Restoration Plan for West Beach Park
Keats Island, British Columbia
for
The Sunshine Coast Regional District

Submitted July 28th, 2021 by Richard C Beard, BDS, Dip RNS
262 Big Amber Road,
Keats Island, British Columbia
Telephone: 778-870-2152
e-mail: richardcbeard@outlook.com

On behalf of the Keats Island Conservation Group

Summary

West Beach is a popular recreation site on Keats Island, British Columbia (Fig 1). The adjoining park comprises approximately 0.25 hectare above the shoreline and provides beach access through two trails, east and west. The gravel beach extends 130 m between rocky headlands on either side.

The shoreline exhibits erosion along its length with undercutting of the bank in many places. Erosion is also present along and adjacent to the two trails, especially the lower portion of the west trail. The erosion is extending to affect adjoining private property.

Ground inspection of the site revealed many factors which contribute to erosion:

1. Underlying sand and pebble subsoil, with some soft sandstone
2. A very thin (2-3 cm) surface vegetation litter layer underlain by a very thin organic soil layer
3. Very steep slopes
4. An open southerly aspect which provides exposure to wave and wind action, and drying effects of the Sun
5. Foot traffic, which has eroded trails and areas at the shoreline
6. Storage of floats and watercraft which leads to erosion through impacts on vegetation
7. Cutting of trees rendered unstable by erosion around their roots. Erosion is then enhanced around the dead roots which do not retain soil well vs live roots
8. A decreased amount of Coarse Woody Debris. CWD contributes to reducing erosion but cut and dead trees tend to be used for firewood.
9. Increasing presence of non-native invasive plants. Some of these e.g. Himalayan blackberry and yellow lamium can form dense layers which inhibit the growth of young trees, with a long term reduction in trees and their soil stabilizing roots.
10. Significant presence of western redcedar trees. Although not an issue here yet, drying trends will increase cedar mortality, as is being seen now throughout our region. This will reduce canopy cover and root stabilization unless they are replaced by more drought tolerant species.

Vegetation management will play a key role in reducing erosion along with physical stabilization measures which, in turn, will encourage vegetation regrowth. Opportunities are outlined for restoration above the shoreline. These include:

1. Building a series of check dams, with rock fill, as steps along the lower portion of the west trail.
2. Creating log and topsoil terraces above the trails in erosion areas. These would be planted with native trees and shrubs including cuttings of Sitka willow. As the logs decay the planted vegetation's roots will increasingly act as soil retainers. Protection form deer browsing will be required for the first few years.
3. Planting drought tolerant tree species in more open areas and near the trails e.g. Douglas-fir, shore pine, Sitka willow.
4. Removal of non-native invasive plants in the park and adjoining private property.
5. Construction of storage racks for floats and watercraft.
6. Prohibition of wood removal.

The prevailing vegetation type, Douglas-fir/Salal, is well adapted to dry conditions. With successful management it could evolve with climate change and help retard erosion at West Beach Park while providing many other benefits.

Long term stability of the park's slope and adjoining property will depend on reducing erosion at the shoreline. The current average erosion rate could be more than 2 cm per year, which will increase as sea levels rise and storm surges increase. This will attract increasing attention from park users, neighbouring property owners, government bodies and insurance companies.

