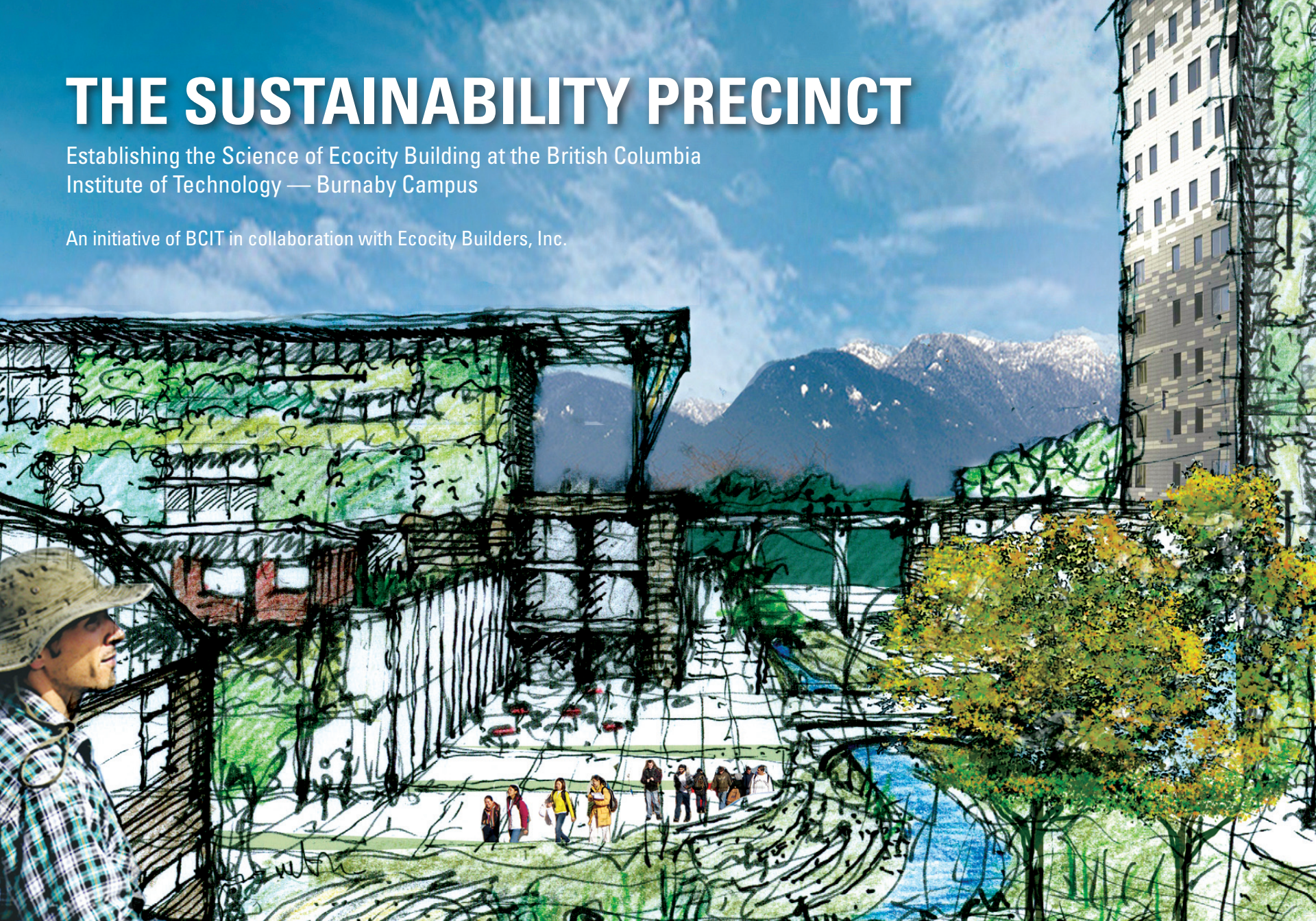
THE SUSTAINABILITY PRECINCT

Establishing the Science of Ecocity Building at the British Columbia Institute of Technology — Burnaby Campus

An initiative of BCIT in collaboration with Ecocity Builders, Inc.



