(2)

TERRAIN AND SOIL INTERPRETATIONS FOR PROPOSED USE AREAS IN KALAMALKA LAKE PROVINCIAL PARK

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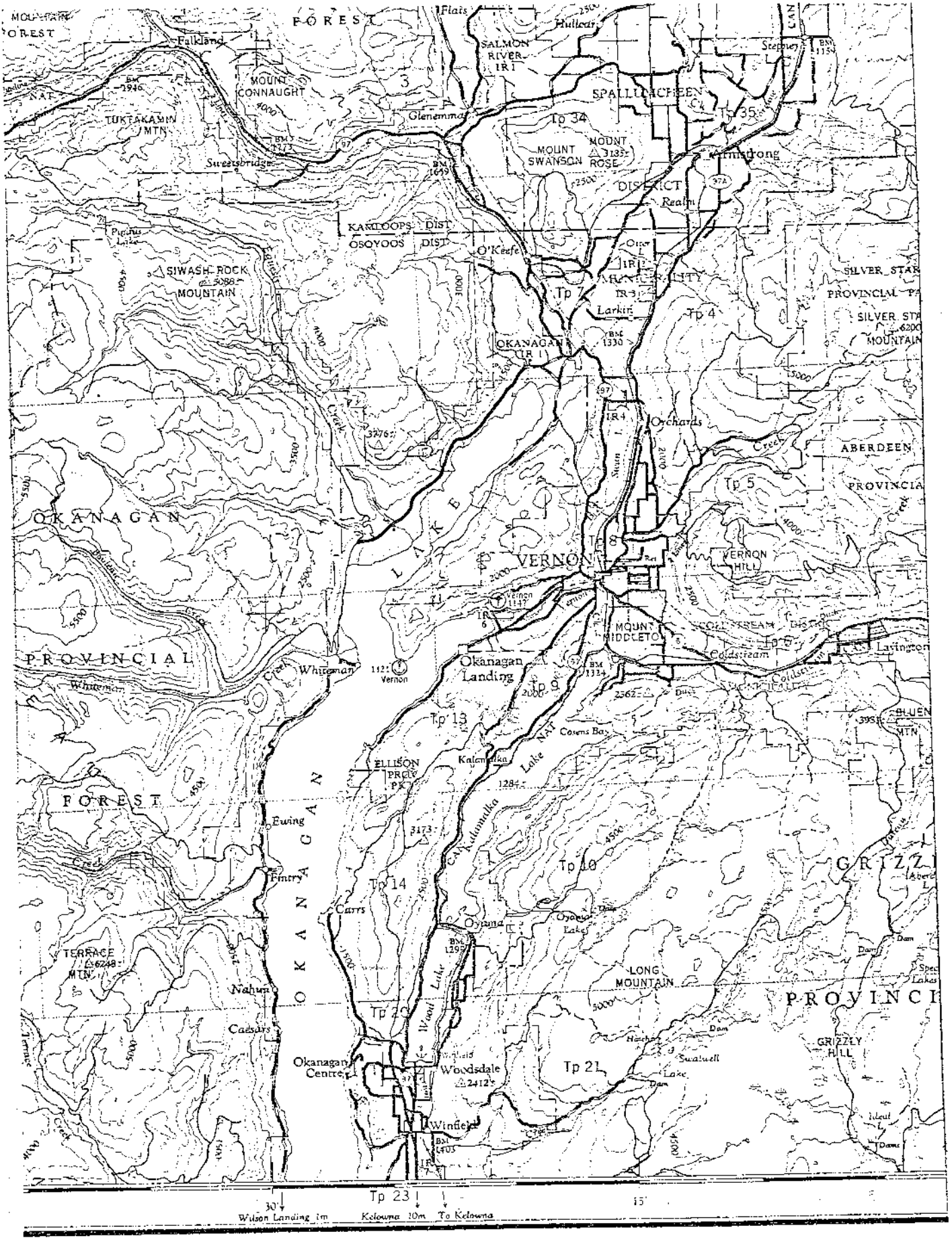

Location Map

Scale 1:250,000 (4 mi/lin).

Location Map

Scale 1:250,000 (4 mi/lin).

INTRODUCTION

In the fall of 1975 the B.C. Parks Branch requested an overall evaluation of Kalamalka Lake Provincial Park with respect to recreational use and development. A short report based on one day of field work in the area was prepared. This gave a general overview of the park with respect to landforms and soils. It outlined those areas most suitable for development and recommended a detailed survey that included soil sampling and selected laboratory analyses, be carried out in these areas. A subsequent request was made this Fall (1976) by the Parks Branch for detailed soils information on sites where a variety of recreational uses had been proposed.

The field work for this project was carried out in October over a period of five days. M. Rafiq and A. Harcombe from the Vegetation Section of the Resource Analysis Branch in Kelowna provided information on the condition of a cottonwood stand adjacent to the lagoon at Cosens Bay and made recommendations as to the future management of the site for tree species (Appendix I). Field assistance was provided by T. Wood, also of the Vegetation Section in Kelowna.

Sample sites and observation sites were chosen that best represented the development area. The samples were analyzed at the soils laboratory in Kelowna under the supervision of V. Osborne and D. Colvey. The table of analytical results is included in Appendix IV. Suggestions and comments on the production of this report by other members of the Resource Analysis Branch (A. Benson, N. Sprout, M. Walmsley, W.C. Yeomans) have been incorporated into the final presentation.

Interpretations for selected uses are based on the "U.S.D.A. Guide for Interpreting Engineering Uses of Soils"*, as modified by the Resource Analysis Branch for recent urban suitability work in northeastern British Columbia. Each individual soil characteristic that is considered to affect

*United Stated Department of Agriculture, Soil Conservation Service, 1971

each potential use has been rated as good, moderate or severe. The criteria used to determine the classification (i.e. good, moderate, severe) of each soil characteristic in relation to each particular use are defined in the guideline tables included in Appendix II.

In addition to each individual soil characteristic rating, an overall rating for each proposed potential use, based on the amount and severity of limiting soil characteristics, has been included for each site. The definitions of these overall rating and the criteria used for their determination are as follows:

a) High: the site is free of soil limitations for a specific use. The individual soils characteristics affecting this use are all rated as "good".

b) Medium: the site has limitations that need to be recognized but can be overcome with good management and design. The individual soils characteristics affecting this use may be all "moderate" ratings, or one "severe" rating with two or less "moderate" ratings.

c) Low: this site has limitations that are severe enough to make use questionable. With careful planning and management these limitations may be overcome, however, economic feasibility may then become a limiting factor. The individual soil characteristics affecting the specific use have more than two "severe" ratings.

Should any one soils factor be significantly important enough to upgrade or downgrade an overall rating it will be noted and discussed in the "comments" section of the table.

The locations of the sample and observation sites as well as the terrain unit* in which they occur are presented on aerial photographs (¼ mi/1 in.) and on a topographic map (800 ft/1 in.) which are included in this report. The stereographic pairs of aerial photographs have also been included.

*Terrain Classification System, E.L.U.C. Secretariat, Resource Analysis Unit, 1976.

Only those units in which development was proposed were described and sampled, as a detailed survey of the entire Park would have required a considerably longer period of time than was available. The sites are described according to 1) their specific characteristics (chemical and physical) required for use interpretation ratings, and 2) the use interpretations of each site for a variety of proposed uses. These are Tables 1 and 2 respectively.

TABLE 1

SOIL CHARACTERISTICS OF THE

SAMPLED AND OBSERVED SITES

THAT AFFECT USE

SOIL CHARACTERISTICS AFFECTING USE/1	SAMPLE AND OBSERVATION SITES - KALAMALKA LAKE							
	1	2	3,a,c,e	4,b	5,f	d	g	h
Drainage Class	imperfect	poor-very poor	well-rapid	moderately well	well to rapid	well-rapid	moderately well	poor
Depth to water table	33cm (seasonal)	47 cm (present at samping)	1 M * *	75 cm.	1 M * *	75 cm.	75 cm.	16 cm.
Flooding (estimates)	None during season of use	occasional	None during season of use	None during season of use	None during season of use	None during season of use	None during season of use	occasional
Perviousness Class	Rapid	Moderate	Moderate - rapid at 70 cm.	Moderate	Moderate - rapid at 65 cm.	Rapid	Moderate	Moderate
Slope	5 %	5 % * *	5 - 14 %	6 %	5 - 15% * *	5 % * *	5 % * *	5 % * *
Surface texture	Sandy loam	Sandy clay loam	loam (sandy gravel at 70 cm)	Sandy Loam	sandy loam (sandy gravel @56cm)	Sandy loam	Fine Sandy Loam	Sandy loam
Depth of Ah/2	13 cm.	26 cm.	Range 11-35 cm.	60 cm.	32 cm.	13 cm.	11 cm.	16 cm.
Topsoil salinity (mmhos/cm)	0.5	1.18	1 * *	1 * *	1 * *	1 * *	1 * *	-
Surface organic matter (%)	12.74	33.77	8.08	4.46	10.52	-	-	-
Solum depth (A & B horizons)	13 cm.	26 cm.	Range 54-70 cm.	75 cm.	56 cm.	46 cm.	11 cm.	16 cm.
ph of Ah ($CaCl_2$ method)	6.9	6.3	6.2	6.4	6.6	-	-	-
Depth to bedrock/ impervious horizon	> 1.5 M	> 1 M * *	> 1 M * *	> 1 M * *	> 1 M * *	> 1 M * *	Slightly impervious horizon at 50 cm.see comment	> 1 M * *
Stoniness class	1	1	1	1 - 2	1	1	1	2 - 3
Rockiness class	0	0	0	0	0	0	0	0
Unified soil group	-	-	ML-CL * *	SM * *	SM * *	SM * *	SM * *	SM * *

/1 for definition of terms see "Glossary of Terms Used in Soil Science" (Reference)

/2 Ah - surface organic mineral horizon

** assumed characteristics that were not measured
1-13 : Sample sites
a-y : observation - sites

SOIL CHARACTERISTICS AFFECTING USE/1	SAMPLE AND OBSERVATION SITES - KALAMALKA LAKE							
	6,i	7,j	k	1	m	n,o	8	P , P* /3
Drainage Class	moderately well	moderately well	poor	moderately well	see comments	see comments	well	see comments
Depth to water table	>1M**	>1M**	15cm (seasonal)	>1M**			>1M**	
Flooding (estimates)	none	none	occasional	none			none	
Perviousness Class	Moderate-slow	slow	slow	slow			moderate-rapid at 42cm	
Slope	<5%	16%	<5&(depression-al)	<5%** undulating			3%	
Surface texture	loam-silt loam	silt loam-loam	silty clay loam	silty clay loam			loam	
Depth of Ah/2	range from 9.32cm	5cm	7cm	13cm			15cm	
Topsoil salinity (mmhos/cm)	<1**	<1**	-	<1**			<1**	
Surface organic matter (%)	6.12	-	-	-			10.21	
Solum depth (A & B horizons)	45cm	60cm	34cm	60cm			42cm	
ph of Ah (Ca Cl_2 method)	6.1	-	-	-			5.7	
Depth to bedrock/ impervious horizon	>1M**	>1M**	>1M**	>1M**			>1M**	
Stoniness class	1	1	1	1			0	
Rockiness class	0	0	0	0			0	
Unified soil group	ML	MH	CL**	MH			SM-GM**	

**Assumed characteristics that were not measured

/1 for definition of terms see "Glossary of Terms Used in Soil Science" (Reference)

/2 Ah - surface organic mineral horizon

/3 An asterisk used as a superscript on an observation or sample site indicates that the sites have similar characteristics (i.e. P* is similar to P,10* is similar to 10).

SOIL CHARACTERISTICS AFFECTING USE/1	SAMPLE AND OBSERVATION SITES - KALAMALKA LAKE							
	q	r	s	t	9,u	10 , 10*,v	w	11
Drainage Class	well	see comments	poor	see comments	well	moderately well-imperfect	see comments	see comments
Depth to water table	>1m		35cm(seasonal)		>1M**	>60cm**		
Flooding (estimates)	none		-		none	none		
Perviousness Class	moderate (rapid at 50cm)		moderate		moderate	slow		
Slope	10%		5%		10% (range to 25%)	8%		
Surface texture	loam-sandy loam		loam		loam	heavy clay		
Depth of Ah/2	25cm		19cm		range of 16-23cm	6cm		
Topsoil salinity (mmhos/cm)	<1**		-		<1**	<1**		
Surface organic matter (%)	-		-		8.95	8.38		
Solum depth (A & B horizons)	45cm		35cm		92cm	54cm		
ph of Ah ($CaCl_2$ method)	-		-		6.0	6.4		
Depth to bedrock/ impervious horizon	>1M**		>1M**		>1M	>1M**		
Stoniness class	1		1		1	1		
Rockiness class	0		0		0	0		
Unified soil group	SM**		-		SM**	MH		

** assumed characteristics that were not measured

/1 for definition of terms see "Glossary of Terms Used in Soil Science" (Reference)

/2 Ah - surface organic mineral horizon

/3 an asterisk used as a superscript on an observation or sample site indicates that the sites have similar characteristics (i.e. P* is similar to P,10* is similar to 10).