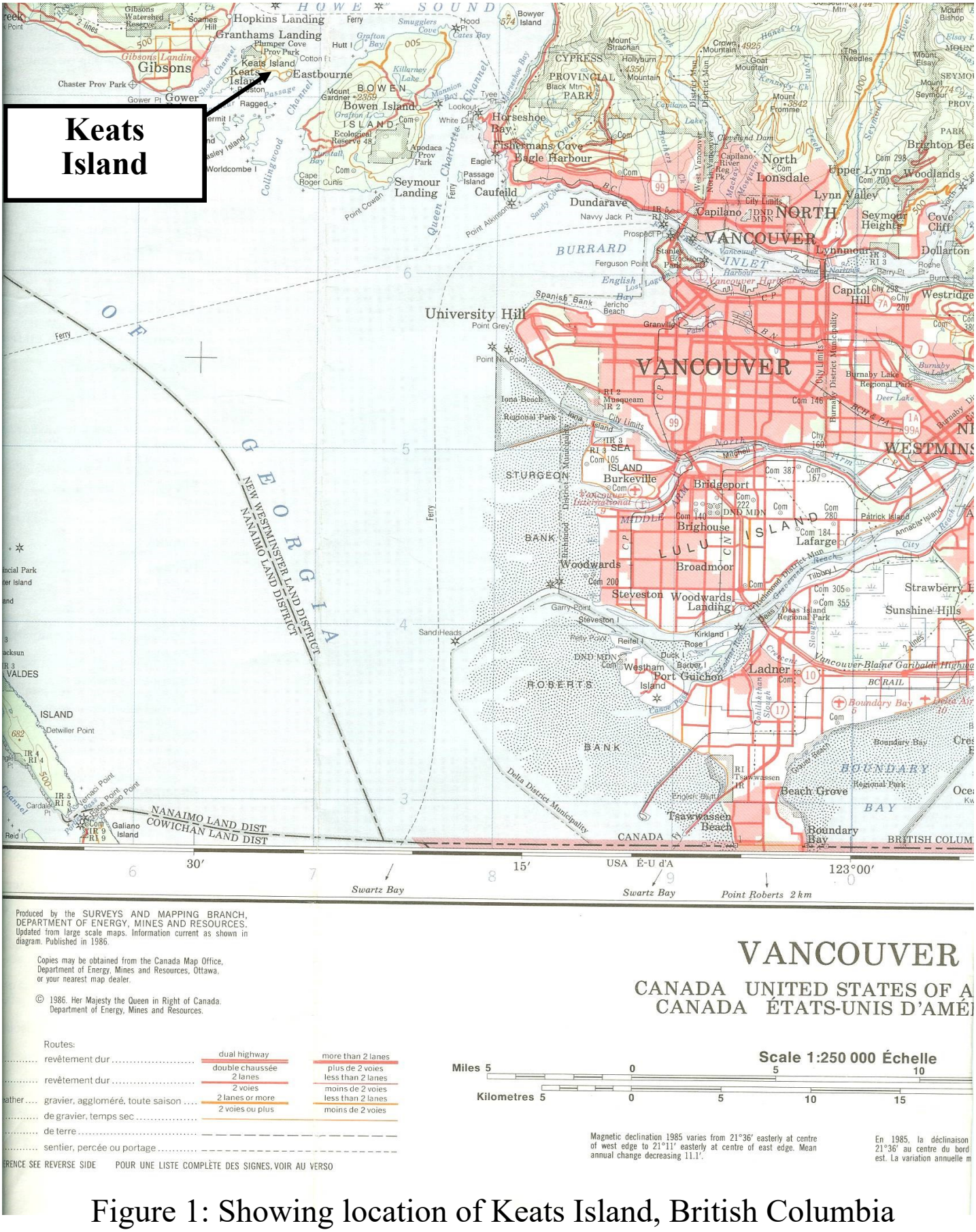


Figure 1: Showing location of Keats Island, British Columbia from Map 92G, Energy, Mines and Resources Canada 1986

↑ = North

Introduction

West Beach is a popular recreation site which is accessed by two trails through West Beach Park. Local residents, some whose property borders the park, have expressed concern about erosion both adjacent to the trail and at the upper edge of the beach. The former is encroaching on private property and will continue unless addressed.

Keats Island residents have expressed the wish to protect "the Island's limited and fragile natural environment, including forests, wildlife…" These wishes are reflected in Goal 2.2 of the Keats Island Official Community Plan (Islands Trust 2002) which is "to preserve the ecological integrity and natural beauty of Keats Island". However, only 47 of the Island's 607 hectares (7.75%) are officially protected (under "park" status). Therefore, it is important that these small portions be managed to protect their ecological values.

Increased use of public areas also presents an opportunity for appreciation and learning. Islanders are becoming involved in park restoration and applying new knowledge to their own property e.g. control of invasive plants.

Project site and description

The project site lies in the southeastern portion of Keats Island, located 27 km northwest of Vancouver's city centre (figure 1). It is centred at latitude 49.4 deg. north, longitude -123.4 deg. (Google Earth).

The park measures approximately 130 m along the beach and slopes steeply, ranging from 30 to 50 degrees, up to two access trails which connect with a narrow unpaved road. The trails are:
1. From the northeast, 90 m in length, "east trail".
2. From the northwest, 110 m in length, "west trail"

These join near the centre of the beach and the level of highest tide.

The park is managed by the Sunshine Coast Regional District which have removed trees considered a hazard. Local residents have performed trail maintenance, including an effective water channeling ditch and pipe at the upper end of west trail.

The park's terrestrial portion consists of established second growth coniferous forest with some deciduous trees present. Water drains through general percolation of the underlying porous soil and some ephemeral seepages.

Method

Intially I consulted:
1. With two long term part-time residents, while walking the site and noting features of concern.
2. Keats Island Sensitive Ecosystem Map (Islands Trust 2002).
3. Keats Island Official Community Plan (Islands Trust 2002) for background information.
4. Long-time island residents for historical information.
5. Sunshine Coast Regional District (SCRD 2020) for parks location map.