Design Charrette & Report in Consultation with Ecocity Builders with Support From BC Hydro

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ACKNOWLEDGMENTS

Every successful initiative can point to a core of dedicated people who provide the right balance of vision, leadership, inspiration, and, very importantly, hard work and perseverance. With the announcement of the Sustainability Precinct project on their Burnaby Campus, British Columbia Institute of Technology has launched a bold and innovative initiative which, if the key actors maintain momentum over the next few years and the approach is maintained into the long term, could bring about a major transformation to not only the campus proper, but to the very Trades themselves and the way British Columbia trains and educates its professionals and therefore builds its cities, towns and villages. The work here is pointing to a future that, if the principles of ecological design and development outlined within this document are taken to heart and implemented on a large scale, will transform and revitalize not only the building industry and trades, but will dramatically lighten our collective ecological footprint and help to usher in a new era that more successfully integrates healthy nature and culture, an era the late cosmologist Thomas Berry termed the "Ecozoic."

John English, BCIT's Dean of the School of Construction and the Environment, along with Jennie Moore, BCIT's Director of Sustainable Development and Environmental Stewardship, have been the key visionaries and drivers of the Sustainability Precinct project to date. Along with Ron Kato and Michel Labrie, faculty in the Architectural Science Degree program, they have forged a strong alliance and shared commitment between BCIT administration, faculty and staff. Also very importantly, they have chosen to ground nearly every aspect of the research, planning, design, and development within the campus departments themselves rather then outsourcing the work. In other words, the student practitioners have been called upon to contribute to their own campus' visioning and development. To date, they have been included in every aspect of the initiative unfolding.

So on that note, it must be said that this report would not be half as informative or instructive without the considerable amount of time and talent poured into the background research for the Design Charrette and forthcoming plans developed post Charrette by the dedicated students of BCIT. With the Sustainability Precinct visioning now anchored firmly within all major sectors of the campus—administration, faculty and staff, and student body— we feel that the chances for transformative and positive change are high.

The following BCIT students worked tirelessly on this project. Many of the charts, illustrations, sketches and notes included in this document are their work.

Julia Baker, Ehran Holm, Mark Grimsrud, Mick Duggan, Anshu Gupta, Henry Tufts, David Tran, Franklin Huang, Andrew Hsu, Navid Fereidooni, Doug Turner, Jason Fung, Melvin Lau, Tyler Friesen, Daniel King, Taylor Shaak, Blain McNaueal, Paul Chia-Pu Hu, Jason Sedar, Daniel Guenter, Adam Quinones

We would also like to thank BCIT's industry partners for contributing their considerable expertise and information: before, during and following up the charrette. Special thanks to BC Hydro for additionally providing financial support to the production of the event as well as for being a key participant during it's convening. Gaining Ground's 2009 Resilient Cities conference, within which the charrette was held as a Shoulder Program, provided a broader forum and foundation for the work and we appreciated being part of their larger gathering. Last but not least, thank you to the charrette participants themselves, many of whom came all three days and applied their best thinking, expertise, hopes and dreams to the visioning work. Your efforts are much appreciated and valued, and it is likely that one day soon you will see the fruits of your efforts realized.

Comprising the Ecocity Builders' BCIT charrette team were Richard Register, Kirstin Miller, Geoffrey Holton, Dmitry Ozeryansky, Penelope Grezbik, Jane Wardani and Lisa Wan.

Authorship

This report was produced largely by Ecocity Builders, a pioneering San Francisco Bay Area USA based ecological city design and planning nonprofit organization, in coordination and collaboration with BCIT School of Construction and the Environment administration and faculty. Kirstin Miller was project lead. Design Action Collective was responsible for the report's design and layout. Geoff Holton created the sketches for the cover and Ecocity Builders' design ideas contributions section. Charrette photos are by Dmitry Ozeryansky, Kirstin Miller and Richard Register. The bulk of the text was written by Kirstin Miller, Geoff Holton and Richard Register. The graphics, diagrams and illustrations were developed by BCIT students and faculty in partnership with Ecocity Builders' team members.

