fields areas ranges from approximately 4% to 10 %.

Soils in the proposed Phase I area are considered well drained. The land is generally free of negative effects of surface water runoff, flooding, erosion and bedrock outcrops. There are no

freshwater bodies and no existing drinking water wells. There are no potential effluent breakout locations within 7.5m of the proposed dispersal areas.

The observed soils are primarily sands and loamy sands; medium to coarse grained; loose and; gravelly to very gravelly (some extremely gravelly). Some of the pits contained sandy loam; moderate structure; friable; and gravelly to very gravelly. Many pits contain cobbles >75mm size. There is a lower permeability layer underlying the coarser soils. It is typically a loamy sand or sandy loam and is typically massive, dense to hard/lightly to moderately cemented and gleyed and distinctly mottled. Seepage observed in the pits in April 2018 indicates a seasonally perched water table on top of this layer.

Observed soil depths above the limiting layer (seasonal high-water table or flow restrictive layer) and suitable for soil-based treatment range from 55cm to 100cm for the Phase I parcel and from 70cm to 90cm within the proposed dispersal area.

Field saturated hydraulic conductivity (Kfs) is estimated at 1000 mm/day to 4000 mm/day based on soil texture, structure and gravel content. Percolation testing results of 1.5 minutes/inch to 4 minutes/inch are reported. These rates are typical of the observed soils and consistent with the estimated hydraulic conductivity noted above.

SITE CAPABILITY AND OPPORTUNITIES

The site and soil conditions are favorable for the dispersal and treatment of sewerage system effluent in accordance with the SSR and the BC Standard Practice Manual (SPM Version 3). The sandy gravelly soils and higher permeability allow for higher hydraulic loading rates and hence more compact dispersal areas.

Pressure distribution of effluent with timed micro-dosing is proposed to optimize soil-based treatment and pathogen removal in the soil. Time dosing keeps the soil in an unsaturated state, promoting aerobic conditions and a healthy microbial environment. It also extends the life of the drainfield by reducing the potential for soil pore clogging.

The site and soils are also favorable to support higher linear loading rates. Dispersal systems perform best when the fields are long parallel to the contours. This will reduce the potential for groundwater mounding under the fields – groundwater mounding decreases the available unsaturated soil depth.

Drainfield options for the Phase I project based on available soil depth above the limiting layer are as per the following table:

AVAILABLE SOIL DEPTH	DRAINFIELD TYPE
75cm to 100cm	Shallow trench system
60cm to 75cm	At-grade system

An advanced Type 2 treatment level is recommended for larger flow systems on the site. This will reduce the required drainfield area and minimize loss of trees and disruption to vegetation. Coupled with good soil-based treatment for effluent polishing and contaminant removal, these systems protect groundwater and public health and minimize impacts to the downstream receiving environment.

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PHASE 1 – RAINBOW RIDGE: USE, OCCUPANCY AND DESIGN FLOW

The proposed rezoning for Phase I, Rainbow Ridge is for a 20 unit affordable housing project consisting of 8 – 1 bedroom units, 8 – 2 bedroom units and 4 – 3 bedroom units. The Daily Design Flow (DDF) is 14,850 litres per day based on the occupancy rates and per capita flows outlined in the following table:

Unit	Occupancy Rate	Per Capita Average Flow Rate	Average Daily Unit Flow	Peaking Factor	Peak Daily Unit Flow	Number of Units	Peak Daily Design Flow (DDF)
	Persons	Litres/day	Litres/day		Litres/day	Each	Litres/day
1 bedroom	2	135	270	2.0	540	8	4,320
2 bedroom	3	135	405	2.0	810	8	6,480
3 bedroom	3.75	135	506	2.0	1012	4	4,050
Total						20	14,850

The above per capita flow rates are based on conserver water use rates typical of the northern gulf islands and actual measured flows from similar facilities (e.g. the existing Cortes Seniors housing project adjacent to this site). Occupancy rates are as per Table II-9 of BC Standard Practice Manual (SPM-V3). A peaking factor of 2.0 is used to calculate peak Daily Design Flows – this is a typical factor for residential systems.