From 11th through 25th June, 2021, I:
1. Plotted site boundaries as defined by the beach, surrounding private property, and access road.
2. Surveyed two 10 m x 10 m plots on the site, selected to yield a good representation of the main vegetation types. Vegetation and soil assessments were based on the standard Ground Inspection Form (Province of British Columbia 1998).
3. Recorded any non-native invasive species encountered.
4. Recorded the dimensions of Coarse Woody Debris, CWD, present in each plot. A modified version of the CWD form (Province of British Columbia 1998) was used to enable calculation of approximate volumes. CWD was defined as 10 cm diameter or greater, the minimum size surveyed for presence of salamanders (Province of British Columbia 1999).



Figure 2: map of Keats Island, British Columbia, showing study site and ecologically sensitive areas from Keats Island Community Plan (Islands Trust 2002)



Figure 3: Map of portion of Keats Island (Google Earth), showing study site, outlined in white

Compiled by Uriel Garcilazo

5. Measured the slope of the trails and composition of surface material.
6. Conducted water percolation tests at six locations along the trails by excavating a hole 5 x 5 x 5 cm, filling with 100 cc water and recording the time for total drainage.
7. Noted erosion areas above the trails and recorded exposed soil types.
8. Walked along the shoreline and trails immediately after significant rain to record evidence of water drainage, erosion, and other features.

Plots were measured with a tape measure and compass, slopes with a Suunto clinometer. CWD volume was assessed using a tape measure for length, and diameters along the length to estimate average diameter for each piece. Vegetation was identified using Pojar and MacKinnon (2004) and iNaturalist (. Plot and trail locations were recorded using a mobile phone.

Results

One vegetation type/site series (Green and Klinka 1994) was identified (appendices 1 and 2) : Douglas-fir/salal (figs 4 and 5).

Non native plant species included: holly, Himalayan blackberry mostly along the trails but with scattered isolated plants, Scotch broom scattered throughout the site, yellow lamium spreading from private property into the park along east trail, lesser periwinkle as above along west trail, common ivy as above on east trail near the road. Recent dumping of vegetation was present south of east trail. See appendix 3 for Latin and common names for plants identified during the survey.

CWD was present at 32 cu m per hectare, from average density of the two plots (appendix 4).

Soil in the two plots showed a very shallow litter layer, then a very shallow organic layer, under-lain by sand (figs 6 and 7). This reflected the predominant composition observed throughout the site at erosion areas: sand with embedded pebbles, with some areas of sandstone. This appears to be several metres in depth judging from the many erosion areas, some over 3 m in elevation.

From the road to the beach, the total length of east trail was 90 m along slope then 20 steps (5 m vertical). Slope range was 10 - 14 degrees. There was evidence of recent log and rock work to stabilize the downhill side of the trail in one area, and several vertical secured wood step/retainers (Fig 8). The trail surface consisted of fine soil and gravel with patchy leaf litter.

West trail measured 110 m from the road to the beach. Slope was 17 degrees over the 30 m above the beach (Fig 9) moderating to 6 degrees 50 m above. Loss of vertical height from the prevailing slope was up to 1.25 m over a width of up to 3.5 m. Below 50 m the surface consisted of sand and pebbles. Above, there was a surface layer of fine soil and gravel with patchy leaf litter. In the lower 30 m an alternative beach access was noted as a switchback to the west, shallower and stepped.

Of the five percolation test holes, three drained in less than one minute. These were all within the bottom 30 m of west trail. The two others, east trail and upper part of west trail, took 9 minutes plus to drain. At one chosen location (30 m up west trail) it was not possible to excavate a hole due to the presence of sandstone. Here, water ran off the surface.

Erosion with some undercutting was visible above both trails, more above west trail, bordering private property. In some places there was evidence of repair using logs or rocks (Fig 10).

Water seepage points were visible where underlying igneous bedrock was exposed, at the extreme ends of the beach. The only other actively flowing water was from two pipes onto the beach from a drainage system constructed at the upper end of west trail.

Several watercraft and a float were observed stored at or just above the shoreline. Vegetation loss was evident by the float (Fig 11).



Figure 4: centre of plot 1, West Beach Park



Figure 5: centre of plot 2, West Beach Park



Fig 6: Soil pit, plot 1
(tape shows inches not cm)



Fig 7: Soil pit, plot 2
(tape shows inches not cm)



Fig 8: East trail showing wooden steps and some fine surface soil with limited fine leaf litter



Fig 9: West trail lower portion showing steeper slope, less fine surface soil and more pebbles vs east trail.