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Over the course of three days, Ecocity Builders and BCIT's School of Construction and the Environment convened a design charrette to explore the transition of first one section of the Burnaby Campus into a "living laboratory" of sustainability to be followed by the ecological redesign of the entire campus as the first in a planned system-wide (all campuses) transformation. The goal is to simultaneously sustainably retune the Trades' educational programming as the physical environment is redesigned — to launch a coordinated and integrated shift to building and teaching for maximum ecological efficiency and livability—to ultimately explore, define, and deploy the "science of ecocity building."

LETTERS

John English
Dean
BCIT School of Construction & the Environment

The British Columbia Institute of Technology (BCIT) School of Construction and the Environment is concerned with the natural environment, the built environment and the relationship between them. Over the years, the School has gained recognition as a leader in sustainability education, contributing to the success of British Columbia's green building industry. An example is the Sustainability Charrette that took place on October 19, 20, and 21st, 2009 as part of the Gaining Ground: Resilient Cities Conference to which BCIT is the educational partner. Students and faculty from the Architectural Sciences Program worked with industry experts and other BCIT staff to explore opportunities for the adaptive restructuring of the northeast portion of BCIT's Burnaby Campus. The goal is to transform the area into a living laboratory of sustainability. BCIT is integral to the economic, social and environmental prosperity of British Columbia. This initiative gives life to that vision and uses contextual-based learning opportunities that integrate applied research with curriculum. I thank the students and faculty for their tremendous efforts in this initiative. I have every confidence that as graduates you will continue the work started here to advance the state of practice towards a sustainable future.

Jennie Moore
Director
Sustainable Development & Environmental Stewardship
BCIT School of Construction & the Environment

The built environment accounts for 30% of global energy and 40% of global materials consumption. The world's scientific community is calling for a four to ten-fold reduction in global levels of energy and materials consumption in order to achieve ecological sustainability, meaning use of ecological goods and services within nature's carrying capacity. Business and industry is responding to this challenge. British Columbia is a leader in green building technologies, and BCIT's School of Construction and the Environment is integral to this success. Applied research in reducing the ecological footprint of campus operations, while maintaining existing service levels, will serve as a key theme to align the concept of BCIT campuses as living laboratories of sustainability with School of Construction and Environment activities. A focus in the northeast portion of campus, currently known as the "Sustainability Precinct," serves as a catalyst for innovation on a broader scale. We are very pleased to be working with Ecocity Builders, a world leader in sustainable building theory and practice, to explore a vision and identify opportunities to achieve a Factor 10 reduction in energy and materials consumption in our built environment. This work can serve as an important foundation to future endeavours.

INTRODUCTION

The BCIT Sustainability Precinct Charrette

Richard Register, President, Ecocity Builders

History now is turning on very large gear wheels. Like a clockwork calendar that never goes back, it reaches times of immense significance and doors are opened or shut forever. Whether such was the case when the charrette for redesigning the northern portion of the British Columbia Institute of Technology campus took place is difficult to say only a few years after the turning of the millenniums. But, shall we say, the stars were lined up and shouldn't we all dare contemplate, in as visionary and practical mode possible, a much healthier future than the one to which we seem to be headed? Revolution, preservation or extinction – which seems most likely, which best and if we do what? On October 19, 20 and 21, 2009 about eighty of us participated in the three-day workshop called a "charrette" which means "little cart" in French. One hundred years ago young architecture students in France named their intensive multi-day dreaming, designing and drawing sessions after the cart they threw their plans upon for the mad dash to the their professor's office assignment's deadline.

On those autumn days we were a collection of students, teachers and administrators from BCIT, some local supporters including representatives of BC Hydro, the regional electric utility, and the Real Estate Foundation of British Columbia. For facilitators we had Kirstin Miller and her four collaborators from Ecocity Builders, a Non-Governmental Organization out of Oakland, California long in the business of visioning and promoting ecologically healthy city, town, village, neighborhood and campus design and development. We were hosted by Jennie Moore of the campus sustainability office and we were located for the three days in the Vancouver Convention and Exhibition Center on the Vancouver north waterfront. The charrette was part of the larger Gaining Ground Conference, fourth in the series to date. The theme: "Resilient Cities." Our BCIT Sustainability Precinct Charrette focused on much of the northern third of the campus where most of the buildings are due soon for demolition or major remodel. We would show exactly how to achieve a resilient city transformation in a real place, a living, teaching community.

