Coho Drive Residential Shoreline Protection Project

This Green Shores Pilot Project provides an example of a common issue in coastal British Columbia waters. The key elements identified in this pilot were:

- the benefits of understanding the cause of the shoreline erosion
- the benefits of understanding the setting and response of the area adjacent to and surrounding the property
- the benefits of using specific attributes of each setting to develop alternatives that maintain the economic interests and the ecological functions of the site in question.

Not all sites will be similar and the specific alternatives will depend to some extent on the proximity of the physical property assets (a private residence in this case) to the shoreline.

SITE DESCRIPTION

The residential property of Mr. S. Duncan is located on Coho Drive, which runs along a narrow coastal strip, approximately 8 n mi. NW of Cape Lazo and 15 n mi. SSE of Cape Mudge at the northern end of the Strait of Georgia (Figure 1). A small group of residential properties occupies this coastal strip between the high tide line and the road right of way for Coho Drive. An escarpment (former coastal bluff) lies on the opposite side of Coho Drive forming an upland boundary to the area (Figure 2).

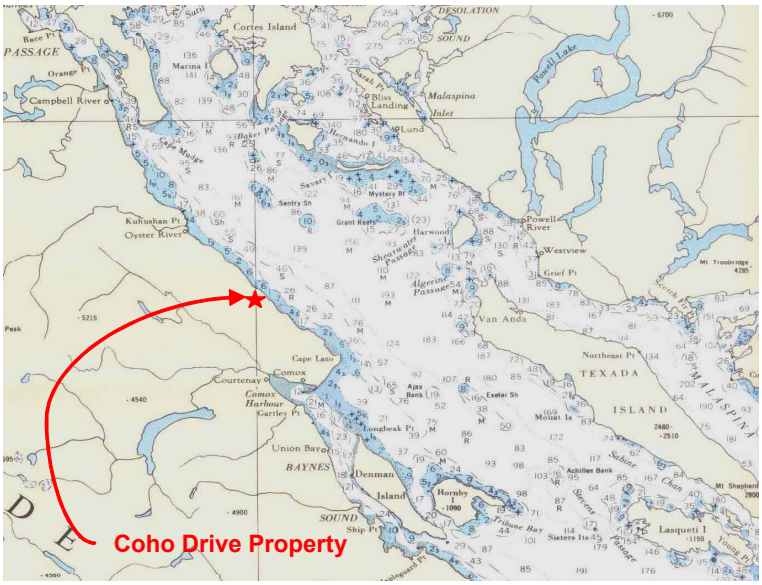

Figure 1. Location of the Duncan Property on the Strait of Georgia

Figure 2. View of the Duncan Property from the foreshore.
Coho Drive is between the house and the coastal bluff in the background

The property is fronted by a coarse sand, gravel and cobble beach which occupies the mid to upper portion of the intertidal zone. A vegetated cobble and boulder zone is reported to exist in the mid to low tide zone and a wide, fine sandy tidal bench exists at the low tide mark. The bench was visible from the high tide line during the site visit due to the clarity of the water. There is a small headland to the immediate south of the residential properties (visible in the background of the right hand image in Figure 3).

Figure 3. Views of the high tide portion of the foreshore looking north (left) and south (right)

The Duncan property is located approximately mid-way along the coastal strip and some of the properties in the area are under-going varying degrees of renovation and upgrading. The Duncan's have owned and occupied the property for two years.

The high tide and immediate "above tide" areas of the property are in a relatively natural state with beach grasses, trees and bushes existing along the riparian edge. Some trees at the seaward edge of the property are estimated to be 20 to 30 years old. A small erosion scarp is barely visible among the logs at the high water mark and the property survey (dated in the mid-1970's) shows the seaward property boundary located approximately at the scarp.

The present owner occupied the property shortly after a series of severe winter storms occurred in December 2002 and early January 2003. The adjacent property on the south side has visible signs of extensive erosion of overlying landfill (with grass lawn) at the high tide mark (visible on the extreme right hand side of figure 3). The owner is concerned about future erosion and expressed a desire to undertake measures to protect the property in a way that would be compatible with ecological values of the site.

This site was adopted as a Green Shores Pilot Project as it provided an excellent opportunity to assess the issues for a typical coastal residential area where erosion is visible, but no hard erosion protection structures or other works have been implemented at either the present property or nearby adjacent properties.