Fig 10: Erosion and evidence of repair above west trail.



Fig 11: Float platform stored just above the shoreline, resting on and with neigbhouring loss of vegetation



Fig 12: Erosion and undercutting of bank at shoreline



Fig 13: Erosion around roots of dead Douglas-fir just above the shoreline

Erosion with some undercutting of the bank, was seen continually along the shoreline (Fig 12). This was present but less apparent towards the west end of the beach, although there was an isolated 3m x 3m x 3m erosion pocket. Just above the shoreline erosion was most apparent around the roots of a dead Douglas-fir (fig 13). A remnant of a rooted tree stump was observed 4m below the shoreline (Fig 14).



Fig 14: Tree stump, possibly rooted on site, 4 m below the shoreline

Interpretation and Discussion

Many conditions at this site contribute to erosion: predominance of unstable sand and pebble soil, very thin overlying litter and organic soil layers, steep slope, exposure to wave and wind action, recreation activities, rising sea levels, periodic tree cutting and increasing influence of non-native invasive plants. The shoreline might be receding at 1.5-2 cm per year (2-3 feet over the last 20 years: local resident personal comment). This would be less than that implied by the tree stump (dead 50 years?) 4 m below the shoreline. This rate will increase with accelerated sea level rise.

Of the factors listed above, vegetation is the most amenable to management control. The maintenance of trees and shrubs will be a key factor in the control of erosion, together with engineered solutions which themselves will retain soil and, in turn, encourage vegetation retention. Until now, trees at the shoreline have become unstable as erosion has occurred around their roots. They have then tended to be cut as "hazards", leading in turn to increased erosion around the dead roots.

In the past, cut trees have been used as firewood rather than being left as coarse woody debris (CWD). This has contributed to the decreased amount of CWD (32 cu m/ha vs 119 cu m/ha given by Feller (2003) for the prevailing biogeoclimatic zone, Coastal Western Hemlock, Very Dry Maritime. Therefore, the benefits conferred by CWD at the park are also less. CWD reduces erosion, increases soil productivity, long term carbon storage (Stevens 1997), and use by wildlife (Matsuda et al 2006). CWD will likely decrease further as there is a lack of younger classes, 1 through 3 (appendix 4).

Western redcedar contributes 15-20% of canopy cover and a significant proportion of stablising roots at the site. Increasingly, dead cedars are being observed throughout our region in areas where they are near their drought tolerance limit. With porous soils and southern exposure, cedars at West Beach Park must be considered vulnerable to the increasingly dry summer conditions induced by climate change. It seems prudent to anticipate this and plant now with more drought tolerant species e.g. Douglas-fir and shore pine, of which there are very few seedlings.

As they spread, non-native invasive plants will contribute to accelerated erosion because fewer tree seedlings will survive under dense stands of e.g. Himalayan blackberry, yellow lamium.

The lower section of west trail is the most eroded and unstable of the trail system and it is associated with the most erosion of private property which lies above it. Due to this section's porosity, it should be possible to place a series of small check dams across it which would also act as steps. Being checked by mini dams, draining water would then percolate more through the underlying sand rather than flowing over the surface to further trail erosion. In this way, some of the form and function of the original uncut slope would be restored.

With this stability, soil retention measures above the trail would stand more chance of success. Envisaged is a series of secured logs to create terraces with some introduction of soil high in organic matter. This would be planted with native trees and shrubs, including sitka willow (*Salix sitchensis)* from cuttings enabling a larger volume of planting with less effort and expense.

By the time the logs decay (10-15 years?) the planted vegetation should be well established as slope stabilisers. Protective deer fencing will be needed during the first few years.

Longer term slope stabiity will depend on retarding shoreline erosion. This will require a thorough assessment, and extensive work, and is beyond the scope of this report.