PROPOSED SEWERAGE SYSTEM

The proposed treatment level is "advanced" Type 2 as defined in the SSR. Type 2 treatment is defined as effluent with a Biochemical Oxygen Demand (BOD) of 45mg/l and Total Suspended Solids (TSS) of 45mg/l. No specific requirements for pathogens (i.e. Fecal Coliform as an indicator organism) or nutrients (Nitrogen and Phosphorous) are specified for Type 2 Effluent. "Advanced" Type 2 exceeds the basic biologic treatment levels noted above (typically 10 to 20 mg/l BOD and TSS), has a reduced fecal coliform level and provides for increased Nitrogen reductions (ammonia and nitrates).

The proposed treatment system is a recirculating packed bed biological filter utilizing textile media. The treatment process is similar to a sand filter, but the area and size of the filter is much smaller and it is easily accessed for inspection of the filter surface and cleaning of the media as required. The proposed system is AdvanTex by Orenco systems. Rationale for using this system includes: 1. Good biological treatment and low energy consumption; 2. Good reduction in fecal coliform; 3. Stable consistent treatment performance and the ability to function well during periods of low flow and during peak flow events; 4. Systems are typically odorless and noise free (they do not utilize compressors for aeration and typically rely on passive ventilation of the filter); 5. Favorable nitrogen reduction without having to provide additional (and often complex) nitrogen reduction steps in the treatment process; 6. Familiarity and track record on Cortes Island; 7. Simple maintenance requirement and access to existing maintenance providers serving other systems on the island and; 8. The option of remote monitoring and operation of the system using telemetry controls. This includes identification of alarms and the ability to troubleshoot problems remotely. This can significantly reduce emergency callout costs and response time. Remote monitoring is well suited for "remote" locations like Cortes Island where service providers typically must travel from Vancouver Island.

Proposed target effluent quality is: 20/20 mg/l BOD/TSS; 10,000 CFU/100ml fecal coliform and; Total Nitrogen 20mg/l.

Systems consist of primary (septic tank) treatment, flow equalization (reduce peak flow rates to the system), recirculation tank for dosing the textile filters and drainfield dosing tank for pressure distribution to the fields. A portion of the treated effluent is returned to the anoxic zone in the primary tanks where there is an available carbon source for denitrification of the effluent (transformation of nitrates to nitrogen gas).

As noted above the plan is to micro-dose the dispersal fields and use shallow trench or at-grade distribution to optimize removal of contaminants and pathogens in the soil. This will also minimize damage to tree root systems. The goal is to locate drainfield lines in locations that will allow thinning of trees rather than clearing the areas. Lines can be curved to minimize tree and vegetation removal.

The use of vegetated bed systems are also proposed, with the goal of nutrient uptake and removal of contaminants in the biologically active rhizosphere. This has been used successfully at the Cortes Natural Foods Co-op (downhill of this project) in Manson's Landing.

DISPERSAL AREA SIZING

An hydraulic loading rate (HLR) of 60 litres/day/sq.m. is selected for the dispersal fields based on Type 2 effluent to sand and a percolation rate of 4 minutes per inch. This rate is reduced to compensate for the native soil coarse fraction (>2mm size) of approximately 60%. The adjusted HLR is 45 lpd/sq.m. and is considered conservative for the proposed advanced secondary effluent quality. For the Daily Design Flow of 14,850 litres per day this results in an infiltration area of 330 sq.m.

A linear loading rate (LLR) of 180 to 250 litres per day/lineal meter is chosen based on the soil texture (gravelly medium to coarse sand), a site slope of 5% +/- and a soil depth of 90cm +/-. This results in a recommended design contour length of 60m to 85m. An 80m contour length is selected for the design flow of 14,850 litres per day.

The 4 proposed drainfield areas are shown on the attached plan. This provides adequate area for primary and reserve drainfield areas. All drainfields are oriented parallel to contours for ease of installation and to meet linear loading rate (contour length) requirements noted above. The proposed drainfield width is 8m – this accommodates drainfield lateral pipe spacing of 1.2m to 2.0m. Three areas of 8m x 40m and one area of 8m x 65m are shown. Total area is 1,480 sq.m. for primary and reserve. This provides an opportunity to maximize tree retention in the dispersal areas.

