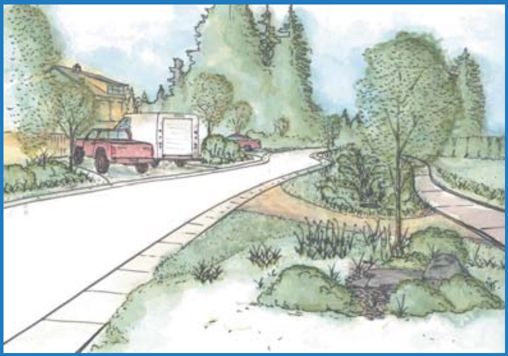
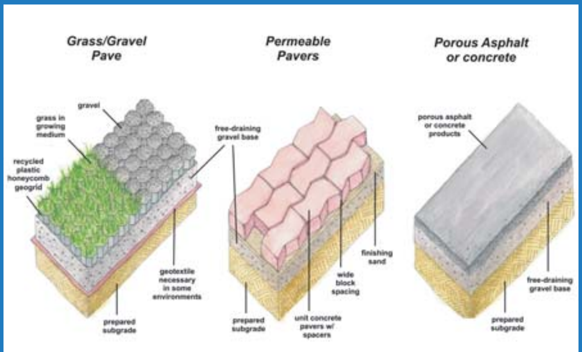
AN ECONOMIC RATIONALE FOR

INTEGRATED STORMWATER MANAGEMENT

A Resource for Urban and Rural Land Development in BC

5.2 Cumbria Woods





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BRITISH COLUMBIA

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5.2 Cumbria Woods – Cumberland, BC

Cumbria Woods (Figure 1) is the site of a proposed 35-acre residential development in the Village of Cumberland in the Comox Valley of Vancouver Island. For the purpose of cost comparison, two alternatives were designed: a conventional suburb typical of what has been built across North America since WWII; and a pedestrian oriented neighbourhood with green stormwater infrastructure. The main differences between these two designs relate to street pattern, stormwater infrastructure, and parks and open space. The comparison reveals that developing the pedestrian oriented, green infrastructure pattern saves over one million dollars in infrastructure costs.

Figure 1 Cumbria Woods Site

CONVENTIONAL PATTERN

Street Pattern

In the conventional scenario, the street pattern is a branching hierarchy of local culs-de-sac that feed into a single residential collector street connecting the neighbourhood to Cumberland. Unlike most suburban developments, this proposal includes some homes with rear lane access. There are no street trees or sidewalks in this design, and all roads and lanes are paved. The street widths range from 10 – 33 meters, and the lanes are 6 meters wide.

Stormwater Infrastructure

Stormwater in the conventional design is handled in a sub-surface piped system found below the street. Curbs and gutters capture and convey stormwater from roads, and roof run-off is directed to the system via tie-ins from each downspout. Virtually all stormwater that lands on the site is quickly directed through a series of pipes until it eventually reaches a single large out-fall in a stream channel off site. The total cost of curb, gutter, storm sewer and catch basins for the conventional plan for Cumbria Woods was $902,975.00.

Parks and Open Space

On the northeast portion of the site, 7.35 acres must be protected as an environmental buffer zone for an adjacent wetland. Public access to this open space is available through two 3-metre wide pedestrian walkways. Otherwise, private, fenced backyards line the edge of this open space zone. An additional 2.6-acres has been designated as park space. This is dispersed across two small parks in the neighbourhood. Neither of these parks, nor the larger buffer zone play a role in the management of stormwater.

PEDESTRIAN ORIENTED GREEN INFRASTRUCTURE PATTERN

Street Pattern

Figure 2 Grid Street Pattern in Cumbria Woods

In the pedestrian oriented, green infrastructure pattern, the streets form an integrated network that closely resembles the street pattern that already exists in the Village of Cumberland (see figure 2). Houses are set close to the street to encourage opportunities for interaction between residents and passers-by. Streets also have sidewalks, trees, and gravel parking verges on each side. Paved travel widths range from 5.5- 6.0 meters. Car storage is handled at the rear of all dwellings and is accessed by gravel lanes. The narrow widths limit the volume and speed of runoff coming from roads and considerable reduce the cost of road construction. The total cost for paving, base gravel, and sub base gravel in this plan amounted to $440,050.00 compared to $651,472.00 for the conventional street pattern. Table 1 provides a detailed cost breakdown for the infrastructure costs in Cumbria Woods.