Restoration

Category	Action	Parties Involved	Timing
Planning	Feedback and discussion	KICG, local residents	July 2021
Planning	Find old photographs of the park, especially the shoreline	KICG, local residents	July-Aug 2021
Planning	Present to SCRD	KICG	Aug 2021
Planning	Discussion, modify plan as needed and adoption	SN, SCRD, KICG, Islands Trust, local residents	Aug-Dec 2021
Communication	Articles, media, website & verbal re. plan, importance of retaining CWD, controlling invasive plants	KICG, SCRD, Islands Trust, local residents	Dec 2021-ongoing
Restoration	Removal of invasive plants	KICG, local residents	Jan 2022-ongoing
Restoration	Build check dams and fill, lower west trail, reinforce east trail	KICG, SCRD, local residents	April-Aug 2022
Restoration	Instal logs and fill in erosion areas above trails	KICG, SCRD, local residents	May-Sep 2022
Restoration	Build rack to accommodate storage of floats to reduce impact on vegetation	SCRD, local residents, KICG	June-August 2022
Restoration	Plant retention areas with shrubs and trees, erect deer barriers	KICG, SCRD, local residents	Oct 2022
Restoration	Plant Douglas-fir, shore pine, in more open areas	KICG, SCRD, local residents	Oct-Nov 2022
Restoration	Willow cuttings placement above and below trails	KICG, SCRD, local residents	Jan 2023
Restoration	Monitoring and repair	KICG, local residents	Feb 2023-ongoing
Planning	Assessment of shoreline and subsequent erosion control	SCRD	SCRD

Table 1: Suggested restoration plan outline for consideration by stakeholders prior to modification and adoption. KICG = Keats Island Conservation Group. SN = Squamish Nation, Sḵwx̱wú7mesh Úxwumixw, SCRD = Sunshine Coast Regional District

Non-native invasive plants will be removed following best practices as published by the Invasive Species Council of Metro Vancouver. Trail work should be designed and supervised by someone with relevant experience.

Conclusion

In British Columbia, climate change and associated sea level rise will have its greatest effect on low lying coastal areas and those subject to erosion. The scale and extent of work needed to mitigate and absorb these effects seems unprecedented and beyond the scope of government bodies alone which have traditionally fulfilled the role of public works. Therefore, groups and individuals will need to assume a much larger role. There will be additional incentive where private property is threatened either by direct effects or insurance issues.

This project might help raise local awareness and encourage practical restoration activities. Owing to the site's vulnerability to erosion, consideration should also be given to designating the park as a sensitive ecosystem.

Acknowledgements

Thank you to: Andrea Cornborough, Steve Procyk and Dan Rogers for providing local information, to Else Mikkelsen for plant identification, and to Uriel Garcilazo for mapping.

References

Feller, M.C. 2003. Coarse Woody Debris in the Old-growth Forests of British Columbia. Environmental Reviews 11:S135-S157. National Research Council of Canada.

Google Earth Pro website, image from 14th May, 2014.

Green, R.N. and K. Klinka 1994. A Field Guide for Site Identification and Interpretation in the Vancouver Forest Region. Research Branch, Ministry of Forests, Victoria, British Columbia.

iNaturalist. Website: Observations · iNaturalist

Islands Trust 2002. Keats Island Sensitive Ecosystem Map. Website: http://keats-island.ca/images/gamkeabylbaseocp0077.pdf Schudule C.

Islands Trust 2002. Gambier Island Local Trust Committee, Keats Island Community Plan. : Website: http://keats-island.ca/images/gamkeabylbaseocp0077.pdf

Matsuda, B.M., D.M. Green and P.T. Gregory 2006. Amphibians and Reptiles of British Columbia, Royal BC Museum, Victoria, British Columbia.

Pojar J. and A. MacKinnon 2004. Plants of Coastal British Columbia, Revised Edition. Lone Star Publishing, Vancouver, British Columbia.

Province of British Columbia 1998. Field Manual for Describing Terrestrial Ecosystems. B.C. Ministry of Environment, Lands and Parks, and B.C. Ministry of Forests, Victoria, British Columbia.

Province of British Columbia 1999. Inventory Methods for Plethodontid Salamanders. Published on website: http://www.ilmb.gov.bc.ca/risc/pubs/tebiodiv/salamanders/assets/psalm.pdf.

Stevens V. 1997. The Ecological Role of Coarse Woody Debris: an overview of the ecological importance of CWD in B.C. forests. Res. Br., B.C. Min. For., Victoria, B.C. Work.Pap. 30/1997.

SCRD Sunshine Coast Regional District 2020. https://www.scrd.ca/pdf-maps Map 10, Gambier and Keats Island.

