

Green Buildings in a Green Community:

A Story from Vancouver

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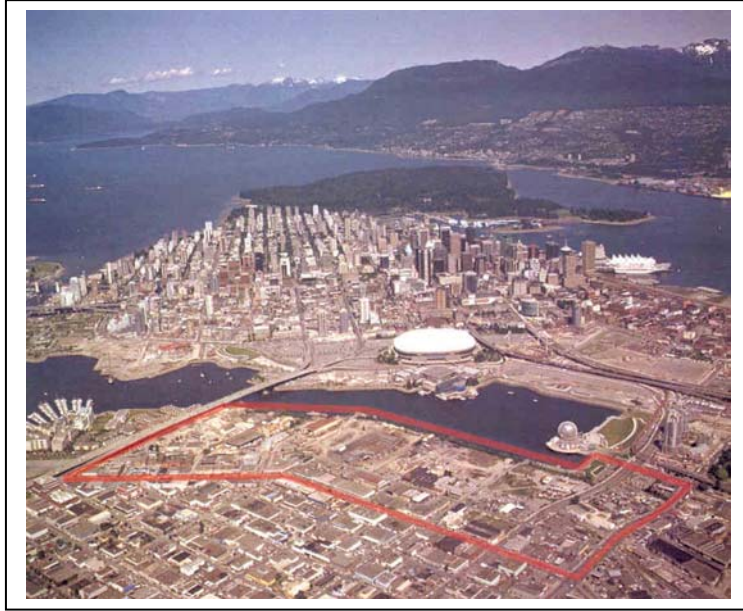
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Abstract

How can building design contribute to the creation of neighbourhoods which have the capacity to support sustainable lifestyles?

This question was addressed by the City of Vancouver, Canada, in a Water and Waste Management Plan for Southeast False Creek, a 37 hectare urban redevelopment planned for 12,000 residents. Six consultants brought together interdisciplinary knowledge to examine ways to integrate buildings and site through the use of water-conserving fixtures, reused greywater, harvested rainwater, source sorting of waste, and many other green design features.

The development of the Plan required extensive research and public consultation. What could work from an engineering viewpoint, what has worked in practice elsewhere, and what is acceptable to residents were all considerations for the team, as well as the costs of approaches and the possible synergies between them. Through building design, this neighbourhood could ultimately reduce energy and resource consumption while limiting production of waste and pollution.



1 Introduction

A sustainable community at its heart - this is the vision of the City of Vancouver in British Columbia, Canada. For more than ten years, the City has been working on remediating a brownfield site in the urban core and designing it to be a community called Southeast False Creek where sustainability could be modeled. The many diverse designers of the community have been challenged to think about how to develop sustainability at every scale - activity, technology, building, site, neighbourhood, community, city, metropolitan area, regional, provincial, bioregional, continental and planet.

This is a story about sustainable issues in building design, but it is also a story about how engineering expertise can be pro-actively integrated at every possible stage of complex, large-scale design processes. In this case, efforts were made to expand the boundaries of the possible in terms of sustainability by improving the quality of engineering contribution at every stage.

The Southeast False Creek context

Vancouver is a city about 200 years old, with a regional population of 2 million, which is located in the mild maritime climate on the west coast of Canada. It has a large harbour reached through a strait protected by Vancouver Island, which is 450 kilometres long.

The Southeast False Creek site (SEFC) is a 36 hectare area of former industrial land, located beside an inlet called False Creek which goes through downtown Vancouver. It has been an industrial area since the late 1800s. Its industrial uses have included sawmills, foundries, shipbuilding, metalworking, salt distribution, warehousing and the city's public works yard.

2 Setting policy directions for Southeast False Creek

After assessing industrial needs in the city, and giving a priority to housing near downtown jobs, the City released the site from the industrial land base and directed that the residential development in SEFC should provide a significant amount of family housing. In recognition of the need for the City to take a leadership role in protecting the environmental quality of the region, the City decided that SEFC should be developed to incorporate principles of energy-efficient community design, with the possibility of being a model for "sustainable development".

To create an urban neighbourhood which can continue to function at sustainable levels of environmental and social performance, a careful balance is required between social, economic and ecological considerations. For many years, Vancouver's large-scale inner-city planning has focused on ensuring that public and social amenities are created by development; SEFC expands this effort by bringing the long-term on-site and off-site environmental benefits to the forefront. The policy process highlighted the conclusions of the Brundtland Report [1], that if we continue with current practices, the earth will not be able to supply enough resources or absorb the waste and pollution for anticipated global population levels. Global warming and climate change,

energy and resource shortages, food shortages, and economic and social instability are the predicted results of the not changing development and consumption patterns to a sustainable form.