Stormwater Infrastructure

Stormwater that lands on the site is managed through a naturalized surface drainage system. Gravel verges and lanes permit infiltration of roof and road run-off lot by lot and block by block. During heavy storms, overflow is directed through the roadside swales to the large environmental buffer and central neighbourhood park, where water can be detained and slowly infiltrated back into the soil. Using these natural ways of returning water to the hydrological system eliminates the need for the curb, gutter, and pipe system. The cost for the system of swales was $114,450.00. See Tables 1 for a more detailed accounting of the infrastructure costs for developing Cumbria Woods.

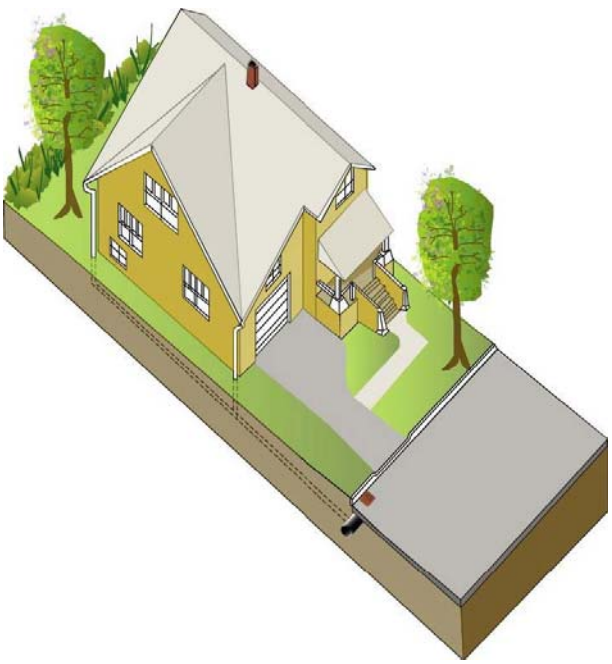
Parks and Open Space

Figure 3 Central Park in Cumbria Woods. In addition to being a community amenity, this park also serves an important role in stormwater management.

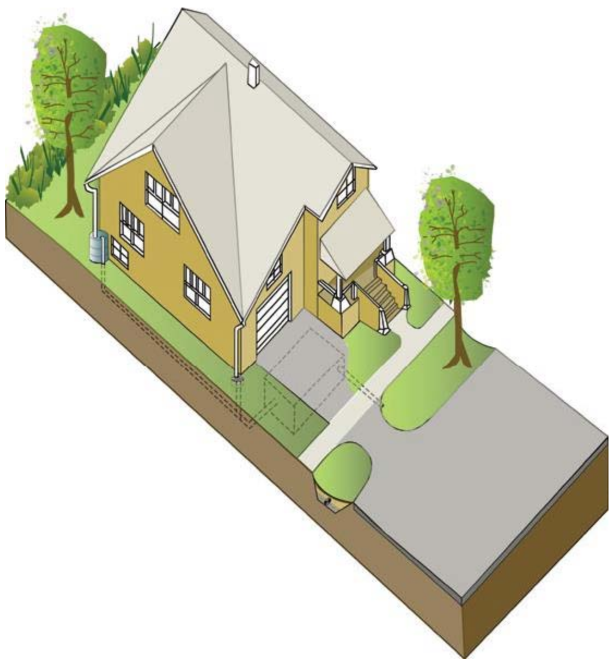
In the pedestrian oriented, green infrastructure pattern, the 7.35 acre buffer is connected to a 2.6 acre central neighbourhood park (See Figure 3). Two smaller parks can be found at the north and southwest corner of the site, indicated on the site plan above. This park and open space network forms an integrated system that is neighbourhood and the Village of Cumberland through sidewalks and a system of trails. In addition, parks and open space are a critical component in the stormwater management system. They accept and infiltrate overflow from large storms minimizing risk to property as a result of flooding, and protect the health of the watershed.