SITE AND DEVELOPMENT ISSUES

Situations such as the Duncan property exist through southern coastal British Columbia and a significant number of properties have constructed hard seawall defences, largely in response to episodic erosion, and often, after the properties have evolved from coastal recreational properties to full-time permanent residences. Full time residency exposes the residents to seasonal or episodic storms, causing erosion that may, in many circumstances, be restored naturally. In some cases, the erosion, and thus the perceived risk, may exist due to re-grading of the upland portion of the property, so that landfill or landscaping now exists in areas formerly flooded during relatively infrequent episodic storms, occurring both at high tide and possibly in conjunction with atmospheric storm surge[1]. Regardless of the risk, there is a real and justifiable requirement to provide a degree of protection to properties of this type for economic and safety reasons.

POSSIBLE DESIGN SOLUTIONS

During the site visit, it was clear that a number of natural and anthropogenic processes were at work in this area:

1. The area is exposed to both SE and NE storm events, but obtains a degree of protection from the headland to the south (Figure 3) and, at low tides, from the relatively stable boulder and cobble bench in the mid-tide zone.
2. A small storm berm of cobble, gravel and coarse sand was visible along the high tide mark at the Duncan property, indicating a state of dynamic equilibrium in which successive storms move gravel along the shoreline, with the direction of movement depending on the storm direction, likely restoring the transient erosion at various places. The source of all materials active along the shore is unknown.
3. In general the properties have considerable frontage, with most residences set back from the high water mark. This provides an upland area where defences for the residence against an extreme event could be constructed without impinging on the coastal riparian strip or marine habitat.

[1] The storm of early January 2003 was such a storm, where the low pressure centre crossed the southern coast of BC over lower Vancouver Island. A more usual scenario is that gale or storm force winds occur in conjunction with the passage of a frontal system, while the low pressure centre, which is the driving mechanism for the storm surge, crosses the central coast or the Alaska Panhandle. Storms such as the January 2003 event are relatively infrequent and therefore should be considered as an extreme design event.

4. Landscaping of the upland areas can result in exposure of erodible material to wave and current action.
5. The presence of mature trees close to or in the riparian zone, together with the close proximity of the coastal bluff, may provide a degree of shelter by causing onshore winds to rise and reduce severe wind and wave action close to shore.

Figure 4. Example from Coho Drive area demonstrating the preservation of the coastal riparian edge, the upper tidal zone and incorporation of a setback retaining wall[3]

In some cases, adjacent property owners had already undertaken measures to provide protection to the residential property while preserving the ecological values of the area (Figure 4)[2]. A nearby road right of way, where no measures (landfill, landscaping or sea defences) were present, also showed no signs of erosion.

Alternatives that could be considered at this site, including the obvious construction of a hard sea defence at the high water mark, are:

1. Do Nothing[3].
2. Construction of a hard sea defence.
3. Enhancement of the existing log and boulder defences by restraining logs with tie backs and seeding boulders above the high tide line to form occasional hard spots for accumulation of debris.
4. Construction of a feeder storm berm, containing imported cobble, gravel and coarse sand material, sufficient in volume to withstand an appropriate number of extreme storms[4].
5. Construction of a hard sea defence (typically a seawall) setback within the upland area of the property to provide a line of defence for the upland physical property asset (home or outbuildings).
6. Planting of mature trees in the coastal riparian zone to assist in dissipation of the wind driving force in the breaking wave zone.
7. A combination of Alternatives 3, 4, 5 and 6.

[2] The wooden wall, between the house and the lawn is likely not designed to act as a sea defence, but retro-fitting to withstand an extreme event could be undertaken.
[3] A "do nothing" alternative is always an option and is included in the Assessment Matrix below.
[4] As the volume of material to be imported, and thus the number of storms that can be withstood, has economic implications, the optimization of initial capital versus future maintenance costs remains a detail design issue.

A sketch arrangement of these alternatives is shown in Figure 5.