SOIL CHARACTERISTICS AFFECTING USE/1	SAMPLE AND OBSERVATION SITES - KALAMALKA LAKE							
	12	x	y	13				
Drainage Class	moderately well	see comments	moderately well	well				
Depth to water table	>1M**		>1M**	>1M**				
Flooding (estimates)	none		none	none				
Perviousness Class	slow		moderate-slow	moderate				
Slope	12%		5-10%**	level (<5%)				
Surface texture	clay		loam-clay loam	fine sandy loam				
Depth of Ah/2	18cm		17cm	46cm				
Topsoil salinity (mmhos/cm)	<1**		<1**	<1**				
Surface organic matter (%)	8.41		-	7.43				
Solum depth (A & B horizons)	51cm		45cm	70cm				
ph of Ah ($Ca Cl_2$ method)	6.3		-	6.1				
Depth to bedrock/ impervious horizon	>1M**		>1M**	>1M**				
Stoniness class	1		1	1				
Rockiness class	0		0	0				
Unified soil group	MH**		CL**	SM**				

/1 for definition of terms see "Glossary of Terms Used in Soil Science" (Reference)

/2 Ah - surface organic mineral horizon

** assumed characteristics that were not measured

TABLE 2

INTERPRETATIONS FOR PROPOSED

USES OF THE SAMPLED AND

OBSERVED SITES

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE																		
					Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptibil	Overall rati for pot use
1	Cosens Bay L ridge of the gravel bar separating the lagoon from the lake	Backshore day use - picnic site	- sandy gravelly fluvial deposit - level to undulating topography - soil development - Rego Humic Gleysol-Calcareous phase	Playground - picnic site	M	M	G	*	M	G	*	*	*	*	*	G	G	G	*	*	*	*	Medium
				Topsoil source suitability	M	*	G	*	G	G	M	G	M	M S	G	*	G	G*	*	*	*	*	Medium Low

Comments: The main limitation for picnic-playground use is the poor condition of the cottonwood stand at the site. A discussion on the condition of the trees and future recommendations for regeneration is included in the appendices.

With regard to soil drainage this coarse textured material is rapidly drained at the surface and does not present a severe limitation for picnic-playground use. Imperfect drainage occurs at depth and is a result of ground water. Strong mottles at 33 cm. indicate the water table position for a short period of the year. At the time of sampling the water table occurred at 130 cm.

The sample site was on the ridge of the bar. On the west side of the bar, adjacent to the lake the surface mineral horizon (Ah) is only 3-10 cm. in depth. Should revegetation be required in this area additional topsoil application would be desirable.

* - not required for interpretation

** - assumed characteristic that was not measured

G - Good

M - Moderate

S - Severe

FIG. 1 Ridge of bar; looking S.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE																		
					Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptibil	Overall rati for pot use
2	Cosens Bay - east side of the bar adjacent to the lagoon	Day use area - picnic and play-ground site; trail use adjacent to the lagoon for observation and interpretation	- sandy gravelly fluvial deposit - unduating - depressional topography - soil development Rego Humic Gleysol	Playground - picnic site	S	S	M	M	M	M	*	*	*	*	*	G	G	G	*	*	*	*	Low
				Topsoil suitability	S	*	M	*	M	M	G	M	G	S	M	*	G	*	*	*	*	*	Low

Comments: The major limitation of this site for intense recreation use (i.e. trails, picnic site) is the existing poor drainage and the depth of the Ah horizon. This area is wet throughout the use season and is very susceptible to compaction and muddiness problems. Should a trail be established, surfacing or elevated board walk construction would be necessary. With regard to the surface fertility of this site for regeneration the magnesium content is much higher than the desired ratio of calcium/ magnesium/potassium - see summary discussion.

FIG 2 East side of the bar; looking east to the lagoon; note standing water

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE																			
					Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptab	Overall ra for pr	
3 a,c,e	Cosens Bay - approximately 150-200' from the lakeshore	- day use area with change houses - septic tank absorption field to accommodate a 12 unit toilet system - parking lot and roads	- sandy gravelly glacial-fluvial deposit - gently sloping topography - soil development Dark Brown Chernozem	Dwellings without basements	G	G	G	*	M-S	*	*	*	*	*	*	G	G	G	*	G	G	M	Medium
				Septic tank absorption field	S	G-M	G	S	G-M	*	*	*	*	*	*	G	G	G	*	*	*	*	Low
				Roads - parking lot	G	*	G	*	G-M	*	*	*	*	*	*	G	*	*	G	*	G	M	High
				Playground-picnic site	G	G	G	G	M-S	G	*	*	*	*	*	G	G	G	*	*	*	*	High-Medium
				Topsoil source suitability	G	*	G	*	M-S	G	G	G	M	M	M	*	G	*	*	*	*	*	Medium

Comments: The most important consideration with respect to this site is the development of toilet facilities. The extremely fragile nature of Kalamalka Lake with respect to the possibility of nutrient pollution is of major concern (i.e.the inlet and outlet characteristics of the lake as related to the flushing action of the lake; the nutrient balance required to maintain the unique lake color - refer to the Okanagan Basin Study).

The occurrence of sandy gravelly materials at an average of 70 cms depth from the surface throughout the area poses a severe limitation to septic tank filter field use (coarse texture depth ranges between 40-80 cm throughout the unit). As the minimum depth for tile placement is approximately 20 in. (50 cm) with an 8 in. (20 cm) tile diameter (giving a total of 70 cm), the bulk of the effluent would be discharged into the coarse textured material. Nutrient pollution of the lake would be a likely occurrence, particularly since extremely heavy use is expected in the summer season, during which time large quantities of effluent would be released into the system.

Another limiting factor influencing the use of septic tanks within the area is the possibility of contamination of the Cosen Creek's underground drainage system. A hydrology study to determine the extent and location of this drainage is advised.

It is strongly recommended that should toilet facilities be developed in this area, alternate means of disposal other than a septic tank system or pit toilet system be investigated. A waterless toilet system (i.e. Clivus system) or the trucking of effluent from the site are methods that could be considered.

With respect to the other uses described, this site is very favourable except for those sections of the unit with steeper slopes (10-14%). Parking lot construction necessitates a cutbank of approximately 4' into the slope. This material should not present an erosion problem providing the cutbank slope is under 32^0. The cutbank area should avoid any gullies that could channel excess run-off over the cutbank Topsoil taken from the site would be well used for the establishment of vegetation on the bank and some irrigation may be required for the initial growth period.

FIG. 3 Looking SW to Kalamalka Lake at

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptabi	Overall rat for pot us
4,b	Cosens Bay west of Cosen's Creek	Similar to those described for site #3	- sandy gravelly fluvial fan formed by Cosen's Creek - slightly sloping to undulating topography - soil development-Black Chernozem	Dwelling without basements	G	G-M	**G	*	G	*	*	*	*	*	*	G	G-M	G	*	G	G	M	Medium
				Septic tank absorption field	G-M	**M	**G	G	G	*	*	*	*	*	*	G	G-M	G	*	*	*	*	Med-Low (see comm
				Roads	G	*	**G	*	G	*	*	*	*	*	*	G	G	G	G-M	*	G	M	Medium
				Playground-picnic site	G	G	**G	G	M-S	G	*	*	*	*	*	G	G-M	G	*	*	*	*	Medium
				Topsoil source suitability	G	*	**G	*	M	G	G	**G	M-S	G	M	*	G-M	*	*	*	*	*	Medium

Comments: Although this site is moderately well drained, the vegetation present (grasses more abundant, lush and greener than site #3; hawthorn trees) indicates that this site is wetter than site #3. Due to its location on Cosen's Creek fan and its proximity to both the creek and the lake, (125') this site is unfavourable for septic tank absorption field use. The site did not appear to have any evidence of recent flooding. However, should development occur, the history of the flood cycle of Cosen's Creek should be examined. The site was sampled to a depth of 75 cm at which point no indication of a seasonal water table was present (i.e. mottling or gleying). As discussed in the "site 3" "comments" the underground drainage system associated with the creek should be evaluated before any development occurs. Trails in this area would be subject to compaction and muddiness problems, with intense use during a wet period, due to the depth of the surface organic mineral horizon (Ah-60 cm).

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptib.	Overall rat. for pr.
5,f	Cosens Bay natural gully area	Road relocation - possible area of septic tank absorption field location	- sandy gravelly glacial-fluvial deposit (within the same unit as site #3) - slightly sloping topography - gullied area - soil development Dark Brown Chernozem	- Septic tank absorption field	G	G	G	S	M	*	*	*	*	*	*	G	G	G	*	*	*	*	Low Medium (see comments
				Roads	G	*	G		M	*	*	*	*	*	*	G	G	G	M	*	G	M	
				Topsoil source suitability	G	*	G	*	M-S	G	M	M	G	*	G	*	G	*	*	*	*	*	Medium

Comments: In this site the surface material to approximately 56 cm. is well drained and moderately pervious (loam-sandy gravelly loam). At this point the texture changes to a sandy gravel which is rapidly drained and rapidly pervious, presenting a severe limitation to filter field use. This 56 cm. depth is too shallow to adequately provide a filtering effect as the minimum depth of the filter field plus tile diameter is 70 cm. and the effluent would be discharged directly into the coarse material. With intense use during the summer season, contamination of the lake is likely to occur.

Road relocation in this site, although the materials do not present major limitations, is unfavourable since the relocation is proposed for the bottom of the gully. The gully channel is vegetated and is stabilized but it indicates a natural drainage pattern of the landscape. Road development in the gully may channel excess run-off creating an erosion problem further downslope. Should road relocation be necessary it should be constructed upslope of the gully bottom with adequate culvert placement to control excess run-off.

FIG. 4 Looking east from Cosens Bay. Note the gully formation in the centre of the photo.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-Swell	Frost susceptability	Overall rating for pot. use
d	Cosens Bay 50' from the lake	backshore use picnic-playground site	- sandy gravelly fluvial deposit with level to undulating topography	Playground-picnic site	MS	G	G	G	M	G	*	*	*	*	*	G	G	G	*	*	*	*	Medium
				Topsoil suitability	G	*	G	*	M	G	M	** G	M	** M	M	*	G	*	*	*	*	*	Medium (see comm.)
				Septic tank Absorption field	S	** S	G	S	G	*	*	*	*	*	*	G	G	G	*	*	*	*	Low

Comments: The site may be rated as moderate in its ability to support backshore day use. Removal of topsoil is not recommended as the horizon underlaying the Ah (13 cm) is sandy gravel and, therefore, is not favourable for vegetation regeneration. It is severely rated for filter field use both on the basis of soil factors and its proximity to the lake (50').

g	Cosens Bay - south end of the bay south of Cosens Creek	Backshore day use for the proposed moorage dock at this end of the lake	- fine sandy fluvial fan deposit with level to undulating topography - soil development: Humic Regosol	Septic tank absorption field	G	** S	** G	G	*	*	*	*	*	*	*	G	G	G	*	*	*	*	Low
				Playground-picnic site	G	*	** G	G	M	G	*	*	*	*	*	G	G	G	*	*	*	*	Medium (see comm.)
				Topsoil source suitability	G	*	** G	*	G	G	M	** G.	** M	S	** M	*	G	*	*	*	*	*	Low

Comments: This site, although moderately well drained, is a moist shady area as indicated by some of the vegetation species occurring (Baneberry, horestail, falsebox and mosses). Indistinct mottling occurs at a depth of 50 cm and it is expected that a seasonal water table may occur between 75-125 cm. The area is part of the previously discussed Cosen's Creek fluvial fan (see site 4) and is associated with an underground drainage system. At 50 cm. the sandy loam material becomes very compact and creates a slightly impervious horizon which could cause an additional limitation to filter field use. Filter field suitability for the area is severe. Pit toilet systems would also be unsatisfactory for the same reasons. Abandoned creek channels occur within this area and before any development occurs the possibility of these channels being activated should be investigated.

Should intense use occur during the wet season, trails in this area would be subject to moderate muddiness and compaction problems.

FIG. 5 Cosens Creek - looking east. Note the abandoned channel in the centre of the photo.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE																		
					Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptabil	Overall rati for pot. use
h	Cosens Bay adjacent to the north side of Cosens Creek	Backshore day use	-gravelly sandy fluvial fan -soil development Rego Humic Gleysol	Septic tank absorption field	S	S	S	G	G	*	*	*	*	*	*	G	M	G	*	*	*	*	Low
				Playground-picnic site	S	S	M	G	M	G	*	*	*	*	*	G	S	G	*	*	*	*	Low
				Topsoil source suitability	S	*	M		G	G	G	-	-	S	-	*	S	*	*	*	*	*	Low

Comments: This area is poorly suited to most uses. Trails would be subject to severe muddiness problems with intense use during the wet season. Should any type of development occur, the flooding cycle and duration of flooding of Cosens Creek should be examined. The use of fill to create a surface for backshore beach use may not eliminate the poor drainage problem and there is the possibility that the fill material itself may become saturated.