Conclusion

Total Infrastructure costs for the entire site are reduced by more than $1 million, or $8,000 per lot when a pedestrian oriented, green infrastructure pattern is built instead of a conventionally designed and engineered pattern. In addition to more effective stormwater management, protected water quality, and increased investment in social and recreational amenities such as reasonably large, connected parks, the savings from developing the pedestrian oriented, green infrastructure pattern creates an opportunity to encourage more affordable and diverse neighbourhoods. It is an economically viable and socially rich approach to residential development for the Village of Cumberland.



Conventional Home and Stomwater Management



Pedestrian Oriented Pattern with Infitration and Swales.

Table 1 - Cost Comparison of Conventional versus Green Infrastructure Pattern

STUDY SITE CHARACTERISITC		CONVENTIONAL	GREEN INFRASTRUCTURE
Site Area [1]	hectares	0.96	1.14
	acres	2.38	2.81
	sq.m.	9,625	11,356.53
Total Lots		13	14
Total Dwelling Units [2]		14	19
Parking [3]	stalls per unit	2	1
	total stalls	28	19
Gross Density	d.u./ha.	15	17
	d.u./acre	6	7
Lot Coverage	net	0.31	0.37
Total Pavement [4]	sq.m.	2,982	1,837.98
	sq.m./d.u.	213	96.74
	sq.f./d.u.	2,291.88	1,040.88
	% of study site	30.98	16.18
INFRASTRUCTURE COST ESTIMATES FOR STUDY SITE			
Asphalt Paving		$44.730.00	$27,569.70
Sub-base Gravel		$13,419.00	$11,679.66
Base Gravel		$11.928.00	$10,381.92
Curb and Gutter		$35,555.00	n/a
Storm Sewer & Catch Basins		$98,460.00	n/a
Excavation, Cut & Fill		$21,880.00	$22,393.60
Swale		n/a	$15,175.65
Sidewalk		n/a	$31,297.70
Sanitary Sewer & Services		$18,750.00	$18,937.50
Watermain & Services		$64,640.00	$69,374.40
Utility Services & Street Lighting		$56,560.00	$60,702.60
Street Trees [5]		n/a	$15,000.00
Total Infrastructure Cost	study site	$365,922.00	$282,512.73
	per hectare	$381,168.75	$247,818.18
	per unit	$26,137.29	$14,869.09
	per parcel	$28,147.85	$20,179.48
Infrastructure Cost Estimates for Entire Site [6]		**$3,747,915.54**	**$2,452,417.36**
Total Cost Difference for Entire Site			***$1,295,498.18***
Approximate Savings per lot using Green Infrastructure			***$7,968.37***
Approximate Savings per unit using Green Infrastructure			***$11,268.19***

[1] To evaluate infrastructure costs, a comparable 'one block' study site of approximately 1 hectare was selected for each development pattern. Each study site consists of single family and duplex lots, and public right-of-ways typical to the development pattern.

[2] The green infrastructure pattern study site includes 19 units: 12 single family units; 4 duplex units; and 3 accessory apartments. Accessory apartments are an integral part of the green infrastructure pattern and are estimated at 1 accessory unit for every 4 single family units. The conventional pattern study site includes 14 units: 12 single family units and 2 duplex units. Accessory apartments are not a part of the conventional pattern.

[3] The alternative pattern accommodates on-street parking in the form of permeable gravel roadside verges for residents and guests. Guest parking in the conventional pattern is provided at asphalt-paved parking bays at the end of blocks.

[4] For the green infrastructure pattern, total pavement includes sidewalks and paved vehicular travel lane. The conventional pattern does not require sidewalks on local streets; thus, total pavement includes vehicular travel lane only.

[5] Street trees are an important component of the green infrastructure pattern. Street trees are generally not found along local roads of the conventional pattern.

[6] The cost estimate for the entire site assumes the 1 hectare study site (the typical single family, duplex lot, and right of way pattern) is replicated across the entire developable area of 9.85 hectares. (This developable area excludes the designated open and park space of 4.31hectares of each development pattern).

Source UBC James Taylor Chair