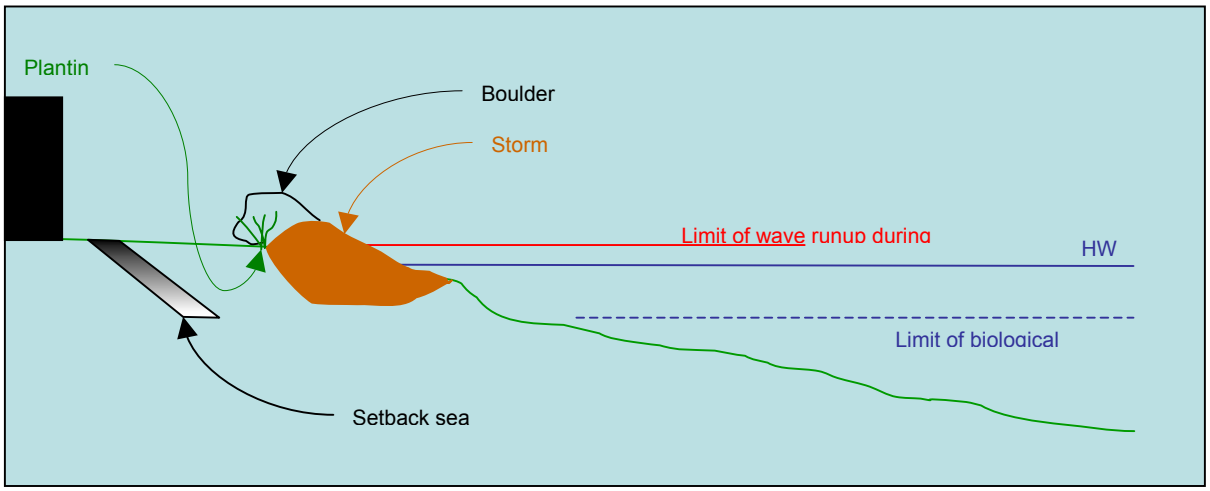

Figure 5. Shore profile showing possible design alternatives

The efficacy of these alternatives would likely be increased if several property owners implemented them in unison. This would ensure that adjacent works were compatible, did not adversely affect other properties, and would allow consolidation of the associated costs to improve the engineering effort and construction integrity.

GREEN SHORES ASSESSMENT MATRIX

A summary of the various alternatives is provided in Table 1. These alternatives are considered from the perspective of the individual property owner; however, in general, one would expect the degree of positive or negative ratings to increase as more property owners on a particular section of coastline addressed a common problem jointly.

LESSONS LEARNED

This pilot Green Shores project provides a useful and typical example of a common issue in coastal British Columbia waters; the perceived erosion of private property. In this particular case it seems very likely that the perception of erosion arises primarily from the erosion of what appears to be landfill (the lawn on the adjacent property). There was no evidence of on-going erosion of the property in question. At best, any changes apparent to the new property owner were likely the result of infrequent episodic storm events and extreme events which would not be expected to re-occur at regular intervals.

Identification of the likely cause and examination of the responses in the area, demonstrated that on-going erosion was not an issue. A range of alternatives that can enhance the ecological function of the shoreline zones, and increase the security or integrity of the private properties economic value, can then be developed.

In some cases, properties similar in character to this property may not have the extensive buffer of property frontage, and therefore less of a margin of safety. In these cases, a more detailed program to understand the physical processes causing erosion (e.g. wave and current regimes, geology and coastal sediment transport processes), the habitat and other ecological issues and viable options will be required.

Table 1. Green Shores Assessment Matrix of Design Alternatives. These alternatives are considered from the perspective of the individual property

Green Shore Principle [a]	Design Rating						
	Design Alternatives						
	1	2	3 [d]	4	5	6 [g]	7
Maintain Integrity of Coastal Processes							
Riparian Zone	-	-	+	+	0	+	+
Intertidal Zone	0	-	0	+	0	0	+
Maintenance or Enhancement of Habitat Function							
Riparian Zone	-	-	0	+	0	+	+
Intertidal Zone	0	-	0	0	0	0	0
Minimize or Reduce Pollution							
Riparian Zone	-	0[c]	0	+	0[f]	0	+
Intertidal Zone	0	0[c]	0	0	0[f]	0	0
Avoid Cumulative Impacts							
Riparian Zone	-	-	0	+	0	0	+
Intertidal Zone	0	-	0	0	0	0	0

Notes:

+ Contributes in a positive manner to the GS principle

0 Has a neutral effect (NB this may be the best possible outcome, such as where a shore protection design allows for continued alongshore sediment transport).

- Does not meet the specific GS principle, has a negative impact on the GS principle.

a: As none of these alternatives substantially interact with the subtidal zone, this zone is not addressed.

b: If several properties combined to undertake related works, the alongshore connectivity would be improved in all zones.

c: In general terms a hard sea defence can minimize any pollution of the foreshore from upland sources.

d: At the present state of engineering design knowledge, a solution using natural log timber has a short and finite design life.

e: As coastal processes tend to sort granular materials according to size, a storm berm of mixed sizes may contribute new material into a habitat zone that does not presently contain that material size, for any number of reasons.

f: An upland sea defence may interact with a septic field.

g: This alternative is unlikely, on it's own, to be a solution to a coastal erosion problem, but is included to identify it's potential beneficial influence.