FIG 6. Cosen s Creek looking north. Note the large surface stones.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptability	Overall rating for pot. use
6,i	Bear Valley adjacent to the eastern park boundary	One of the main areas proposed for a large campsite development (110 units)	- sandy silty glacial fluvial deposit with level to gently undulating topography - soil development Dark Brown Chernozem	Dwellings without basements	G	G	G	*	G	*	*	*	*	*	*	G	G	G	*	M	G	S	Medium
				Septic tank absorption field	G	G	G	M	G	*	*	*	*	*	*	G	G	G	*	*	*	*	Medium
				Roads	G	*	G	*	G	*	*	*	*	*	*	G	G	G	G-M	*	G	S	Medium
				Playground-picnic site use	G	G	G	M	G-M	M	*	*	*	*	*	G	G	G	*	*	*	*	Medium
				Topsoil source suitability	G	*	G	*	G	G	G-M	G	M	M	M	*	G	*	*	*	*	*	Medium

FIG. 7 Site #6 looking east. The fence in the middle-left marks the park boundary.

Comments: Generally this is a good to moderate site for campsite development. The moderately fine texture of the material (silt loam) is the major limitation for use. Susceptibility to frost action may not be considered a severe limitation if the area is not prone to heavy frosts (i.e. enough snowfall occurs for insulation, etc.) The site could present muddiness and compaction problems on trails and unsurfaced roads if heavy use were to occur in the wet season.

The size of the unit described is approximately 15 acres (five of which are outside the park boundary) which would not support the size of campsite proposed.

This site has a slightly low ratio of potassium in relation to calcium and magnesium which may have a slightly unfavorable effect on revegetation - see summary for discussion of nutrient ratios.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE																		
					Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of An	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptibi	Overall rating for [illegible]
7,j	Bear Valley narrow section of the valley west of site #6	-part of the large campsite proposal area as described in site #6	- silty clay lacustrine deposit with undulating topography - soil development Orthic Gray Luvisol	Dwellings without basements	G	G	G	*	M_S	*	*	*	*	*	*	G	G	G	*	S	G	S	Low
				Septic tank absorption field	G	G	G	S	M-S	*	*	*	*	*	*	G	G	G	*	*	*	*	Low
				Roads	G	*	G	*	M	*	*	*	*	*	*	G	*	*	M	*	G	S	Medium (see comments)
				Playground-picnic site	G	G	G	S	S	M	*	*	*	*	*	G	G	G	*	*	*	*	Low
				Topsoil source suitability	M	*	G	*	S	M	S	G	*	M	-	*	G	*	*	*	*	*	Low

Comments: Due to the very fine texture of this material and its slow perviousness this site is very poor for most uses. The vegetation present is indicative of a moist site (cedar, thimbleberry, false box and sedges). Because this site is in a more moist location in the narrow section of the valley it is more susceptible to frost action than site #6. Trails and unpaved roads in the area would be severely susceptible to compaction, muddiness and puddling problems, as is already the case on the existing road.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE																		
					Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptability	Overall rating for potential use
k	Bear Valley - narrow section of the valley on the south side	part of the proposed campsite area described in site #6	- silty clay lacustrine deposit with undulating topography - soil development-Luvic Gleysol	Dwellings without basements	S	S	S	*	G	*	*	*	*	*	*	G	G	G	*	** G-M	G	S	Low
				Septic tank absorption field	S	S	S	S	G	*	*	*	*	*	*	G	G	G	*	*	*	*	Low
				Roads	S	*	M	*	G	*	*	*	*	*	*	G	G	G	M	*	G	S	Low
				Playground-picnic site	S	S	M	S	G	M	*	*	*	*	*	G	G	G	*	*	*	*	Low
				Topsoil source suitability	S	*	M	*	G	M	S	-	-	S	-	*	G	*	*	*	*	*	Low

Comments: The high seasonal water table (15cm) as indicated by strong gleying at this depth and the fine texture of the material, create severe limitations for any type of development within this area.

FIG. 8 Site #k, looking west. Note the depressional position of the site.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE																		
					Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of An	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptibility	Overall rating for potential use
l	- west end of Bear Valley	- part of the campsite development area described in site #6	- silty clay lacustrine deposit with level to undulating topography - soil development - Orthic Gray Luvisol	Dwellings without basements	G	G	G	*	G	*	*	*	*	*	*	G	G	G	*	S	G	S	Medium -Low
				Septic tank absorption field	G	G	G	S	G	*	*	*	*	*	*	G	G	G	*	*	*	*	Medium -Low (see comments
				Roads	G	*	G	*	G	*	*	*	*	*	*	G	G	G	M	*	G	S.	Medium
				Playground - picnic site	G	G	G	S	M	M	*	*	*	*	*	G	G	G	*	*	*	*	Medium
				Top soil source suitability	G	*	G		G	M	M	-	-	M	-	*	G	*	*	*	*	*	Medium

Comments: This site is moderate to severe for development. The fine texture of the material is the major use limitation and is very important with respect to septic tank filter field use, particularly if a large toilet complex was anticipated.

Trails and unpaved roads would be subject to compaction and muddiness problems should heavy use occur in the wet season.

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m	- west end of Bear Valley	- if included at all, this site would be in the extreme western boundary of the large campsite proposal area	- glacial fluvial deposit with 20-40% large gravels and cobbles of up to 5" in diameter - level to gently undulating topography - soil development- Dark Brown Chernozem	Comments: This is a moderate site for development. The high percentage of large gravels and cobbles may have a moderate limitation to filter field placement and collection of topsoil. The surface mineral horizon (Ah) is 20cm in depth and would be worth removing for revegetation use should development occur.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of An	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-Swell	Frost susceptibility	Overall rating for potential use
8	- terrace above the southern slopes of Bear Valley	- alternate site for the camp-site development discussed in site #6	- sandy gravelly fluvial terrace with level to gently undulating topography - soil development - Orthic Eutric Brunisol	Dwellings without basements	G	G	G	*	G	*	*	*	*	*	*	*G*	G	G	*	G	G	G-M	High
				Septic tank absorption field	G	G	G	G-S	G	*	*	*	*	*	*	*G*	G	G	*	*	*	*	Medium
				Playground - picnic site	G	G	G	G	M	G	*	*	*	*	*	*G*	G	G	*	*	*	*	High - Medium
				Roads	G	*	G	*	G	*	*	*	*	*	*	*G*	G	G	G	*	G	G-M	High
				Topsoil source suitability	G	*	G	*	G	G	G	G	M	M	M	*	G	*	*	*	*	*	Medium

Comments: This area is good to moderate for campsite development. The total acreage of the unit is approximately 2½ acres which would not accommodate the size of campsite proposed.

The coarse textured, rapidly pervious material that occurs at 42cm is not suitable for filter field use, however, this is not a serious problem in this area as it is not within a critical distance of a water body. Placement of a filter field should be within a minimum depth of the surface so as to make use of the filtering effect of the finer textured surface horizons.

It would be advisable, in the case of filter field development, to accurately determine the depth to bedrock throughout the filter field placement area. Pit toilets should be considered as an alternate toilet facility.

FIG. 11. Site #8 looking west.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage; H_2O table depth; Flooding; Perviousness; Slope; Surface texture; Depth of Ah; Topsoil salinity; o.m. content; Solum depth; ph of Ah; Depth bed./ imp. hor.; Stoniness; Rockiness; Subgrade; unified soil group; Shrink-swell; Frost susceptibility; Overall rating for potential use
n,o	- southern slopes above Bear Valley	- a possible alternative area for campsite development	- the unit is a complex of colluvial veneer and blanket with some bedrock outcrops (20%) - undulating to hummocky topography - soil development - Lithic Eutric Brunisol	Comments: This site has a slope range of between 2 and 31%. Bedrock outcrops cover 20% of the surface area and a major portion of the area is shallow to bedrock (within 45cm. of the surface). This site is, therefore, rated "severe" for those uses associated with campsite development (i.e. dwellings without basements, septic tank absorption fields, playgrounds, roads and topsoil suitability). This area, however, would be well suited to trail use and hiking activities.	

FIGS. 9 and 10. Area of sites #n, o. Note the undulating - hummocky topography and bedrock knoll in the photo on the right.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage; H_2O table depth; Flooding; Perviousness; Slope; Surface texture; Depth of Ah; Topsoil salinity; o.m. content; Solum depth; ph of Ah; Depth bed./ imp. hor.; Stoniness; Rockiness; Subgrade; unified soil group; Shrink-swell; Frost susceptibility; Overall rating for potential use
p̄,p*/1	-small terrace south of site #8	- possible campsite location	- complex unit of colluvial and fluvial veneer with approximately 15% of the surface area covered by bedrock outcrops - level to undulating topography - soil development - Lithic Eutric Brunisol		

Comments: This area is very similiar to site #'s n, o with respect to shallow materials and bedrock outcrops. Although the slopes are much more favorable for development (5-15%), the area would still be rated "severe" for major campsite use with its associated facilities (i.e filter fields, roads, etc.)

This site is well suited for trail development and hiking or riding activities.

FIG. 12. Sites p, p* looking east.

1/ Observation site p̄* has similar characteristics to p.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-Swell	Frost susceptibility	Overall rating for potential use
q	hillside approximately ½ ml. east of Cosens Creek	service site area that would include a parking lot, road, year round office space and filter field system	- sandy gravelly glacial fluvial deposit with gently sloping topography - soil development - Dark Brown Chernozem	Dwelling with basements	G	G	G	M	*	*	*	*	*	*	*	G	G	G	*	G	G	G-M	High-Medium
				Dwellings without basements	G	G	G	M	*	*	*	*	*	*	*	G	G	G	*	G	G	G-M	High-Medium
				Septic tank absorption field	G	G	G	G-M	M	*	*	*	*	*	*	G	G	G	*	*	*	*	High-Medium
				Roads	G	*	G	*	M	*	*	*	*	*	*	G	G	G	*G*	*	G	G-M	High-Medium
				Topsoil source suitability	*	*	G	*	S	G	G	G	*M*	M	-	*	G	*	*	*	*	*	Medium

Comments: This area is a good to moderate site for development with a slope of 10% being the main limitation.

With respect to septic tank absorption fields the coarse textured material occuring at 50cm (sandy gravelly) could present a severe use limitation if the field were located too close to Cosens Creek. Filter field placement should be 200' away from the Creek particularly since the Creek starts to drain underground below this area. As mentioned previously hydrologic information on the underground drainage system of the creek would be necessary to determine filter field placement. Filter field placement should be within a minimum depth from the surface to make use of the filtering effect of the finer textured surface horizons.

FIG. 13. Site q, looking north-west to Cosen's Bay.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptibi	Overall rat. for pot. u
r	northeast slope above the lagoon	- possible site for the development of a small nature interpretation house.	- sandy gravelly glacial fluvial deposit with moderately sloping topography - soil development Dark Brown Chernozem	Dwellings without basements	G	G	G	*	S	*	*	*	*	*	*	G-M**	G	G	*	*	G	*	Medium-Low

Comments: This slope gives a very good view of the lagoon for observation and interpretation. The main limitation of the area for the development of a nature house is the slope (approximately 20-30%), although this may not be considered serious depending on the building design used. The area is well drained with a surface (Ah) horizon of 10 cm. Trails in the area would not be susceptible to muddiness or compaction problems.

FIG. 14. Site r looking southwest to the lagoon and Cosens Bay.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE																		
					Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptibility	Overall rating for potential use
					S	S	G	*	G	*	*	*	*	*	*	*	G	G	*	*	G	G-M	Low
S	north end of the lagoon at Cosens Bay	- nature house development - associated trail along the north end of the lagoon	- sandy glacial fluvial deposit with gently sloping topography - soil development - Humic Gleysol	- Dwelling without basements																			

Comments: This area is poorly suited for development and use due to the high seasonal watertable (35cm). The area would be subject to severe muddiness and compaction problems should heavy use occur in the wet season. The area immediately adjacent to the lagoon is muddy throughout the season. Should a trail be developed here, surface fill or board-walk construction would be recommended.

FIG. 15. Site S - looking east.

ITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptibility	Overall rating for potential use
t	existing road into Cosens Bay approximately 3/4 mi. east of the lake	- road relocation	- sandy gravelly glacial fluvial material with undulating topography - soil development - Dark Brown Chernozem	Comments: Road relocation in this area should not present any serious problems. It is much like site #3 with regard to road construction and cutbank stability. The area has a surface mineral horizon (Ah) of 20cm which would be worth recovering for use in revegetating the existing road.																			
9,u	Eastern Park boundary	- service site area which would include year round office, road access, parking lot and septic tank absorption field - site #9 was designated for road relocation	- morainal (till) deposit with slightly sloping topography - soil development- Dark Brown Chernozem	Dwellings with basements	G	G	G	*	M	*	*	*	*	*	*	G	G	G	*	G	G	M	Medium
				Dwellings without basements	G	G	G	*	M	*	*	*	*	*	*	G	G	G	*	G	G	M	Medium
				Septic tank absorption fields	G	G	G	G	M	*	*	*	*	*	*	G	G	G	*	*	*	*	Medium
				Roads	G	*	G	*	M	*	*	*	*	*	*	G	G	G	M	*	G	M	Medium
				Topsoil source suitability	*	*	G	*	S	G	G	G	M	G	M	*	G	*	*	*	*	*	Medium

Comments: This site is generally well suited for service area development. The main limitations to use are slope and frost susceptibility (may not be considered a serious problem in this area).

The road relocation slightly downslope of site #9 should present no serious problems. The percentage of silt and clay (55%) in the material make this site moderately susceptible to erosion. Cutbank slopes should not exceed 32°. Topsoil recovery is recommended for use in revegetation of the cutbanks and the existing road.

FIG. 16. Site "u" - looking east to Coldstream Ranch.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptibility	Overall rating for potential use
10 10* /1 v	- approximately 1/2 - 3/4 mi. east of Twin Bays	- small "walk-in" group campsite with possibly one cooking building and 15-20 tenting sites. - a road and a small parking lot are considered for site #10	- clay lacustrine deposit with slightly undulating to gently sloping topography - soil development Orthic Gray Luvisol	Dwellings without basements	G-M	*G*	G	*	G-M	*	*	*	*	*	*	G	G	G	*	S	G	S	Low
				Septic tank absorption field	G-M	*M*	G	S	G-M	*	*	*	*	*	*	G	G	G	*	*	*	*	Low (see comments)
				Roads	G-M	*	G	*	G-M	*	*	*	*	*	*	G	G	G	M	*	G	S	Medium
				Topsoil source suitability	M	*	G	*	M	S	S	G	M	M	M	*	G	*	*	*	*	*	Low

Comments: This site is rated "low" for high use campsite development. The proposed use of the area was for a small group campsite and this rating may not be considered as serious for such development. The proposed group campsite design probably includes pit toilet use rather than a flush system, however, it should be emphasized that the very fine texture of the material (slow perviousness) gives the site a "low" rating for filter field use.

Trails and unpaved roads in this area would be subject to muddiness problems should intense use occur in a wet season of the year.

FIG. 17. Group Campsite proposal area (10b).

/1 Sample site 10* has similar characteristics to 10.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage; H_2O table depth; Flooding; Perviousness; Slope; Surface texture; Depth of Ah; Topsoil salinity; o.m. content; Solum depth; ph of An; Depth bed./ imp. hor.; Stoniness; Rockiness; Subgrade; unified soil group; Shrink-swell; Frost susceptab; Overall ra for po
W	- gully on the north side of Twin Bays	- main trail use to the Twin Bays area	- complex unit of colluvial (veneer and blanket) and morainal materials		

Comments: Location of the trail in the gully area should avoid the centre of the gully bottom so as to prevent the possibility of downslope erosion by the channelling of excess run-off. The centre of the gully appears to be a more moist site as indicated by the more lush vegetation occurring there and would be more susceptible to muddiness problems with heavy use than the upslope areas of the gully.

The surface texture of the area varies from a clay loam to a sandy clay loam and would be moderately susceptible to muddiness and compaction problems should heavy use occur during a wet period of the year.

FIG. 18 Gully - north side of Twin Bays looking east.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage; H_2O table depth; Flooding; Perviousness; Slope; Surface texture; Depth of Ah; Topsoil salinity; o.m. content; Solum depth; ph of An; Depth bed./ imp. hor.; Stoniness; Rockiness; Subgrade; unified soil group; Shrink-swell; Frost susceptibi; Overall rat for po u
11	- west end of gully described in site w.	- main trail use to the Twin Bays area	- sandy gravelly fluvial veneer overlying a silty clay glacial fluvial deposit - gently sloping topography - soil development Cumulic Regosol		

Comments: This is a moist site as is indicated by the existing vegetation (hawthorn, cottonwood suckers, mint, geranium and lush grasses). The surface texture of the material is a clay to clay loam and the site is moderately well drained with moderate-slow perviousness.

Trail development should avoid this area as it is highly susceptible to muddiness and compaction problems. It is expected that the site will remain damp throughout the use season as it was moist at the time of sampling in mid-October.

FIG. 19 Gully area adjacent to the lake - north side of Twin Bays.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-Swell	Frost susceptibility	Overall rating for potential use
12	Twin Bays	backshore use associated with Twin Bays, (trails, playgound-picnic site, topsoil suitability, pit toilet use)	- silty clay lacustrine deposit with gently sloping topography - soil development Dark Brown Chernozem	Playgound-picnic site	G	G	G	M	S	M	*	*	*	*	*	G	G	G	*	*	*	*	Medium
				Topsoil source suitability	G	*	G	*	S	M	G	** G	M	M	M	*	G		*	*	*	*	Low

Comments: This is a moderate site for backshore use. The fine texture of the material and the depth of the surface mineral horizon make the site moderately susceptible to muddiness and compaction problems should heavy use occur during a wet period of the year.

Due to the slow perviousness of the material and the proximity of the site to the lake, septic tank absorption field use would be rated "severe". Pit toilets should be located away from the lake and the water table depth should be accurately determined before placement occurs.

The view of the Twin Bays area from Highway 97 on the west side of Kalamalka Lake is of provincial significance and should be of major consideration in any development plan for the site.

Fig. 20 - Site #12 Twin Bays backshore area, looking west.

X - east of Twin Bays	- trail access to Twin Bays	- medium textured morainal (till) deposit with moderately sloping topography - soil development Dark Brown Chernozem	Comments: This is a well drained site with moderate perviousness. Surface texture ranges from a loam to a clay loam and the depth of the surface mineral horizon (Ah) is 22 cm. This area presents no serious limitations with respect to trail development.

SITE	LOCATION	GENERAL PROPOSED USES	TERRAIN & SOIL CLASSIFICATION	POTENTIAL USES	DEGREE OF SOILS LIMITATIONS AFFECTING POTENTIAL USE: Drainage	H_2O table depth	Flooding	Perviousness	Slope	Surface texture	Depth of Ah	Topsoil salinity	o.m. content	Solum depth	ph of Ah	Depth bed./ imp. hor.	Stoniness	Rockiness	Subgrade	unified soil group	Shrink-swell	Frost susceptibility	Overall rating for potential use
y	- immediately south of the park boundary gate at the Lisheen Estates subdivision	- road location	- medium-fine textured morainal (till) deposit with gently sloping topography - soil development Dark Brown Chernozem	Roads	G	*	G	*	M	*	*	*	*	*	*	G	G	G	M	*	G	S	Medium
				Topsoil source suitability	G	*	G	*	M-S	M	G	G**	M	M	M	*	G	*	*	*	*	*	Medium
				Comments: This is a moderate site for road location with the fine texture of the material presenting the most serious limitation. Unpaved roads and trails would be moderately susceptible to compaction and muddiness problems should heavy use occur during a wet period of the year.																			
13	-approximately 0.6 km east of the Lisheen Estates	- this site was proposed as a small parking lot location, however, it appeared to be a good area for camp-site development and is interpreted for all the associated uses.	- fine sandy fluvial terrace with level to gently sloping topography - soil development - Black Chernozem	Dwellings with basements	G	G	G	*	G	*	*	*	*	*	*	*	*	*	*	G	G	M	High-Medium
				Septic tank absorption field	G	G	G	G	G	*	*	*	*	*	*	G	G	G	*	*	*	*	High
				Playground picnic-site	G	G	G	G	G-M	G	*	*	*	*	*	G	G	G	*	*	*	*	High
				Roads	G	*	G	*	G	*	*	*	*	*	*	G	G	G	M	*	G	M	Medium
				Topsoil source suitability	G	*	G	*	G	G	G	G**	M	M	M	*	G	*	*	*	*	*	Medium
				Comments: This is a good to moderate site for campsite development. The "moderate" rating for frost susceptability would not be considered a serious limitation. The area covers approximately 17 acres which is inadequate to accommodate the size of campsite proposed for the park (110 units).																			

Fig.21 Site #13 - looking south.

SUMMARY

This summary provides a general comparison and/or discussion of the proposed major development areas in Kalamalka Lake Park. Soils, landform or terrain units, and to some extent vegetation, are the only physical parameters of the landscape that have been assessed with respect to the uses associated with the proposed developments.

Kalamalka Lake is a lake of provincial, if not national, significance with respect to its landscape position, unique color, warm temperature and attractive beaches. As such, development adjacent to the lake in the Cosens Bay area was a major concern of this study. The facilities included in the intensive day use area proposed for Cosens Bay consist of a change house and 12-unit flush toilet complex, a parking lot, a picnic site and a backshore play area.

With the exception of a filter field disposal system the area presents no serious physical limitations to backshore use. The suitability of the development area of Unit III for septic tank system use is severe (see comments, page 9) and it is recommended that alternate methods of waste disposal be seriously considered (i.e. waterless toilet systems or the trucking of effluent from the site). An effort was made to contact the U.S. National Park Service as to their experience with the waterless toilet system and the related correspondence is included in Appendix I.

It should be noted that presenting a topsoil suitability rating for the proposed use sites does not imply that an area be used solely as a topsoil source. If development of such a nature as to disturb the surface is undertaken in an area with a high to moderate overall rating for topsoil, then an effort should be made to carefully remove the required topsoil from the immediate development area. This material can then be used in other areas of the park as it is needed.

The gravel bar separating the lagoon from the lake - (Unit I) was proposed as a picnic site. However, the extremely poor condition of the existing

cottonwood stand on this site may be considered a major use limitation (see Appendix I for discussion). The introduction of exotic tree species into this area, although an alternative to the present vegetation situation, would not be desirable with respect to the concept of maintaining the inherent natural landscape of the Cosens Bay area.

A 110 unit campsite that requires approximately 30 acres was proposed for the park. The two areas considered by the Parks Branch were the Bear Valley area (Units V, VI, VII) and the upland area south of Bear Valley (Units VIII and IX). A third area, east of Twin Bays (Unit XVI - Site 13) has been included in this comparison as it is one of the few larger areas within the park that is suitable for relatively major development. Campsite areas have been assessed with respect to the following associated uses - buildings withouts basements, septic tank absorption fields, roads, play-ground-picnic site areas, and topsoil source suitability.

The entire Bear Valley area was chosen for possible campsite development, however, the very fine clay texture of the material and poor drainage conditions make all but the eastern end of the Valley (Unit V) unsuitable for development. This unit V area (Site #6) is still a fairly fine textured material, however, the drainage conditions are much more favourable. It covers approximately 15 acres, five of which are outside the park boundary. The ten acres within the park boundary would not accommodate the size of campsite proposed.

The upland area south of Bear Valley (Unit VIII - sites n, o, p, p*) is shallow to bedrock and has undulating to hummocky topography in which slopes of up to 31% occur. These limitations make the unit severely unsuitable for campsite development. A small glacial fluvial terrace area (Unit IX) that presents no major use limitations occurs within this area, however, it covers only 2½ acres which is not adequate to accommodate any large scale campsite development.

The area west of Twin Bays (Unit XVI - Site 13) presents no major limitations to campsite use and comprises an area of approximately 17 acres.

Of the three areas proposed for campsite use, none provides adequate

acreage for the size of campsite anticipated. If the five acres of Coldstream property in Bear Valley were purchased, a total of 15 acres (Unit V) would be available for development. In order to provide 110 camping units, the two larger areas (Unit V and XVI) could be developed to accommodate 55 units each, although major development in two sections of the park may not be considered desirable. If intensive development of the Bear Valley was of enough importance Unit VI could be used, although considerable extra development expense would be expected. If toilet facilities were to occur, a waterless system or the trucking of effluent from the site is recommended.

A year-round service area with an office building and yard, parking lot and flush toilet facilities was proposed for either Unit III - site q or Unit X - site u. Neither of these areas present major limitations to use, however, Unit X - site u offers a larger development area, with respect to favourable topography than does Unit III - site q. Unit X may also be more suitable, in that Unit III - site q is visually more sensitive to development, considering the view from the lake and from Cosens Bay.

The group campsite proposed for the area west of Twin Bays (Unit XII - site 10, 10*, v) is planned as a small walk-in tenting area with one cook building and pit toilet facilities. It would be associated with an access road and small parking lot at site 10a. This area is unsuitable for intensive use and/or large scale development due to the very fine texture of the material (clay). Limited group use of the type described by the park planners (i.e. girl guide - boy scout camps) could occur without site deterioration providing it does not take place during the wet periods of the year. A possible alternative to the location of the group campsite area is Unit IX - Site 8 which, although too small for large scale campsite development, presents fewer limitations to use than does Unit XII.