The general principles chosen to guide development in SEFC [2] were:

1. Implementing sustainability - SEFC should promote sustainable development principles in an urban setting.
2. Stewardship of Ecological Health - the development of SEFC should improve the ecological health of the False Creek Basin.
3. Economic Viability and Vitality - Development in SEFC should ensure economic viability without subsidy
4. Social and Community Health - the development in SEFC should seek ways to strengthen social networks and enhance the quality of life for all in the neighbourhood.

These principles were developed through a lengthy consultation process which started in 1997 and involved adjacent communities, business owners, groups actively interested in the redevelopment of the site, open houses, public workshops, senior governments and academics. Further principles were articulated related to land use, built form, open space, transportation and circulation, environment, and economic development and stewardship.

The goals for environmental protection and enhancement, which helped shape all policy for SEFC, were summarized as follows:

"SEFC will be a neighbourhood which helps protect the local and global environment by using less energy and water, by reducing waste and pollution, by minimizing air emissions, and by maintaining healthy soils and habitats for plants and animals."

3 Policy Statement of Goals

Within the topic of environment, the SEFC policy process named goals for water management, waste management, energy use, recycling and composting, soils, air quality, and urban agriculture. The first two were addressed in detail in the Southeast False Creek Water and Waste Management Plan [3].

3.1 Water Management Goals in Southeast False Creek

To investigate, and possibly implement, technologies and strategies in SEFC which do not significantly raise costs or diminish the quality of life, but which reduce the use of potable water in all types of land use:

- To manage surface runoff in SEFC so as: to increase the quality of runoff reaching False Creek; to increase on-site amenities; to reduce the need for irrigation; to increase the habitat value of the open space; and to increase the opportunities for learning about the site's ecosystem, including the natural water cycle.
- To explore, and possibly implement, methods of dealing with liquid waste in SEFC in a manner which is feasible and meets economic, environmental, learning and liveability objectives
- To use SEFC as an opportunity to promote and further educate citizens in Vancouver on existing water conservation measure that the City has in place, including the rain barrel program and ecologically-based landscape design guidelines.
- To reduce and control pollutants at their source, as much as possible and wherever feasible.

3.2 Waste, Recycling and Composting Goals

- To plan for a significant reduction in the amount of solid waste generated in SEFC, during the entire life cycle of the neighbourhood.
- To divert as much of SEFC's waste as possible from landfills or incinerators, into recycling and re-use systems.
- To divert from landfills as much demolition and construction waste as possible during redevelopment of SEFC.
- To minimize the amount of transportation needed to deal with solid waste and recyclable products from SEFC, and to maximize the local economic opportunities connected to dealing with SEFC waste.

4 Implementation of Goals

4.1 Implementation of Water Management Goals

One hundred L of potable water, per person per day, was the performance target for water consumption for South East Fast Creek (SEFC). This goal, a reduction of 70% from present levels, was based on consideration of the local context of water availability and water use practices.

SEFC has plentiful water resources, but water availability depends on winter precipitation stored in mountain lakes and fed by gravity to the urban area. Present regional levels of water consumption are not considered sustainable. Implementing demand management, 50% reduction of indoor water usage, was deemed preferable to creating supplemental water sources that would require energy to operate. In the SEFC context as a high density community, the water demand is dominated by indoor use, the areas available for collection and storage are limited, and some building functions are the job of strata councils (multi-unit residential building councils) rather than individual property owners.

In terms of local technology and practices, the base level of water consumption was approximately 330 L/per/day. Contributing to this consumption were fixtures and appliances with the following minimum consumption:

- Toilets 6 L/flush
- Urinals 3.8 L/min
- Showerheads 9.5 L/min
- Kitchen and lavatory faucets (taps) 8.3 L/min
- Clothes washers 155 L per load
- Dishwashers 36 L per load

These consumptions are minimums, available for new builds or retrofit, while the average existing installed fixture has higher consumption.

Fixture or usage	Uses per day		Unit Consumption		Per-Capita Consumption (L/c/d)
Toilet	6	flushes	6	L/flush	36
Clothes Washer	0.37	loads	155	L/load	57
Shower	10	min	9.5	L/min	95
Faucets (taps)	8.1	min	8.3	L/min	67
Bathtub	0.14	baths	150	L/bath	21
Dishwasher	0.42	loads	36	L/load	15
Leaks					10
Other/Unknown					28
TOTAL					330

To find ways to meet the 100 L goal, four scenarios were explored.