A minimum unsaturated constructed vertical soil depth of 60cm (measured infiltration surface to the seasonal high-water table) is proposed with micro-dosed pressure distribution. This meets the requirements of Table II-16 of the SPM-V3.

The system layout is in accordance with the BC Sewerage System Regulation, SPM-V3:

1. Well Setbacks: >30m to all potable drinking water wells from tanks and dispersal areas.
2. Building Setbacks: Minimum 3m from building foundations to dispersal areas.
3. Property Line Setbacks: Minimum 3m from property lines to the dispersal areas.
4. Potential Breakout Setbacks: Minimum 7.5m to dispersal areas.
5. Fresh Water Body Setbacks: Minimum 30m to dispersal areas.

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PERFORMANCE AND ENVIRONMENTAL MONITORING

Monitoring of system performance and the receiving environment (down-gradient ground and surface water runoff) is proposed for systems on the land. This is partially in response to concerns over nutrient loading and degradation in water quality and risks to public health from upslope wastewater systems in Hague Lake. Proposed monitoring would include sampling of treatment system effluent for BOD, TSS and Fecal Coliform and Total Nitrogen and Nitrates and groundwater sampling downslope of fields for Nitrogen/Nitrates and Phosphorous. Predevelopment monitoring of groundwater is recommended to establish existing baseline levels and for evaluating the impacts of the installed, operating systems.

Monitoring wells and surface water sample locations ideally will be proposed by the project hydrogeologist who will be reviewing the existing and proposed water quality to assess drinking water impacts and nutrient loading to the watershed. The design of the treatment and dispersal system and setting of target effluent levels and water quality objectives follow the recommendations of the project hydrogeologist.

SUMMARY AND CONCLUSIONS

1. In general, it is concluded that site and soil conditions, available area and contour length for dispersal fields at the proposed Phase I site are feasible and suitable for the expected design flows and wastewater characteristics.

2. The treatment system and dispersal technologies presented can be configured to meet water quality objectives and provide for protection of public health and drinking water and reduced impacts to downstream surface water.

3. If installed and maintained in accordance with the BC Sewerage System Regulation, the proposed system will not cause, nor contribute to a health hazard.

I trust the foregoing meets your needs regarding the proposed rezoning of the property for an affordable housing residential development. Please contact the undersigned at your convenience if you have any questions or wish to discuss this report further.

Yours truly,

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA R. J. McMurtrie 19/10/2017

Ron McMurtrie, P.Eng.

Attached:

Appendix 1 – Soil Test Pit Logs
Dispersal Area Site Plan

APPENDIX 1 SOIL TEST PIT RESULTS PHASE I – RAINBOW RIDGE

SOIL TEST PIT SUMMARIES (MEASURED DEPTHS) ABBREVIATIONS – SEE BELOW							
TEST PIT #	**FLOW RESTRICT LAYER[1] (cm)**	**ROOT DEPTH[2] (cm)**	**MOTTLES[3] (cm)**	**GLEYED[4] (cm)**	**SEEPAGE[5] (cm)**	**SOIL DESCRIPTION[6] TEXTURE; GRAVEL[7]; STRUCTURE; DENSITY**	**DEPTH TO LIMITING LAYER[8] (AVAILABLE SOIL DEPTH) (cm)**
TP1	55 LS MASS CEM	55C 60F	50D	55	55	LS(M) G-VG SG L	55
TP2	>100	60C 80F	50F	-	80	LS-S(C) VG-XG SG L	70
TP3	>125	100C 115F	45F	-	-	S(M-C) VG-XG SG L	100
TP4	>135	75C 95F	45F	-	100	S(M-C) VG-XG SG; L	90
TP5	>100	60C	65D	-	75	S(M-C) VG-XG SG L	65
TP6	>100	70C 85F	80D	80	80	S(M-C) VG-XG SG L	80
TP27	80 SL MASS CEM	60C 80F	60F 70D	70	75	SL G-VG BLK-SA-2 FRI	70

NOTES:

1. Flow restrictive layer indicates transition from soils of higher permeability to soils of lower permeability. Where observed, soil texture, structure and density are indicated (see below for abbreviations used). Where not observed a > symbol is entered. No bedrock was observed in any of the test pits.