Appendix 1: Plot 1, Ground Inspection Data

BRITISH COLUMBIA — GROUND INSPECTION FORM

G ☐ vs V ☐	PHOTO	X:	Y:	DATE 12 JUNE 2021
PROJECT ID. WEST BEACH PARK		SURV. RICHARD C. BEARD		
MAP SHEET 92 G6		PLOT # 1		POLY.#
UTM ZONE	LAT. / NORTH 49.39192	LONG. / EAST −123.44245		
ASPECT 185 °		ELEVATION 3 m		
SLOPE 60 %	SMR 2	SNR B		

MESO SLOPE POSTION	☐ Crest	☐ Mid slope	☐ Depression	
	☐ Upper slope	☒ Lower slope	☐ Level	
		☐ Toe		
DRAINAGE - MINERAL SOILS	☐ Very rapidly	☐ Well	☐ Poorly	
	☒ Rapidly	☐ Mod. well	☐ Very poorly	
		☐ Imperfectly		
MOISTURE SUBCLASSES - ORGANIC SOILS	☐ Aqueous	☐ Aquic	☐ Perhumid	N/A
	☐ Peraquic	☐ Subaquic	☐ Humid	
MINERAL SOIL TEXTURE	☒ Sandy (LS,S)	☐ Silty (SiL,Si)		
	☐ Loamy (SL,L,SCL,FSL)	☐ Clayey (SiCL,CL,SC,SiC,C)		

ORGANIC SOIL TEXTURE N/A ☐ Fibric ☐ Mesic ☐ Humic	SURF. ORGANIC HORIZON THICKNESS ☒ 0–40 cm ☐ > 40 cm
HUMUS FORM ☐ Mor ☒ Moder ☐ Mull	ROOT RESTRICTING LAYER Depth > 100 cm Type _____
COARSE FRAGMENT CONTENT ☐ < 20% ☐ 20–35% ☐ 35–70% ☒ > 70%	

TERRAIN

COMPONENT: TC1 ☒ TC2 ☒ TC3 ☐

	TERRAIN TEXTURE	SURFICIAL MATERIAL	SURFACE EXPRESSION	GEOMORPH PROCESS
1	Sand w pebbles	Glaciomarine	Unidirect. steep	slow mass movement
2	Sandstone	"	"	"

ECOSYSTEM

COMPONENT: EC1 ☒ EC2 ☐ EC3 ☐

BGC UNIT CWH xm	ECOSECTION GEL
SITE SERIES 03 FdHW - Salal	SITE MODIFIERS steep slope
STRUCTURAL STAGE 5ci. Young coniferous forest - varying canopy cover	CROWN CLOSURE 25 %

ECOSYSTEM POLYGON SUMMARY

	%	SS	SM	ST
EC1	100			
EC2				
EC3				

TERRAIN POLYGON SUMMARY

	%	Classification
TC1	80	(estimate)
TC2	20	
TC3		

Appendix 1: Plot 1 Vegetation

A = tree layer B = shrubs C = herbs D = mosses See appendix 3 for full names
Abbreviations are first four letters of genus and first three of species names.

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	A: 25	B: 2	C: 60	D: 10

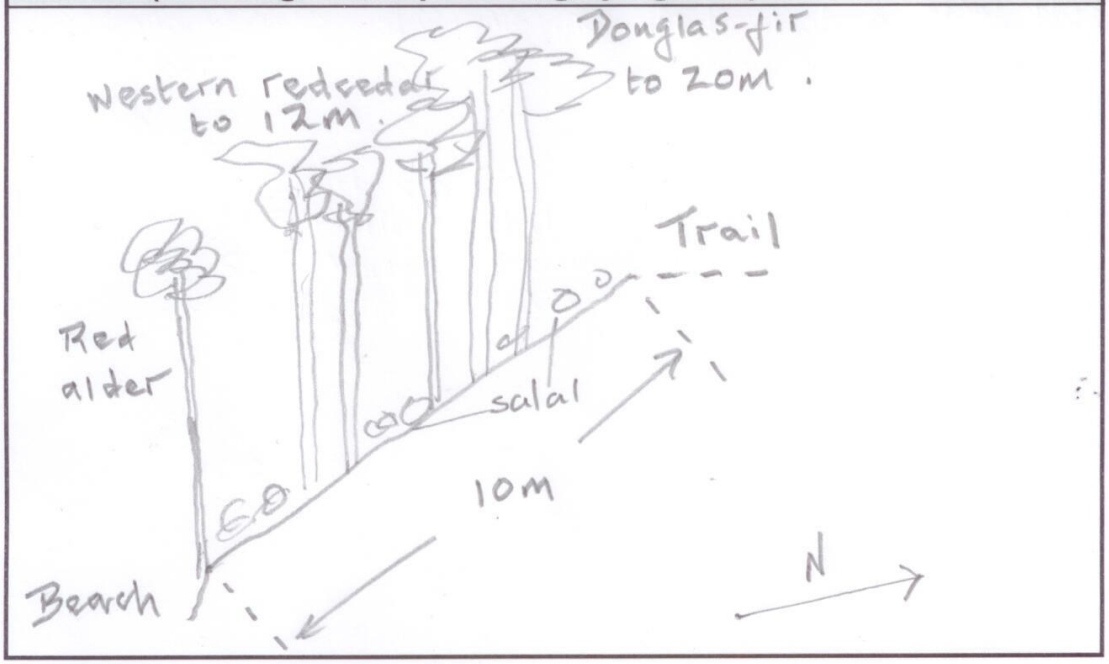
L.	SPECIES	%	L.	SPECIES	%	L.	SPECIES	%
A	Pseu men	<20	D	Kind ore	10			
A	Thuj pli	5	D	Dicr sco	<1			
A	Alnu rub	1	D	Clad chl	< 1			
B	Gaul sha	1						
B	Cyti sco	1						
C	Gaul sha	60						
C	Pter aqu	<1						
C	Grass sp	<1						
C	Allo vir	<1						
C	Loni cil	<1						