It is recommended that, in the case of any substantial development within the park, the topsoil be recovered and used for revegetation purposes, provided the topsoi source suitability rating is moderate to good.

With regard to trail development in the assessed areas, special consideration with respect to construction would be necessary in the poorly drained areas that have been described (site h - Cosens Creek, Unit II

adjacent to the lagoon, Units VI and VII - Bear Valley and Unit XIII - site II - Twin Bays).

The highest precipitation month for this area in general is June (1.75 inches). Intense recreation use and development or construction programs, particularly in areas in which fine textured materials and/or poor drainage occur, should be carefully considered if carried out in May or June.

With respect to the nutrient fertility status of the topsoil for revegetation, a generally accepted mix ratio of calcium/magnesium/potassium is 65/10/5 respectively. The following sites are significantly outside this ratio - #2, #6, #8 and #10. Should major revegetation programs occur in these areas, it is recommended that topsoil samples be sent to the soils laboratory at Kelowna for fertilizer recommendations once the species to be used in revegetation are known.

It should be stressed that the input of this report relates mainly to soils and landform information. The information presented is not intended to exclude the need for a detailed inspection of the site when a certain type of construction is identified. It is strongly recommended that before any development occurs in the vicinity of Cosens Creek, hydrologic information be obtained for the Cosens Creek drainage system. Information on the underground drainage system, the occurrence of flooding, and the activity of the channels that occur throughout the fan area (Unit IV) is particularly important.

APPENDIX I

(a) Vegetation Report on the Condition of the Cosens Bay Cottonwood Stands.

(b) Correspondence - United States Department of the Interior - National Park Service.

Environment and Land Use Committee

secretariat

1873 Spall Road, Kelowna, British Columbia V1Y 4R2

October 25th, 1976

Ms. V. Hignett
Analysis/Impact Division
Resource Analysis Unit
E.L.U.C. Secretariat
Parliament Buildings
Victoria, B.C.
V8V 1X4

Dear Val,

Re: Black Cottonwood at Kalamalka Lake

I have attempted to find some of the silvicultural information for black cottonwood (Populus trichocarpa Torr. and Gray) in British Columbia, though this information is sparse; and then, hypothesize why the trees we saw at Kalamalka are doing so poorly.

Studies on black cottonwood conclude that the optimum pH is believed to lie between 6.0 and 7.0. These studies also show:

1. At least 18 inches (46 cm) of loam or heavier soil is required for good growth if this soil is underlain by gravel. The poorest quality soils for cottonwood occur on newly formed gravel bars.

2. Lack of aeration in the water limits growth.

3. Late frosts frequently kill or injure black cottonwood.

Apparently, many cottonwoods were killed outright or killed back from 2 to 20 feet in height by a late fall frost in November, 1955, in British Columbia. Frost cracking provides entrance for decay fungi.

Because both stands (see sketch) have damaged trees right on the lake margin, frost may have been a contributing factor in some of the damage. The rest of the cottonwoods in Stand 2 seem healthy and are growing well, so it is probably a good site, with the moving water from the creek providing good aeration. Stand 1, however, is damaged to such an extent that the trees will not recover. It is hypothesized that the eutrophication process of the pond behind the bar would limit oxygen present in the water. Fine sediment deposited in the pond, in combination with increased organic material under the bulrush (Scirpus validus) might tend to reduce aeration and nutrient movement from the pond area to the lake. The soil on the gravel bar is obviously poor. Some soil removal from the bar during storms must occur, as observed from exposed tree roots. Trees in a stressed situation are more vulnerable to pests and diseases. Studies in the Quesnel area have found over 70 different fungal species causing rot in cottonwood. If this hypothesis is correct, one might have the choice of retaining the pond in its present condition (a "bird in the hand") and not having cottonwoods, or attempting to improve the pond water by forming a direct connection to the lake to get better aeration (a "bird in the bush"). I would not recommend the latter choice. The whole problem of attempting to find the "why" in plant physiological problems is extremely complex because cause and results are tied together very strongly.

It is felt that the cottonwoods on the bar cannot be saved as shade trees because damage is too far advanced to hope for survival. New cottonwood suckers would still face the same problems the present trees have. Management of cottonwoods may be successful over the short term. One may be able to build the bar up and successfully grow other nature species, such as ponderosa pine or western red cedar. This would have to be tried. The reasonable alternative may be to try an ornamental species such as weeping willow. This would have to be discussed with a horticulturist or landscape architect.

I enclosed a copy of M. Rafiq's information on the pathological condition of the stands.

Sincerely yours,

Andrew P. Harcombe

A. P. Harcombe,
Plant Ecologist

APH:ez

cc - J. W. van Barneveld
M. Rafiq

Age: 55 years

Stand 1 is located on about 25' wide and about 100' long sandy gravelly bar and is flanked by water bodies, namely a lake and a pond, thus resulting in high water table. Tree species constituting this stand are 85% black cottonwood and 15% birch.

Black cottonwood stand consists of 80% suspect trees, which are living trees exhibiting external indications of decay, 10% residual trees, which are living trees exhibiting no external signs of decay and remaining 10% are dead snags. Most of birch trees are already dead. 7% of the ground cover consists of black cottonwood regeneration, but most of this is sickly looking with apparent apical bud deformity.

Suspect black cottonwood trees show the following pathologic symptoms:

1. Conks
2. Scars
3. Frost cracks
4. Rotten branch bases and dead branches
5. Dead and broken tips
6. Leaf spots

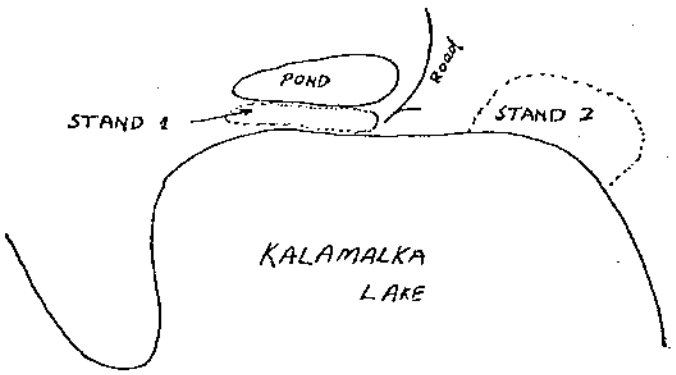
STAND 2

Age: 70 years

This stand consists of Douglas fir, black cottonwood and birch trees and can be divided into two vegetation types on the bases of tree composition.

Vegetation type 1 comprises of black cottonwood and birch trees and runs in a belt of about 30' width along the lake margin, and is characterized by poor drainage. Cottonwood trees of this section are sound, other than the ones right on lake margin. The suspect cottonwood trees show the symptoms mentioned for Stand 1. The birch trees are 70% dead and the rest consist of suspect trees exhibiting disease symptoms most prevalent of which is Polyporus betulinus.

Vegetation type 2 comprises of Douglas fir and birch trees and occupies the back slope from the cottonwood stand and is better drained. All the Douglas fir trees are sound, however, the birch trees are mostly dead or dying. The causal fungus on these birch trees is also mostly Polyporus betulinus.



Ministry of the Environment
Resource Analysis Branch
Parliament Buildings
Victoria, British Columbia V8V 1X4
January 5, 1977

Supervisor
Olympic National Park
Port Angeles, Washington

Dear Sir:

In process of conducting soils studies for our component Branch (Parks) in their design analysis of campground and picnic site l locations, we have come into the problem of possible affluent pollution of sensitive areas. Thus, it becomes advisable to research waterless toilet,waste disposal methodologies.

I would, therefore, appreciate receiving any information you may have on the subject, with particular emphasis on waterless (aerobic) disposal methods you may be using within the park.

I hope this does not inconvenience you and that we may reciprocate in kind should the need arise.

Yours truly,

W.C. Yeomans, Manager
ANALYSIS/INTERPRETATION DIVISION
RESOURCE ANALYSIS BRANCH

WCY:mgk

c.c. Valerie Hignett

United States Department of the Interior
NATIONAL PARK SERVICE
Olympic National Park
600 East Park Avenue
Port Angeles, Washington 98362

IN REPLY REFER TO:

K14

January 13, 1977

Mr. W. C. Yeomans, Manager
Ministry of the Environment
Resource Analysis Branch
Parliament Buildings
Victoria, British Columbia V8V 1X4
CANADA

Dear Mr. Yeomans:

The problems pertaining to waterless toilet waste disposal apply only in the backcountry of Olympic National Park. Our inquiries have indicated that systems presently available on the market must have either heat or power sources available.

We are taking the liberty of forwarding your letter to our Denver Service Center. They may be able to provide you with additional information. Several years ago they were exploring the possibility of using waterless toilet disposal systems in some of the parks that had extremely low water supplies.

If at all possible, we would appreciate receiving a copy of your final analysis.

Sincerely yours,

Sherman D. Knight
Chief of Maintenance

cc:
Manager, Denver Service Center w/c inc.

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APPENDIX II

GUIDELINES FOR INTERPRETATION RATINGS

Soil limitation ratings for dwellings (Without basements)

Item affecting use	Degree of soil limitations		
	Slight	Moderate	Severe
Soil Drainage class	very rapidly, rapidly well, moderately well drained	imperfectly drained	Poorly drained, very poorly drained
Apparent Water Table	Below a depth of 30 inches	Below a depth of 20 inches	Above a depth of 20 inches
Flooding	None	None	Rare, occasional or frequent
Slope 3/	0-8 %	8-15%	More than 15%
Inferred Shrink-well potential	Low	Moderate	High
Unified soil group	GW,GP,SW,SP, GM,GC,SM,SC, CL with PI5/ less than 15	ML, CL with PI6/ 15 or more	CH, MH, OL, OH
Potential frost action	Low	Moderate	High
Stoniness class 7/	1	2 and 3	4 and 5
Rockiness class 6/	0	1	2,3,4 and 5
Depth to bedrock 8/	More than 40 inches	20-40 inches	Less than 20 inche

1/ Some soils given limitation rating of moderate or severe may be good sites from the standpoint of esthetics but require more preparation or maintenance.

2/ For class definitions see CSSC Systems of Soil Classification for Canada, 1975.

3/ Reduce slope limits 50 percent for those soils susceptible to hillside slippage.

5/ PI means plasticity index.

6/ Use this item only where frost penetrates to assumed depth of footings and where soil is moist during freezing weather. See Guide for Interpreting Engineering Uses of Soils USDA, U.S.D.A. - 45

7/ For class definition see appendix.

8/ If bedrock is soft enough so that it can be dug out with light power equipment, such as backhoes, reduce ratings of moderate and severe by one step.

Soil limitation ratings for dwellings (with basements)

Item affecting use	Degree of soil limitation		
	Slight	Moderate	Severe
Soil Drainage class	very rapidly, rapidly, well drained	Moderately well drained	Imperfectly drained, poorly drained, very poorly drained
Apparent Water Table	Below a depth of 60 inches	Below a depth of 30-60 inches	Above a depth of 30 inche
Flooding	None	None	Rare, occasional or frequent
Slope 3/	0-8%	8-15%	More than 15%
Inferred Shrink-well potential	Low	Moderate	High
Unified soil group	GW, GP, SW, SP, GM, GC, SM, SC, CL, with PI5/ less than 15	ML, CL, with PI6/ 15 or more	CH, MH, OL, OH*
Potential Frost action	Low	Moderate	High
Stoniness class 7/	1	2 and 3	4 and 5
Rockiness class 6/	0	1	2,3,4, &5
Depth to bedrock 8/	More than 60 inches	40-60 inches	Less than 40 inches

1/ Some soils given limitation ratings of moderate or severe may be good sites from the standpoint of esthetics but require more preparation or maintenance.

2/ For class definitions see CSSC System of Soil Classification for Canada, 1975.

3/ Reduce slope limits 50 percent for those soils susceptible to hillside slippage.

5/ PI meands plasticity index.

6/ Use this items only where frost penetrates to assumed depth of footings and where soil is moist during freezing weather. See Guide for Interpreting Engineering Uses of Soils USDA, U.S.D.A. - 45

7/ For class definitions see appendix.

8/ If bedrock is soft enough so that it can be dug out with light power equipment, such as backhoes, reduce ratings of moderate and severe by one step.

Soil limitation ratings for septic tank absorption fields

Item affecting use	Degree of Soil Limitation		
	Slight	Moderate	Severe
Perviousness Class	Upper end of moderate	Lower end of moderate	Rapid, slow
Soil Drainage	Well, moderately well	Imperfect	Very rapid, rapid, poorly, very poorly
Depth to water table	More than 72 in.	48-72 in.	Less than 48 in.
Flooding	None	Rare	Occasional or frequent
Slope	0-8 %	8-15 %	More than 15 %
Depth to hard rock, 2/bedrock, or other impervious materials	More than 72 in.	48-72 in.	Less than 48 in.
Stoniness class 3/	1	2 and 3	4 and 5
Rockiness class 4/	0	1	2,3,4,and 5

1/ Class limits are the same as those suggested by the Cansis Manual for Describing Soil in the Field (1975). The limitation ratings should be related to the permeability of soil layers at and below depth of the tile line.