1. Current Best Practices

By using best practices, the daily usage could be reduced from 330 L to 167 L. This is the lowest usage that could be achieved with ‘conventional’ fixtures. Toilet consumption would go from 6 L to 4.5 L/flush by using dual flush toilets. Clothes washers would go from 155 L – 53 L/load, showers from 9.5 L/min to 5.7 L/min, dishwashers from 36 L/load to 17 L/load. Leaks and other losses would be minimized. This scenario would require specifying, in the SEFC comprehensive development by-law, the number and type of fixtures and appliances that developers and owners could install in their condo units.

Fixture or usage	Uses per day		Unit Consumption		Per-Capita Consumption (L/c/d)
Toilet	6.6	flushes	4.5	L/flush	30
Clothes Washer	0.37	loads	53	L/load	20
Shower	10	min	5.7	L/min	57
Faucets (taps)	6.7	min	3.8	L/min	25
Bathtub	0.14	baths	150	L/bath	21
Dishwasher	0.42	loads	17	L/load	7
Leaks					3
Other/Unknown					4
TOTAL					167

2. Stormwater Harvesting

By using stormwater harvesting for indoor purposes, the daily usage could be further reduced from 167 L to 144 L/day by using stormwater (when available) for flushing toilets. Stormwater could supply about 75% of flushing needs over the year. A tank sized at 150,000 L for a 100-suite building would be required, in order to provide a one-month supply of stormwater.

Under the British Columbia Building Code, this scenario would require a treatment tank with sediment chamber, disinfection systems, sand filtration system, pumping to convey treated water back up to the dedicated toilet plumbing system, and other controls including a potable-water connection so that during prolonged drought, the tank could be topped up with water controlled by float switches. The potable-water supply line would need to be provided with a backflow device or air gaps to prevent cross-connection with the domestic water system. Treated water would be pumped through a separate piping system labelled as containing non-potable water.

It is estimated that the use of stormwater in a 100 suite building would cost about \$1400 (US\$1044) per suite in capital costs, plus about about \$50 (US\$37) per suite per year in operating costs. With present water costs, the payback period would be more than 50 years.

3. Greywater Flushing

By using greywater for flushing, consumption could be reduced to 137 L/c/d since there would be sufficient greywater to provide for all toilet flushing.

Greywater for treatment would need to be collected through a separate waste pipe system, treated and delivered to a dedicated toilet piping system. The treatment would at a minimum require a collection storage tank, a filter, a disinfection system, a pumping system with control panel, and an overflow to the sewer. There would be a requirement for similar safeguards in the dual piping system as there were for using stormwater. A tank sized at 9,000 L would be required, to provide two days' supply of greywater.

Using greywater for flushing is somewhat cheaper than using stormwater, because the tank used is only intended to contain two days' supply rather than one months' supply. It is estimated that to equip a 100-suite building with greywater reuse would have a capital cost of \$1,250/suite (US\$932), and operating costs of \$800/month (US\$596/month). The payback period at present water rates would be about 35 years.

4 Stormwater/Greywater for drinking

By using treated stormwater and/or greywater for drinking, consumption could be decreased below 100 L, but the expense of treating reclaimed water to drinking water standards was considered to be prohibitive. Such an approach would require skilled plant operators and very high levels of monitoring, reporting and enforcement of the water quality.

The development of the stormwater management plan took into account performance targets including that 25% of roofs were to be green roofs, and that stormwater might need to be harvested from other roofs and stored on-site to provide water for toilet flushing. All other stormwater management components were site-related rather than building-related.

4.2 Implementation of Stormwater Management Goals

The goal for stormwater on the Southeast False Creek site was that the run-off quality post-redevelopment would be better than the run-off quality pre-development, and that the stormwater management approach would increase understanding of water in the community. Four options were considered:

- Baseline scenario: Conventional Stormwater Management (SWM) servicing
- Option 1: Best Management Practices and Low Impact Development Initiatives
- Option 2: Onsite storage for Indoor water use
- Option 3: Extensive LID Measures with On-site storage for Indoor Use

Option 3, which was the eventual recommendation, was the most aggressive plan. It involved:

- Reducing road width
- 100% rainfall capture in courtyards and pedestrian areas, using permeable paving and landscaping
- underground parking for all buildings
- eliminating all curbs, gutters and storm sewers

Option Two had included the use of green roofs for capturing rainfall, but this contribution of stormwater was dropped from Option Three because in dry weather, the green roof would catch and hold stormwater. All roofs were designed to be green but not used for stormwater collection. The landscaping, green roof and roadside landscaping costs would add up to a premium of about \$2300 (US\$1500) per unit. The Option 3 design gave a lower Effective Impervious Area than other options, which was an advantage.