COMPLETE ☒ PARTIAL ☐

Tree Mensuration

Spp.	DBH	Ht. Calculation to DBH: Top	Bot	SD	SL	HD	HT	Ht. to DBH	Total HT	BH Age	Path Y/N
16 xDouglas-fir	Max 30 cm									Max 20m	
2 x w redcedar	Max 20 cm									Max 12m	
1 red alder	8 cm										

NOTES (site diagram, exposure, gleying, etc.)



Appendix 2; Plot 2 Ground Inspection Data

BRITISH COLUMBIA — GROUND INSPECTION FORM

G ☐ vs V ☐	PHOTO	X:	Y:	DATE 12 June 2021
PROJECT ID. WEST BEACH PARK		SURV. RICHARD C. BEARD		
MAP SHEET 92 G6		PLOT # 2		POLY. #
UTM ZONE	LAT. / NORTH 49.39223	LONG. / EAST -123.443 24		
ASPECT 185 °		ELEVATION 4 m		
SLOPE 70 %	SMR 2	SNR B		

MESO SLOPE POSTION
☐ Crest ☐ Mid slope ☐ Depression
☐ Upper slope ☒ Lower slope ☐ Level
☐ Toe

DRAINAGE - MINERAL SOILS
☐ Very rapidly ☐ Well ☐ Poorly
☒ Rapidly ☐ Mod. well ☐ Very poorly
☐ Imperfectly

MOISTURE SUBCLASSES - ORGANIC SOILS N/A
☐ Aqueous ☐ Aquic ☐ Perhumid
☐ Peraquic ☐ Subaquic ☐ Humid

MINERAL SOIL TEXTURE
☒ Sandy (LS,S) ☐ Silty (SiL,Si)
☐ Loamy (SL,L,SCL,FSL) ☐ Clayey (SiCL,CL,SC,SiC,C)

ORGANIC SOIL TEXTURE N/A
☐ Fibric ☐ Mesic ☐ Humic

SURF. ORGANIC HORIZON THICKNESS
☒ 0–40 cm ☐ > 40 cm

HUMUS FORM
☐ Mor ☒ Moder ☐ Mull

ROOT RESTRICTING LAYER
Depth >100 cm Type _____

COARSE FRAGMENT CONTENT
☐ < 20% ☐ 20–35% ☐ 35–70% ☒ > 70%

TERRAIN

COMPONENT: TC1 ☒ TC2 ☒ TC3 ☐

TERRAIN TEXTURE	SURFICIAL MATERIAL	SURFACE EXPRESSION	GEOMORPH PROCESS
1 sand > pebbles	1 glaciomarine	1 Unidir. steep	1 slow mass movement
2 Sandstone	2 "	2 "	2 "

ECOSYSTEM

COMPONENT: EC1 ☒ EC2 ☐ EC3 ☐

BGC UNIT CWH xm	ECOSECTION GEL
SITE SERIES 03 - FdHw - Salal	SITE MODIFIERS steep slope
STRUCTURAL STAGE 5Ci Young coniferous forest - varying canopy	CROWN CLOSURE 35 %

ECOSYSTEM POLYGON SUMMARY

	%	SS	SM	ST
EC1	100			
EC2				
EC3				

TERRAIN POLYGON SUMMARY

	%	Classification
TC1	80	(estimate)
TC2	20	
TC3		

Appendix 2: Plot 2 Vegetation

A = tree layer B = shrubs C = herbs D = mosses See appendix 3 for full names
Abbreviations are first four letters of genus and first three of species names

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	A: 35	B: 15	C: 50	D: 1

L.	SPECIES	%	L.	SPECIES	%	L.	SPECIES	%
A	Pseu men	28	C	Loni cil	1			
A	Thuj pli	5	C	Veronica sp	<1			
A	Acer mac	1						
A	Abie gra	1	D	KINT ORE	1			
B	Gaul sha	5						
B	Rubu arm	5		artefacts	2			
~~B~~	~~Thuj pli~~	5						
C	Gaul sha	45						
C	Maho aqu	2						
C	Rubu arm	1						
C	Rubu urs	1						
C	Poly mun	<1						