2/ Based on the assumption that tile is a depth of 2 feet.

3/ See Appendix to report.

4/ For class definitions see Soil Survey Manual, pp. 216-223.

Soil limitation ratings for local roads and streets

	Degree of soil limitation		
	Slight	Moderate	Severe
Soil drainage class 1/	Very rapidly, rapidly well drained, and moderately well drained	imperfectly drained	Poorly drained and very poorly drained
Flooding	None	Rare, occasional	Frequent
Slope	0-8%	8-15%	More than 15%
Depth to bedrock 2/	More than 40 in.	20-40 in.	Less than 20 in.
Subgrade 3/ a. AASHO group index 4/ b. Unified soil group	0-4 GW, GP, SW, SP, GM GC 5/, SM 5/, SC5/	5-8 CL with PI 6/ less than 15	More than 8 CL with PI 15 or more CH, MH 8/, OH, OL, PT
Inferred shrink-swell potential	Low SM, SP-SM, SP, MH CL, SC, ML-CL, ML	Moderate CL, MH-CH, CH	High CH
Susceptibility to frost action Texture Class- S, LS, cours SL Unified Class - GW, GP, SW, SP	Low	Moderate C SiC, SL(med.) SCL, Si, SiL, SiCL, L, CL, fineSL SC, GM, GC, SC, CH ML, CL, OL, MH, SM OH	High
Stoniness class	1 and 2	3	4 and 5
Rockiness class	0	1	2,3,4, and 5

1/ For class definitions see Systems of Soil Classifications for Canada, 1975.

2/ If bedrock is soft enough so that it can be dug with light power equipment and is rippable by machinery, reduce limitation ratings of moderate and severe by one step.

3/ Use AASHO Group Index values if available from laboratory tests; otherwise use the estimated Unified soil groups.

4/ Use Group Index values according to AASHO Designation M145-49 and M145-66I; for most soils with group index values below about 8, both designations (methods) give results nearly enough alike to be considered alike for the purpose of this guide.

5/ Downgrade limitation rating to moderate if content of fines is more than about 30 percent.

6/ PI means plasticity index.

7/ Upgrade limitation rating to moderate if MH is largely kaolinitic, friable and free of mica.

GUIDELINES TO EVALUATE SOIL SUITABILITY FOR PLAYGROUND USE

Items Affecting Use	Degree of Soil Limitation		
	None to Slight	Moderate	Severe
Soil drainage	Well and moderately well drained soils.	Imperfectly drained soils.	Rapidly drained, imperfectly drained if subject to ponding. Poorly and very poorly drained soils.
Depth to water-table	Below 3 feet during season of use.	Below 2 feet during season of use.	<2 feet during season of use.
Flooding	None during season of use.	May flood once in 3 years during season of use.	Floods more than once in 3 years during season of use.
Perviousness	Very rapid to moderate. (20 in/hr - 0.6 in/hr)	Moderately slow (0.20 - 0.60 in/hr)	Slow and very slow. (<0.20 in/hr)
Slope	0 - 2 percent	2 - 5 percent	>5 percent
Surface soil texture	sl, fsl, vfsl, l, ls with textural B horizon	sil, cl, scl, sicl, la.	sc, sic, c, organic soils, s and ls subject to blowing.
Depth to bedrock	3 feet	2 - 3 feet	<2 feet
On Surface			
Stoniness	Classes 0 & 1	Class 2	Classes 3, 4, & 5
Rockiness	Class 0	Class 1	Classes 2, 3, 4 & 5

Suitability Ratings of Soils as Sources of Topsoil

Items Affecting Use	Degree of Soil Suitability		
	Good	Fair	Poor
Flooding	None	May flood occasionally for short periods.	Frequent flooding or constantly flooded.
Drainage	Well and moderately well drained soils not subject to pending.	Well and moderately well drained soils subject to occasional ponding. Somewhat poorly drained soils not subject to ponding.	Poorly and very poorly drained soils. Somewhat poorly drained soils subject to ponding for periods of more than 4 weeks during construction season.
Slope	0-5%	>5-9%	>9%
Stoniness	0-1	2	3,4,5
Surface Soil Texture	SL, FSL, VFSL, L, SiL	CL, SCL, SiCL	LS, S, SC, SiC, C, organic soils
Depth of Ah	>6 inches	3-6 inches	<3 inches
Salinity of Topsoil	1/E.C. 0-1	E.C. 1-3	E.C. >3
O.M. content of Ah if present or solum average if not present	>15%	5-15%	<5%
Depth of Solum (A+B) horizons	>30 inches	15-30 inches	<15 inches
pH of Ah if present or solum average if not	6.5-7.5	5.0 to 6.5 and 7.5 to 8.0	<5.0 or >8.0

1/ E.C. - electrical conductivity

The soil suitability ratings of "good, fair, and poor" correspond to the limitations of "none to slight, moderate, and severe" respectively and the definitions are essentially the same. The soils may also be rated "unsuitable" as sources of topsoil.

Guide Sheet 15.--General relationship of systems used for classifying soil samples

[This table may be used as a guide in classifying soils for which no engineering test data are available. The symbol > means "greater than;" the symbol < means "less than."]

USDA texture class name & symbol	Unified symbol	AASHO symbol	Soil properties related to classifications
Clay; silty clay "c"; "sic"	CH	A-7	High shrink-swell clays.
	MH	A-7	Mica, iron oxide, kaolinitic clays.
	CL	A-7	Low LL. Generally < 45 pct clay.
Silty clay loam "sicl"	CL	A-7	Low LL. Plastic. (A-6 if clay < 30 pct).
	ML-CL	A-7	Low LL. Mod. plastic. (A-6 if clay < 30 pct).
	CH	A-7	High LL. High shrink-swell clays.
	MH	A-7	High LL. Mica, iron oxide, kaolinitic.
Clay loam "cl"	CL	A-6 or A-7	Low LL. Plastic.
	ML-CL	A-6	Low LL. Moderately plastic.
	CH	A-7	High LL. High shrink-swell clays.
	MH	A-7	High LL. Mica, iron oxide, kaolinitic.
Loam "l"	ML-CL	A-4	Moderately plastic (A-6 if clay > 21 pct).
	CL	A-6	Plastic (A-4 if clay < 22 pct).
	ML	A-4	Low plasticity (A-7 if clay > 21 pct).
Silt loam "sil"	ML-CL	A-4	Moderately plastic (A-6 if clay > 21 pct).
	ML	A-4	Low plasticity (A-7 if clay > 21 pct).
	CL	A-6	Plastic.
Silt - "si"	ML	A-4	Low plasticity.
Sandy clay "sc"	CL	A-7	Fines > 50 pct.
	SC	A-7	Fines 50 pct or less.
Sandy clay loam "scl"	SC	A-6	Plastic. Fines 36-50 pct.
	SC	A-2-6	Plastic. Fines 35 pct or less.
	CL	A-6	Plastic. Fines > 50 pct.
Sandy loam "sl"	SM	A-2-4 or A-4	Low plasticity.
	SC	A-2-4	Plastic.
	SM-SC	A-2-4	Moderately plastic.
Fine sandy loam "fsl"	SM	A-4	Nonplastic. Fines 50 pct or less.
	ML	A-4	Nonplastic. Fines > 50 pct.
	ML-CL	A-4	Moderately plastic. Fines > 50 pct.
	SM-SC	A-4	Moderately plastic. Fines 50 pct or less.
Very fine sandy loam "vfsl"	ML-CL	A-4	Moderately plastic.
	ML	A-4	Low plasticity.
Loamy sands "ls"; "lfs" "lvfs"	SM	A-2-4	Nonplastic. Fines 35 pct or less.
	SM-SC	A-2-4	Moderately plastic. Fines 35 per or less.
	SM	A-4	Low plasticity. Fines > 35 pct.
	ML	A-4	Little or no plasticity.
Sand; fine sand "s"; "fs"	SP-SM	A-3	Fines approx. 5-10 pct.
	SM	A-2-4	Fines approx. > 10 pct.
	SP	A-3	Fines < 5 pct.
Very fine sand "vfs"	SM	A-4	Low plasticity.
	ML	A-4	Little or no plasticity.
Coarse sand "cs"	SP; GW	A-1	Fines < 5 pct.
	SP-SM	A-1	Fines 5-12 pct.
	SM	A-3	Fines 13-25 pct.
	SM	A-2-4	Fines > 25 pct.
Gravel, "G"	GP;GW	A-1	Fines < 5 pct.
50 pct passes No.200	GM or GC	A-1	Fines 5-25 pct.
50 pct of coarse	GM or GC	A-2	Fines 26-35 pct.
passes No. 4 sieve	GM	A-4	Fines > 35 pct.
	GC	A-6	Fines > 35 pct.

Soil Drainage Classes

Very rapidly drained -- Water removed from the soil very rapidly in relation to supply. Excess water flows downward very rapidly if underlying material is pervious. There may be very rapid subsurface flow during heavy rainfall provided there is a steep gradient. Soils have very low available water storage capacity (usually<1 inch (2.5 cm)) within the control section and are usually coarse textured and/or shallow. Water source is precipitation.

Rapidly drained -- Water removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep gradients during heavy rainfall. Soils have low available water storage capacity (1-1.5 inches (2.5-3.8 cm)) within the control section, and are usually coarse textured and/or shallow. Water source is precipitation.

Well drained -- Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying pervious material or laterally as subsurface flow. Soils have intermediate available water storage capacity (1.5-2 inches (3.8-5 cm)) within the control section, and are generally intermediate in texture and depth. Water source is precipitation. On slopes subsurface flow may occur for short durations but additions are equalled by losses.

Moderately well drained.-- Water is removed from the soil somewhat slowly in relation to supply. Excess water is removed somewhat slowly due to low perviousness, shallow watertable, lack of gradient or some combination of these. Soils have intermediate to high water storage capacity (2-2.5 inches (5.0-2 cm)) within the control section and are usually medium to fine textured. Precipitation is the dominant water source in medium to fine textured soils; precipitation and significant additions by subsurface flow are necessary in coarse textured soils.

Imperfectly drained -- Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly downward if precipitation is major supply. If subsurface and/or ground water is main source, flow rate may vary but the soil remains wet for a significant part of the growing season. Precipitation is main source if AWSC is high; contribution by subsurface and/or ground water flow increases as AWSC decreases. Soils have a wide range in available water supply, texture and depth, and are gleyed phases of well drained subgroups.

Poorly drained -- Water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen. Excess water is evident in the soil for a large part of the time. Subsurface flow and/or ground water flow in addition to precipitation are main water sources; may also be perched water table with precipitation exceeding evapotranspiration. Soils have wide range in available water storage capacity, textures and depth, and are gleyed subgroups, gleysols and organics.

Very poorly drained -- Water is removed from the soil so slowly that the watertable remains at or on the surface the greater part of the time the soil is not frozen. Excess water is present in the soil the greater part of the time. Ground water flow and subsurface flow are major water sources. Precipitation is of lesser importance except where there is a perched watertable with precipitation exceeding evapotranspiration. Soils have a wide range in available water storage capacity, texture and depth, and are either gleysolic or organic.

Soil Perviousness Classes

Rapidly pervious -- The capacity to transmit water vertically is so great that the soil would remain wet for no more than a few hours after thorough wetting if there were no obstructions to water movement outside the body classified. The horizons and soils have large and continuous or connecting pores and cracks that do not close with wetting. Many, but not all, fragmental, sandy, skeletal soil bodies provide these conditions, as do some medium and fine textured horizons that have extremely strong, granular structure and large, connecting pores.

Moderately pervious -- The capacity to transmit water vertically is great enough that the soil would remain wet for no more than a few days after thorough saturation if there were no obstructions to water transmission outside the body classified. Most moderately pervious soils hold relatively large amounts of water against the force of gravity, and are considered good, physically, for rooting and supplying water to plants. Soil horizons may be granular, blocky, weakly platy or massive (but porous) if continuous conducting pores or cracks are present which do not close with wetting.

Slowly pervious -- The potential to transmit water vertically is so slow that the horizon or the soil would remain wet (saturated) for periods of a week or more after thorough wetting whether or not there were obstructions to water movement outside the body classified. The soil may be massive, blocky or platy, but connecting pores that could conduct water when the soil is wet are few, and cracks or spaces among peds that may be present when the soil is dry close with wetting. Even in positions accessible to plant roots, roots are usually few or absent and if present, they are localized along cracks when the soil is wet.