4.3 Implementation of Solid Waste Management Goals

The current baseline waste generation is 417 kg/capita/year. Reductions could be achieved both by diversion and by prevention of waste production. This prevention would be due to the cumulative impact of living in a model sustainable community: buying in bulk, shared use of materials through facilities such as the equipment "library", and in general being more conscious of the impact of consumption.

Limiting the analysis to waste diversion, and starting with the baseline of 417 kg/capita/year, two scenarios were explored: a waste diversion rate of 64%, and a waste diversion rate of 88%.

Diversion will be achieved by requiring waste generators to separate their waste materials into three streams (recyclables, organics and garbage) prior to disposal into common building receptacles for each stream.

For an effective diversion program, recycling and organics diversion must be as easy as garbage disposal. Arrangements within the residential units are expected to vary depending on the buildings' design. In-suite containers will serve as visual reminders of the diversion programs, assist the resident in keeping their suites tidy, and provide a container for transporting the materials to the waste disposal/recycling area. "Blue Boxes" will be designed into each suite. For organics collection, food waste diversion can be achieved by providing residents with a container for their kitchen in which food scraps and peelings can be stored: metal or plastic, stored under the sink or on the counter. Containers for organics collection will be emptied and cleaned by the resident. Avoiding the inclusion of garbage disposals (kitchen waste disposal units installed in the sink drain) in kitchen design will encourage residents to channel organics to compost.

Building (centralized) collection options were considered, ranging from high tech to low-tech. In highrises, a chute system may be cost-effective, where multiple chutes or one chute with a control panel send waste into the correct collection bin. Alternatively, space could be provided to collect each waste stream on each floor, or with one centralized area in the building, near street level, for waste bins. A labour-intensive option would be to have the different waste streams collected by staff from outside the unit doors.

The costs of the program will vary depending on what collection system is selected for the building. Costs for collection systems within the building will be borne by the developer. For collection costs, estimates vary widely at present in the City of Vancouver, depending upon the contract that was negotiated with the collection company and on the level of service provided. To give an idea of current costs, collection of industrial, commercial and institutional waste, a 4 m³ container, costs approximately \$30 per pickup (US\$22). For residential recycling, current costs are \$12/suite annually (US\$9/suite), but vary depending on cost of truck fuel and the state of the recycling markets.

Meeting the moderate diversion goal of 64% would place Southeast False Creek at a diversion level only presently attained in Canada by overall programs that include the single-family residential sector and industrial, commercial and institutional sector (which typically have higher diversion rates) along with the multi-family residential sector. It would represent an exceptional achievement of diversion.

Meeting the optimal diversion goal of 88% would place Southeast False Creek in a category of its own.

5 Future for Southeast False Creek redevelopment

The Southeast False Creek redevelopment is an ongoing project. Plans have been completed for the areas of energy, urban agriculture and sustainable transportation as well as water management and waste management. The five plans are currently being consolidated into one coherent vision for the site which will take into consideration the synergies possible between the plans. All five plans are posted on the City of Vancouver web site [4], along with announcements for the ongoing consultation process. Discussions regarding the Official Development Plan for the redevelopment are nearly complete.

The water management and waste management plans are important parts of the overall design for a sustainable community on the Southeast False Creek site. Designing buildings so that water and waste management is facilitated has required extensive study but the result has the potential to be a community which can set the pace for sustainable urban development in Canada and in the Pacific Northwest of North America.

References

Note: The web sites listed are maintained by the City of Vancouver and are expected to last long enough to be useful to the reader of this paper.

- [1] Brundtland, Gro Harlem. Our common future. (Oxford : World Commission on Environment and Development), c1987.
- [2] City of Vancouver Planning Department, **Southeast False Creek Policy Statement**, adopted by City Council, October 1999.
(<http://www.city.vancouver.bc.ca/commsvcs/guidelines/sefc/>, accessed July 4, 2003)
- [3] **Southeast False Creek Water and Waste Management Plan**, presented to City of Vancouver Planning Department by Keen Engineering Co. Ltd., September 2002.
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- [4] <http://www.city.vancouver.bc.ca/commsvcs/southeast/background.htm>, accessed July 4, 2003

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