COMPLETE ☒ PARTIAL ☐

Tree Mensuration

Spp.	DBH	Ht. Calculation to DBH: Top	Bot	SD	SL	HD	HT	Ht. to DBH	Total HT	BH Age	Path Y/N
5 x Douglas-fir	Max 45 cm								13 m topped		
2 x W redcedar	Max 35 cm								7 m topped		
1 Grand fir	13 cm										

NOTES (site diagram, exposure, gleying, etc.)



Appendix 3: List of plants recorded at West Beach Park during survey 15th-25th June 2021

Douglas-fir (*Pseudotsuga menziesii)*
Shore pine (*Pinus contorta)*
Red alder (*Alnus rubra)*
Pacific crab apple (*Malus fusca)*
English holly (*Ilex aquifolium)* *
Common laburnum (Laburnum anagyrodes) *
Grand fir (Abies grandis)
Western redcedar (*Thuja plicata)*
Bigleaf maple (Acer macrophyllum
Arbutus (*Arbutus menziesii)*
Ivy (*Hedera helix)* *

Red huckleberry (*Vaccinium parvifolium)*
Salal (*Gaultheria shallon)*
Pacific ninebark (*Physocarpus capitatus)*
Baldhip rose (*Rosa gymnocarpa)*
Himalayan blackberry (*Rubus armeniacus)* *
Salmonberry (*Rubus spectabilis)*
Scotch broom (*Cytisus scoparius)* *
Red elderberry (*Sambucus racemose)*
Oceanspray (*Holodiscus discolor)*
Cherry laurel (*Prumus laurocerasus)* *
Western trumpet honeysuckle (*Lonicera ciliosa)*
Saskatoon (*Amelanchier alnifolia)*
Nootka rose (*Rosa nootkana)*
Cutleaf blackberry (*Rubus lacinatus)*
Trailing blackberry (*Rubus ursinus)*
Thimbleberry (*Rubus parvifolus)*
False box (*Pachistima myrsinites)*
Common snowberry (*Symphoricarpos albus)*
Dull Oregon-grape (*Mahonia nervosa)*
Cotoneaster *(Cotoneaster sp)* *

Sweet vernal grass (*Anthoxanum odoratum)* *
Small-flowered wood-rush (*Luzula parvifolia)*
Creeping buttercup (*Ranunculus repens)*
White hawkweed (*Hieracium albiflorum)*
Heath groundsel (*Senecio sylvaticus)* *
Oregon gumplant (*Grindelia stricta)*
Common plantain (*Plantago major)* *
Lesser hop trefoil (*Trifolium dubium)* *
Ivy-leaved toadflax (*Cymbialis muralis)* *
Heath sppeedwell (*Veronica officinalis)* *
Candystick (*Allotropa virgata)* **rare**
Bamboo (*Sub fam Bambusoidea)* *
Fool's onion (*Brodiaea hyacinthine)*
Large leaved avens (*Geum macrophyllum)*
Spotted hawkweed (*Hieracium maculatum)* *
Nipplewort (*Lapsana communis)* *
Ribwort plantain (*Plantago lanceolata)* *
Fringed willowherb (*Epilobium ciliatum)*
Yellow lamium (*Lamium galeobdolon)* *
Small periwinkle (*Vinca minor)* *
Herb-Robert (*Geranium robertianum)* *
Western starflower (*Trientalis latifolia)*

Bracken fern (*Pteridium aquilinum)*
Sword fern (*Polystichum munitum)*

Oregon beaked moss (*Kindbergia oregana)*
Broom moss (*Dicranium scoparium)*

False pixie cup lichen (*Cladonia chlorophaea)*

Identifications using Pojar and McKinnon (1994) and iNaturalist (website) * denotes non-native species

Appendix 4: Plots 1 and 2, Coarse Woody Debris measurements

Coarse Woody Debris Calculation, West Beach Park

Plot 1

Diameter m	Length m	Volume cu m	Vol/Hectare cu m	Decay class (1-5)
0.1	3	0.02		4
0.15	0.6	0.01		5
0.15	0.75	0.01		4
0.2	0.75	0.02		5
0.3	2	0.14		5
0.25	2	0.10		5
0.5	1.4	0.27		4
		0.59	58.5	
Plot 2				
0.25	1	0.05	4.9	4
Average			31.7	