Mission Accomplished

By near sheer coincidence and an invitation from one of Ecocity Builders' supporters, the previous week I'd had dinner with the man who saved the world, and with that story I started out my talks at both the charrette and the larger Gaining Ground conference. Crossing paths with Mario Molina, the Mexican atmospheric scientist and Nobel Laureate, was a stunning experience in inspiration. He actually did save the world! At least the living portion of it we know and love so well. It is possible! He, with his research and campaign partner Sherwood Rowland, identified the problem with CFC refrigerants and aerosol sprays back in 1973. Then, in shock themselves at the implications for the ozone layer in the stratosphere and all life below it, they went on to successful work refining the science, bringing the tale to the public and motivating the politicians and diplomats to a successful conclusion in the Montreal Protocol. Thus averted was an apocalyptic plague of ultraviolet radiation-induced cancer for thousands of species on the Earth's surface and deep into its waters.

Vancouver Ready to Go

Segue to Vancouver where steady efforts over the last twenty years by pioneers like Jennie Moore and ecocity activist/professor Mark Roseland have helped produce one of the closest approximations to date, along with Curitiba, Brazil; Portland, Oregon and some of the more ancient pedestrian cities of Europe and Asia, of an "eco-city." The large number of people living in downtown Vancouver, so many they tend now to commute outward to jobs instead of vice versa, the tall buildings with rooftop and terrace gardens and trees behind windscreens or open to the migrating birds, the tiny "Aquabusses" that zip so conveniently from shore to shore, the city Planning Department's commitment to eco-density and sustainability under the energetic direction of Brent Toderian... all these are beginning to add up. All that's

missing is a single place where, small though the diverse components might be, they are all there and well arranged. In "ecocity" circles we call this an "ecocity fractal" a fraction of the whole small enough to be built relatively quickly. Such a built project is not a monastery for hiding the best survival secrets and cultural creations for a future time, not an arc for salvaging our present favorites into a post disaster future, but instead a reconnaissance vehicle – that we have to build ourselves – to explore what a healthy future might communicate back to us. We need to see the whole thing even if as a miniature to see better what an ecologically health built and thriving community looks like. Housing, learning, working, commerce, celebration, support for and from nature and proper systems of supply and recycling and service back to our biosphere ever regenerating and evolving in health – that's what we need and the BCIT ecocity charrette is leading the way.

On October 19, 20 and 21 we discussed the parameters of the project, the development potential and zoning of the surrounding community, the basic principles behind ecologically healthy design. We tried out which building and associated use should go where. How should the creek be restored and where course through? What sort of centers for the congregation of people would work best and where might they be located? What sort of foot and bike paths and transit connectors internally and to the community outside? What percentage of working, studying people of BCIT should live on or near campus? What about the views to the mountains to the north? What classes would make the most noise and what need the most quiet and where then should the housing and socializing areas be placed? What design would express the muscular intelligence of the school's mission to train for design and building the best of British Columbia and possibly the world in the years coming, as if we needed such a mission tied to sustainability? Does anyone anymore doubt that we need this? Why shouldn't BCIT take the lead? Can we make our campuses, and by extension our cities, not just less damaging to our world and its climate and life systems but as Jennie Moore has said "net contributor cities" an in this case a net contributor campus?