Soil Textural Classes

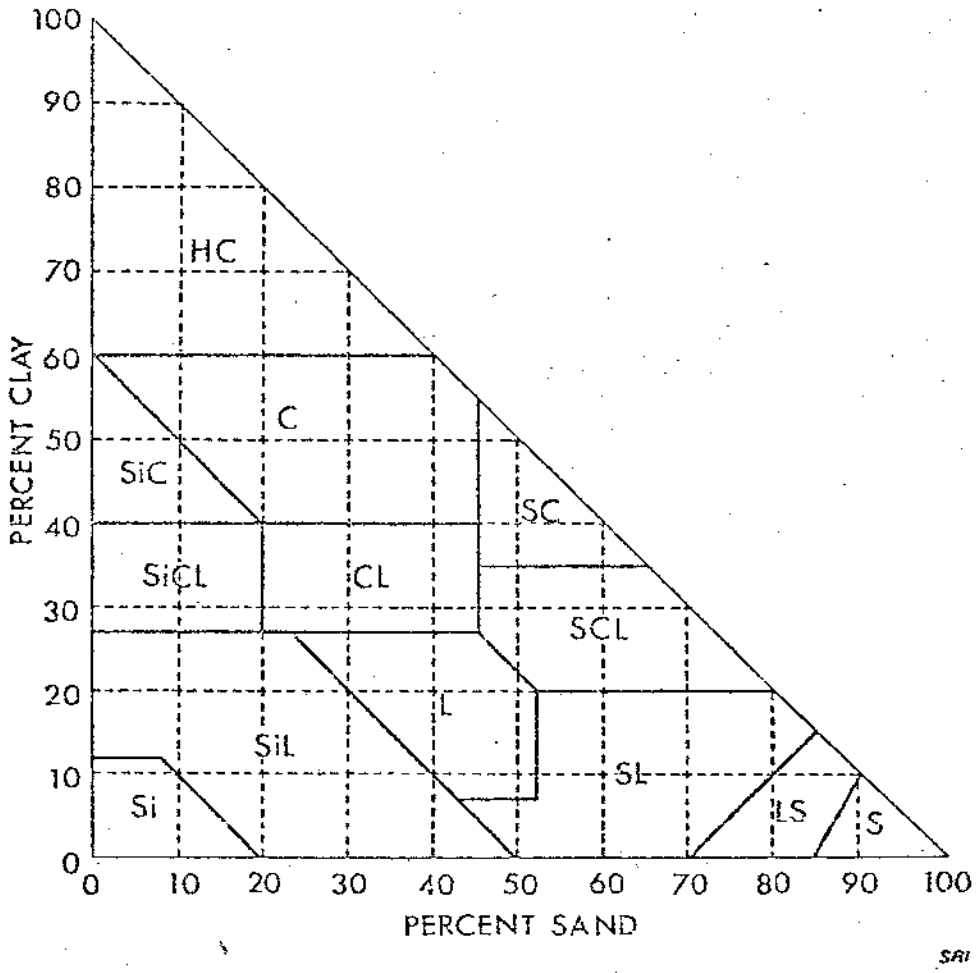


Fig. 34. Soil textural classes. Percentages of clay and sand in the main textural classes of soils; the remainder of each class is silt.

ROCKINESS CLASSES

The classes of rockiness are defined as follows:

Rocky 1 (Slightly rocky land)—Sufficient bedrock exposures to interfere with tillage but not to make intertilled crops impracticable. Depending upon how the pattern affects tillage, rock exposures are roughly 100 to 300 feet apart and cover 2 to 10% of the surface.

Rocky 2 (Moderately rocky land)—Sufficient bedrock exposures to make tillage of intertilled crops impracticable, but soil can be worked for hay crops or improved pasture if other soil characteristics are favorable. Rock exposures are roughly 30 to 100 feet apart and cover 10 to 25% of the surface, depending upon the pattern.

Rocky 3 (Very rocky land)—Sufficient rock outcrop to make use of machinery impracticable, except for light machinery where other soil characteristics are especially favorable for improved pasture. The land may have some use for wild pasture or forests, depending on the other soil characteristics. Rock exposures, or patches of soil too thin over rock for use, are roughly 10 to 30 feet apart and cover 25 to 50% of the surface, depending on the pattern.

Rocky 4 (Exceedingly rocky land)—Sufficient rock outcrop (or very thin soil over rock) to make all use of machinery impracticable. The land may have some value for poor pasture or for forestry. Rock outcrops are about 10 feet or less apart and cover 50 to 90% of the area.

Rocky 5 (Excessively rock land)—Land on which over 90% of the surface is exposed bedrock (rock outcrop).

As a guideline, land with more than 50% bedrock exposed is a complex of Rockland and a soil series.

The names, sizes, shapes, and kinds of fragments are designated as follows:

STONINESS CLASSES

STONES 1.	0 to 10 percent of surface area
STONES 2.	11 to 20 percent of surface area
STONES 3.	21 to 40 percent of surface area
STONES 4.	41 to 80 percent of surface area
STONES 5.	81 percent and greater of surface area

Stoniness refers to those coarse fragments over 10" in diameter that occur in the surface soil horizons.

APPENDIX III

CLIMATE DATA FOR THE REGION

MEAN TOTAL PRECIPITATION (INCHES) PRECIPITATION TOTALE MOYENNE (POUCES)

	JAN JAN	FEB FEV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOUT	SEP SEP	OCT OCT	NOV NOV	DEC DEC	YEAR ANNEE	TYPE TYPE
BRITISH COLUMBIA														
VERNON	1.73	1.05	0.73	0.80	1.17	1.49	1.17	1.18	1.34	1.24	1.27	2.06	15.23	8
VERNON COLDSTREAM RANCH	1.57	1.06	0.78	0.81	1.32	1.75	1.20	1.31	1.34	1.20	1.27	1.85	15.46	1

MEAN SNOWFALL (INCHES) PRECIPITATION MOYENNE DE NEIGE (POUCES)

	JAN JAN	FEB FEV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOUT	SEP SEP	OCT OCT	NOV NOV	DEC DEC	YEAR ANNEE	TYPE TYPE
BRITISH COLUMBIA														
VERNON	14.9	6.1	2.8	0.4	0.0	0.0	0.0	0.0	0.0	0.5	4.5	13.6	42.8	8
VERNON COLDSTREAM RANCH	13.4	6.1	2.6	0.1	0.0	0.0	0.0	0.0	0.0	0.1	4.3	13.6	40.7	1

MEAN RAINFALL (INCHES) HAUTEUR DE PLUIE MOYENNE (POUCES)

	JAN JAN	FEB FEV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOUT	SEP SEP	OCT OCT	NOV NOV	DEC DEC	YEAR ANNEE	TYPE TYPE
BRITISH COLUMBIA														
VERNON	0.24	0.44	0.45	0.76	1.17	1.49	1.17	1.18	1.34	1.19	0.82	0.70	10.95	8
VERNON COLDSTREAM RANCH	0.23	0.45	0.52	0.80	1.32	1.75	1.20	1.31	1.34	1.18	0.79	0.46	11.35	1

APPENDIX IV

LABORATORY ANALYSIS RESULTS

REFERENCES

1. Canada Department of Agriculture, 1974 - Revised. The System of Soil Classification for Canada.

2. E.L.U.C. Secretariat, Resource Analysis Unit, 1976. Terrain Classification System.

3. The Environment and Land Use Sub-Committee on Northeast Coal Development, 1976. Northeast Coal Study - Preliminary Environmental Report.

4. United States Department of Agriculture, Soil Conservation Service, 1971. Guide for Interpreting Engineering Uses of Soils.

5. V. Osborne, Head, Laboratory Services, Kelowna. Personal communication.

SAMPLE & HORIZON		PARTICLE SIZE %S	%Si	%C	Tex-ture	%MOISTURE	pH 1:1 HOH	1:2CaCl2	%C	%O.M	%N	C/N	EXCHANGEABLE BASES me/100g Ca	Mg	K	Na	%Fe	%Al	%P	ELECTRICAL CONDUCTIVITY mmohs/cm	PLASTIC LIMIT	P.I.	UNI. SOIL GR.
1-Ahca																							
Ah	1373	77.25	11.62	11.13	SL	3.09	7.2	6.9	7.39	12.74	0.453	16.33	36.39	6.55	1.20	0.03			36.9	.50			
Ckaj	1374	80.22	13.43	6.35	LS	0.62	8.0	7.5			0.019		7.64	1.76	0.47	0.04			2.5	.42			
Ckg	1375	82.05	12.41	5.54	LS	0.59	8.2	7.6			0.019		5.56	1.82	0.19	0.06			6.5	.32			
2-Ah	1376	45.03	24.56	30.41	SCL-CL	8.89	6.4	6.3	19.59	33.77	1.334	14.67	38.22	26.24	0.76	1.59			10.3	1.18			
Ckg	1377	74.54	16.58	8.88	SL	0.95	7.1	6.6			0.056		4.49	3.87	0.36	0.15			9.6	.60			
3-Ah1	1378					3.89	6.7	6.2	4.68	8.08	0.385	12.13	25.26	2.91	2.22	0.03			68.4				
Ah2	1379					3.08	7.2	6.7	2.28	3.95													
Bm	1380	40.82	20.00	30.18	CL	3.07	7.4	6.8			0.132		17.41	3.08	1.76	0.06			64.2				
Ck	1381	66.62	20.88	12.50	SL	1.16	7.7	7.1			0.022		9.99	1.61	0.40	0.07			33.2	.29			
4-Ah1&2	1382	68.79	18.33	12.88	SL	1.54	6.9	6.4	2.58	4.46	0.173	14.94	13.27	2.32	0.78	0.01			106.9				
5-Ah	1383					3.45	7.0	6.6	6.10	10.52	0.480	12.72	29.59	4.93	3.36	0.03			137.1				
IC	1384	50.55	32.49	16.96	L(SL)	1.72	7.4	6.9			0.116		12.92	1.84	2.24	0.05			236.5				
6-Ah1	1385					2.51	6.6	6.1	3.55	6.12	0.276	12.86	17.69	2.20	1.86	0.03			164.0				
Ah2	1386					2.06	6.9	6.3	1.90	3.28	0.142	13.38	13.22	1.44	0.75	0.07			273.0				
IC(Btj)	1387	26.49	53.99	19.52	SiL		7.1	6.4												.14	20.98	3.03	ML
IIC	1388	36.00	47.81	16.19	L(SIL)		7.0	6.5												.20	20.85	2.49	ML
7-Btk	1389	5.53	21.94	72.53	C (HC)		7.0	6.2												.23	35.86	36.14	MH
8-Ah	1390					3.48	6.4	5.7	5.92	10.21	0.344	17.18	16.06	3.35	1.70	0.02			155.2				
Bm(f)	1391					2.14	6.6	6.0			0.065						0.06	0.05	74.1				
9-Ah	1392					1.82	6.9	6.4	2.67	4.60	0.210	12.72	13.49	1.63	1.12	0.10			88.6	.24			
BC	1393	44.64	37.27	18.09	L	1.02	7.2	6.7			0.036		6.08	1.39	0.34	0.03			9.6	.28	17.03	5.19	ML-CL
Ck	1394	54.65	30.10	15.25	SL	0.83	8.1	7.6			0.018		17.47	1.17	0.13	0.04			3.8	.46	16.91	2.91	ML
10-Ah	1403	8.79	27.33	68.88	HC	5.06	6.8	6.4	4.86	8.38	1.429	12.86	22.76	11.56	3.08	0.06			110.3				
AB	1404	8.68	28.19	63.13	HC																		
Bt	1405	2.49	14.35	83.16	HC		7.1	6.7												.20	38.39	31.47	MH
Ck	1406	0.66	13.19	86.15	HC		8.2	7.9												.46	37.19	37.39	MH
11-Ah1&2	1407	27.05	30.81	42.14	C																		
IIC	1408	32.70	33.97	33.33	CL																		
12-Ah1&2	1409					1.42	6.7	6.3	4.88	8.41	0.360	13.55	47.67	6.77	2.58	0.04			104.0				
AB	1410	13.25	36.07	50.68	C																		
Btj	1411	6.78	19.02	74.20	HC																		
13-Ah	1412					2.91	6.7	6.1	4.31	7.43	0.324	13.30	35.61	3.84	2.26	0.02			79.8				
Bh	1413	58.62	17.43	23.95	SiL	2.32	7.6	7.0	2.26	3.90	0.180	12.56	28.29	3.91	1.87	0.07			107.4				

SAMPLE & HORIZON		PARTICLE SIZE %S	%Si	%C	Tex-ture	%MOISTURE	pH 1:1 HOH	pH 1:2 $CaCl_2$	%C	%O.M	%N	C/N	EXCHANGEABLE BASES me/100g Ca	Mg	K	Na	%Fe	%Al	%P	ELECTRICAL CONDUCTIVITY mmohs/cm	PLASTIC LIMIT	P.I.	Uni. Soil GR.
g-Ck	1395	62.54	24.20	13.26	SL																		
1-Btk	1396	2.11	41.54	56.35	SiC		7.8	7.5												1.35	37.73	36.14	MH
t-Ah_1	1397					3.17	6.6	6.0	5.19	8.95	0.429	12.09	20.09	3.01	0.87	0.03			82.3				
Ah_2	1398					2.09	7.0	6.3	2.52	9.34	0.199	12.67	13.12	1.76	0.82	0.04			93.9				
w-Ah	1400	49.47	25.87	29.66	CL-SCL																		
B	1401	33.62	46.85	19.53	L(Si)																		
x-Ah	1402					3.31	6.4	6.0	4.33	7.96	0.361	12.01	18.81	4.12	1.41	0.05			62.0				

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

WHEN REPLYING PLEASE QUOTE FILE No. 1-2-1-176

DEPARTMENT OF RECREATION AND CONSERVATION
PARKS BRANCH
V8W 2Y9

Victoria, B.C.
September 5, 1975.