2. Root depth followed by C indicates common typical average rooting depth observed and is considered a relatively strong indicator of seasonal high water table. Root depth followed by F indicates few or very few roots extending to that depth and is less likely to indicate seasonal high water table.

3. Soil mottling (oxidizing environment) indicates alternating cycles (of relatively short duration) of soil saturation and un-saturation. Mottle depth followed by F indicates faint mottling and is not necessarily a strong indicator of seasonal high water table. Mottle depth followed by D indicates distinct mottling and is considered a strong indicator of seasonal high water table.

4. Soil gleying (reducing environment – no oxygen present) indicates periods of prolonged seasonal soil saturation and is considered a strong indicator of seasonal high water table.

5. Seepage depth is indicated where groundwater was observed entering the test pits on the dates excavated. For TP1 to TP26 these observations were made at the end of or near the end of the "wet season" and give an indication of the groundwater level on that date. The measurements tend to follow the soil indicator depths noted and hence are considered good supporting evidence for the seasonal high water table estimation (see Note 8 below). The seepage depths noted are all shallower than the restrictive layer which supports the conclusion that there is a perched seasonal water table on the site.

6. The soil description includes soil texture, coarse fragment content (i.e. gravel), soil structure and density (or consistency) - (see below for abbreviations used). It is based on the USDA classification system.

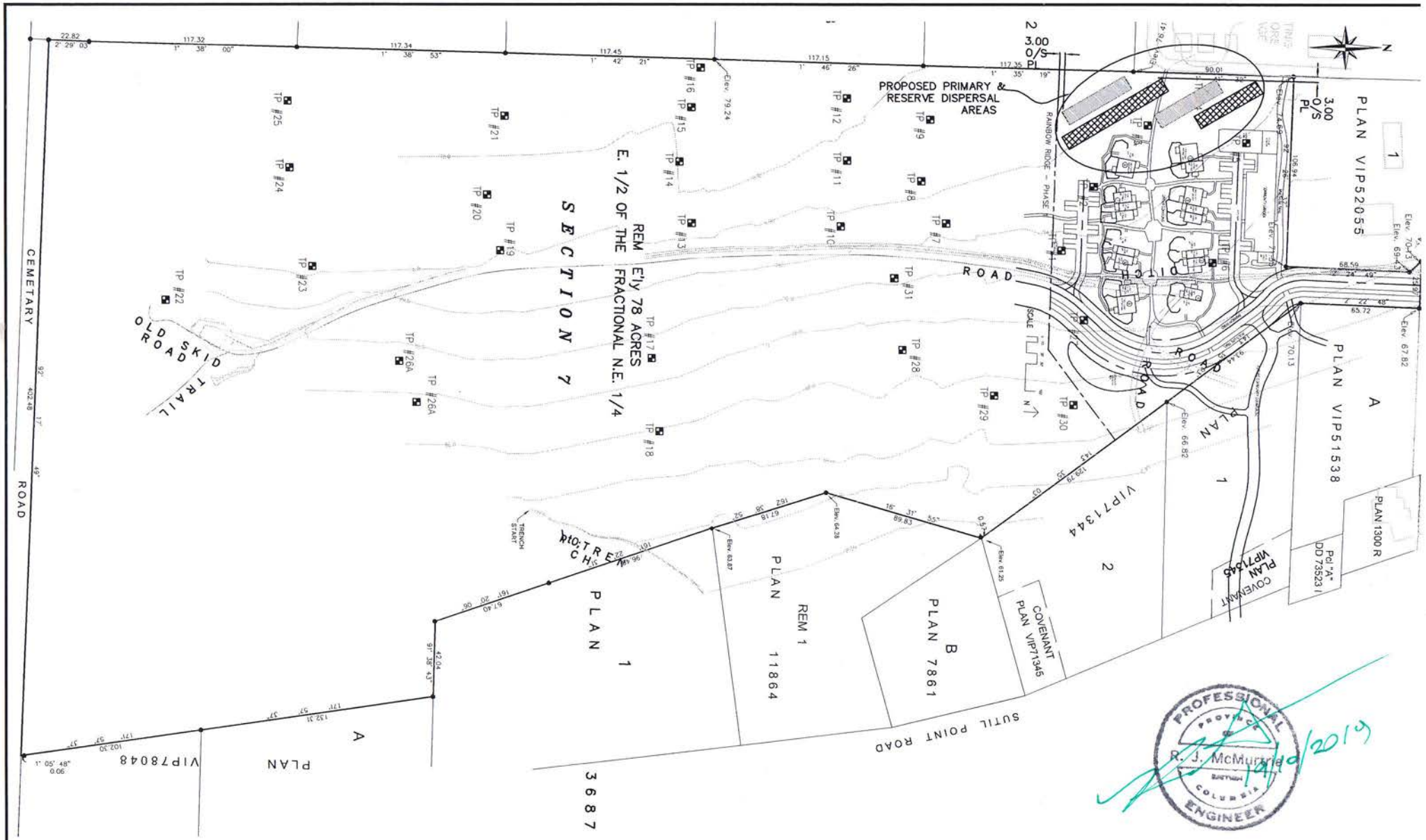
7. Most of the test pits excavated, in addition to gravel (>2mm particle size), larger stones or cobbles >75mm size were commonly observed.