Mr. A. Benson,
Assistant Director,
E.L.U.C. Secretariat,
BUILDINGS,

Attention: Norm Sprout

Dear Mr. Benson,

Re: Kalamalka Lake Park

I must apologize for the delay in our confirming a project request on Kalamalka Lake Park but in the rush of the field season staff in this office neglected to confirm previously held conversations. As discussed by Mr. Derek Thompson and Mr. Sprout and later Ms. Val Parsons, this Division has some short term needs which your recreation section may be able to fulfill.

The Parks Branch has now taken over responsibility for the Coldstream Ranch purchase and is entering the inventory phase of planning. We have been and will continue to collect information on recreation features. Two further areas of concern are however a little beyond our capability, these relate to the soils in the property and their carrying capacity for recreation.

We understand from Ms. Parsons that she will be able to work on this project in October and produce a brief resume of the situation during that month. Our reason for requesting such a rapid analysis is that we are, in the planning concept stage, working with members of the public. Our next major meeting with these persons will be on November 18th when we hope to present our total inventory information. Hopefully we will then be able to begin discussions on planning options.

Our staff is prepared to meet on site with Ms. Parsons sometime in early October, Mr. J.D. Anderson 5705, i/c Central Planning will co-ordinate in this matter.

I hope that this is a reasonable summary of our understanding to date.

Yours very truly,
PARKS BRANCH,
T.E. Lee, Director.

G.F. Macnab, Chief,
Planning Division.

c.c. - D. Thompson

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

WHEN REPLYING PLEASE QUOTE FILE No. 1-2-1-176-27

DEPARTMENT OF RECREATION AND TRAVEL INDUSTRY
PARKS BRANCH
V8W 2Y9

Victoria, B.C.
September 24, 1976.

Mr. N. Sprout,
2i/c Resource Analysis Unit,
Environment and Land Use Committee Secretariat,
Department of the Environment,
BUILDINGS,

Dear Sir:

Re: Soils and Vegetation Inputs, Kalamalka Lake Park Plan.

As part of a public commitment, the Parks Branch is involved in an assessment of various planning alternatives for Kalamalka Lake Park. In determining constraints and opportunities provided by the site for recreational use, we are attempting to document the physical characteristics of the setting and the implications of various types and levels of recreational use on the natural environments of the park. Two areas requiring specific detailed inputs are:

1.) an assessment of the durability, stability and fertility of soils in the immediate vicinity of Cosens Bay, with recommendations for earthworks

2.) an assessment of the health, age and stability of a stand of cottonwoods on the main beach at Cosens Bay, with recommendations for future management of the stand

3.) a review of soil conditions and limitations in areas not previously sampled

In 1975, V. Parsons conducted a survey of soils in Kalamalka Lake Park with reference specifically to zoning areas for recreational uses on the basis of the physical carrying capacity of the site. At that time, more detailed survey of potential development areas was suggested, allowing 1½-2 weeks for field work, plus laboratory analysis. It is not known how long would be required for an evaluation of the beach cottonwood stand.

...../2.....

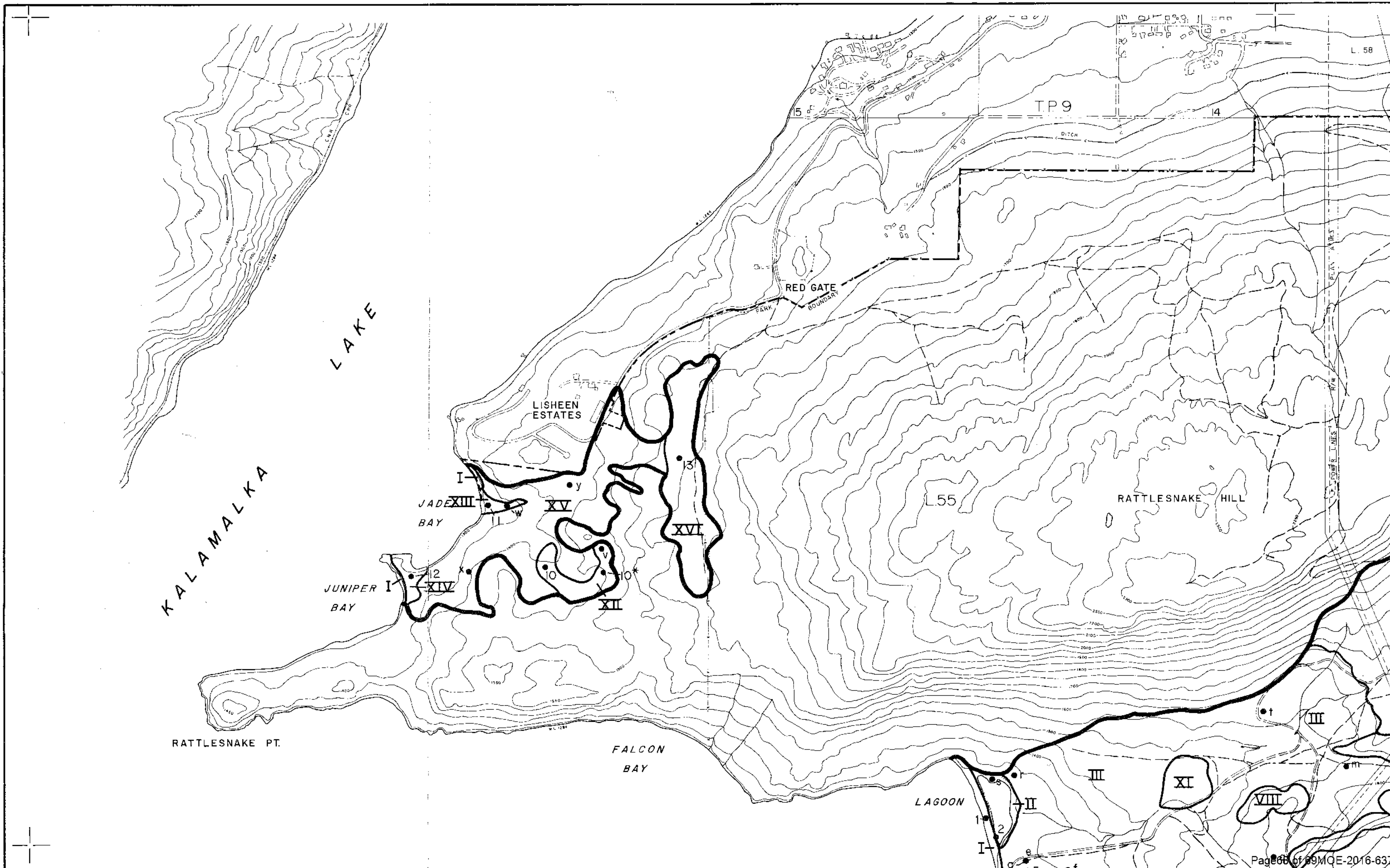
It is hoped that the inventory and assessment portion of the park planning process can be completed by mid-October, in anticipation of developing specific planning alternatives by mid-November, and a public meeting in early December.

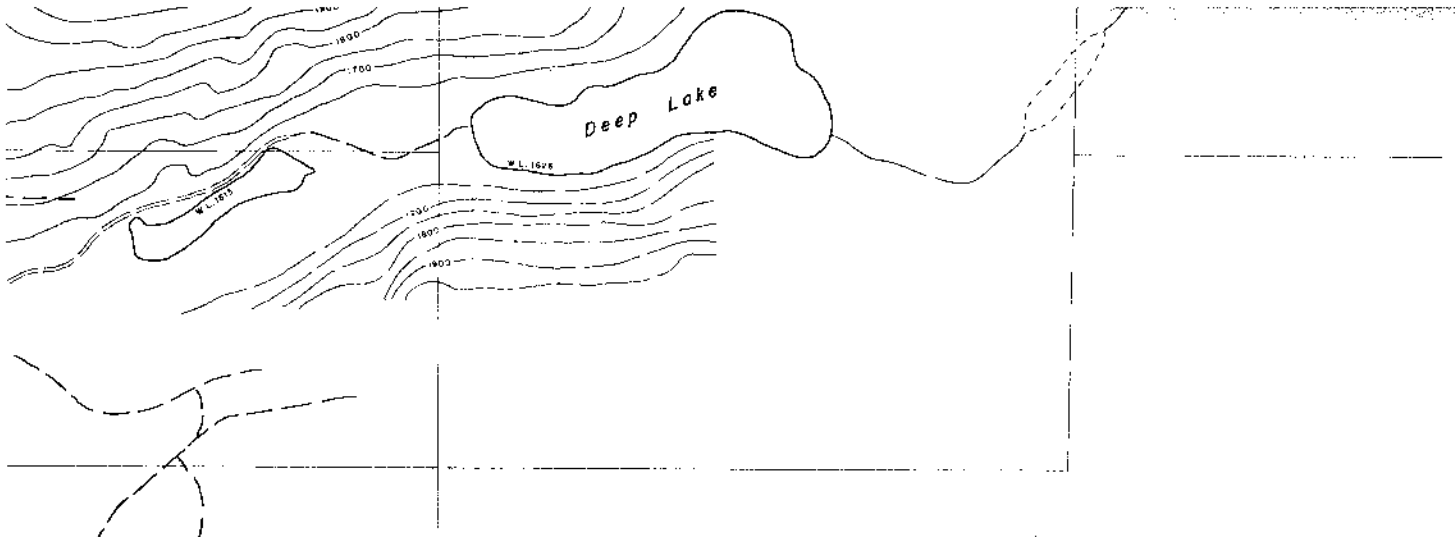
Mr. M. Bocking of our planning team in Victoria and Mr. K. Baker of the Parks Branch Kamloops office are responsible for compiling necessary information in the park and will be available for site visits to discuss the above problems.

Please advise whether it is possible to meet our requirements in the time allotted, and what further arrangements should be made in conducting the necessary assessments.

Yours very truly,
PARKS BRANCH,
T.E. Lee, Director.

J.D. Anderson,
i/c Central Planning.


KALAMALKA LAKE
LISHEEN ESTATES
RED GATE
PARK BOUNDARY
T.P.9
L.58
L.55
RATTLESNAKE HILL
JADE BAY
JUNIPER BAY
RATTLESNAKE PT.
FALCON BAY
LAGOON
DITCH
POWER LINES
XIII
XIV
XV
XVI
XII
XI
VIII
III
II
I



TERRAIN:SOILS MAP OF PROPOSED DEVELOPMENT AREAS

MAP UNITS /1	GENERAL DESCRIPTION	SAMPLE SITES IN UNIT	OBSERVATION SITES IN UNIT
I	Well to rapidly drained sandy gravelly fluvial deposit	1	d
II	Poorly drained sandy fluvial deposit	2	s
III	Well to rapidly drained glacial fluvial deposit	3,5	a,c,e,f,m,q,r,t
IV	Moderately well to poorly drained sandy gravelly fluvial fan deposit	4	b,g,h
V	Moderately well drained sandy silty gravelly fluvial deposit	6	i
VI	Moderately well drained silty clay lacustrine deposit	7	j,l
VII	Poorly drained silty clay lacustrine deposit		k
VIII	Complex of colluvial material and bedrock outcrop		n,o,p,p^{*} /2
IX	Well drained sandy gravelly fluvial terrace deposit	8	
X	Well drained medium textured morainal deposit	9	u
XI	Poorly drained glacial fluvial deposit		
XII	Moderately well to imperfectly drained clay lacustrine deposit	10,10^{*} /2	v
XIII	Complex unit of colluvial, morainal and fluvial material	11	w
XIV	Moderately well drained silty clay lacustrine deposit	12	
XV	Moderately well drained medium textured morainal deposit		x,y
XVI	Well drained fine sandy fluvial terrace deposit	13	

/1. Map Unit: terrain units and subdivisions of terrain units based on soil drainage and soil texture characteristics.

/2. An asterisk used as a subscript on an observation or sample site indicates that the sites have similar characteristics (ie p^{*} is similar to p, 10^{*} is similar to 10)

STUDY BOUNDARY

800 0 800 1600

scale in feet

Base provided by Department of Recreation and Conservation, Government of B.C. Sept, 1975

File No. 2-2-1-176
DWG. No. 2-1-176 KEY