8. The limiting layer is defined as the depth where soil-based treatment of the effluent no longer occurs (treatment of effluent is considered to occur only in the un-saturated zone of the soil profile). Typically on the coast this is usually the depth of the seasonal high water table. The seasonal high water table is defined as "the upper limit of the soil water table which persists for more than 21 consecutive days or 30 total days, during a year which has normal precipitation". However, it may be a flow restrictive layer such as clay soils or other very low permeability soils or bedrock. Other considerations are permeable structured soils with a "cemented" or hard consistency where effluent will not penetrate the structural units (soil micro-pores) and hence bypass treatment via rapid drainage through large pores (macro-pores) between the structural units. The depth to limiting layer basically indicates "the available soil depth for treatment". The

depth to limiting layer shown in the above table is an estimate of the available soil depth for treatment in the wet season based on predominant soil indicators and groundwater observations made on the date of excavation. It is considered conservative and appropriate for site planning and preliminary design purposes.

ABBREVIATIONS

1. SOIL TEXTURE: S – SAND; LS – LOAMY SAND; SL – SANDY LOAM
2. SAND MODIFIERS: F – FINE; M – MEDIUM; C – COARSE
3. GRAVEL CONTENT; BLANK - <15%; G – 15% - 35% ; VG – 35% - 65% ; XG - >65%
4. STRUCTURE : SG – SINGLE GRAIN (STRUCTURELESS); BLK-SA – BLOCKY SUBANGULAR; MASS – MASSIVE (STRUCTURELESS); PL - PLATY
5. GRADE OF STRUCTURE: 1 – WEAK; 2 – MODERATE; 3 – STRONG.
6. DENSITY (MOIST CONSISTENCY): L – LOOSE; FRI – FRIABLE; CEM – LIGHT TO MODERATELY CEMENTED OR HARD
7. ROOTING DEPTH: C – COMMON; F – FEW TO VERY FEW
8. MOTTLING: F – FAINT; D - DISTINCT



PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA R. J. McMurtrie

14/10/2019

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ON-SITE
SEWAGE SYSTEM
PROPOSED DISERSAL AREAS

PROPOSED RE-ZONING – PHASE 1 RAINBOW RIDGE
–
LOT A, SECTION 7, REM 78 ACRES E 1/2 OF NE 1/4, SAYWARD DISTRICT
951 & 965 BEASLEY ROAD, CORTES ISLAND, B.C.

Engineer

Designed RM	Job No. 0921	V.I.H.A. File CVI
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