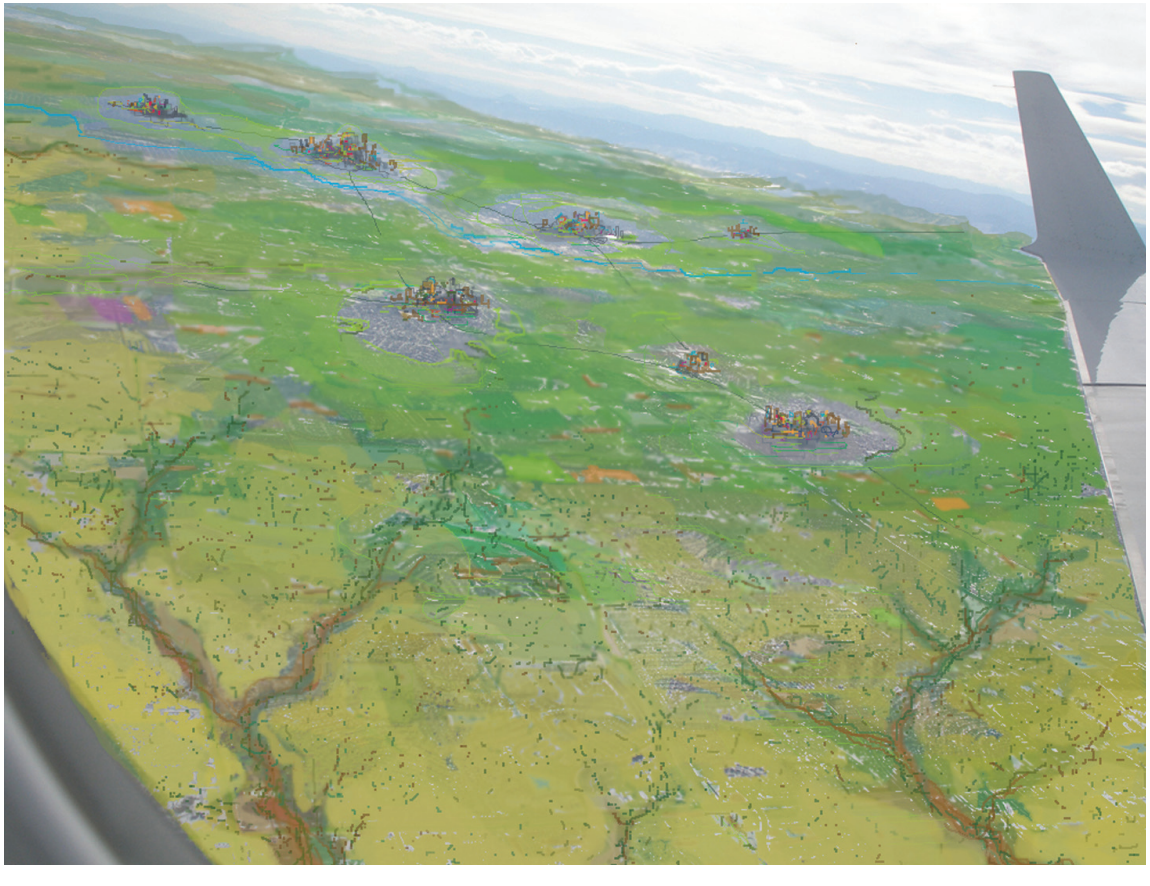
New Mission

Certainly we know times are dire with climate change arriving on the shoulders of looming resources depletion, especially that of oil and rare metals which people have come to see as an entitlement of the post industrial information world dream. But as they say, you can't eat the menu and behind the information there needs to be the forests, farm lands, fisheries, mines, solar and wind energy technologies and exceedingly thorough recycling if we are to have a secure future to share with what remains spared by human excesses and myopia. All this needs the context and physical, literal support and shelter of the city that has learned from and been tuned to ecology. With glaciers melting rapidly, the great "Brown Cloud of Asia" spreading at times all the way from India and China to the North American west coast while contagious Los Angeles asphalt and delusions of independent ego grandeur spread paving from Australia to Canada, from Brazil to Nigeria, Turkey to Thailand... Where are you now, Mario Molina, and who are you if not all of us willing to try to redesign the way we live and learn? Time to save the world. Again. ■






Denver from the air - finding its centers.



New compact cities and towns can arise where today hundreds of thousands of acres are covered by low density sprawl in typical car-dominated larger metropolitan areas. At the same time three quarters or more of the land can be liberated for agriculture or returned to nature. Centers can be reinforced with more density and diversity of land uses and compact ecological city infrastructure. Here we see a sequence of changes starting with a aerial photograph in a pattern moving toward far more energy and land conserving cities imagining Denver transforming into the future. Ecocity Builders' "ecocity mapping" can help guide this development-shifting transition over a few decades. (Denver ecocity sequence by Richard Register)

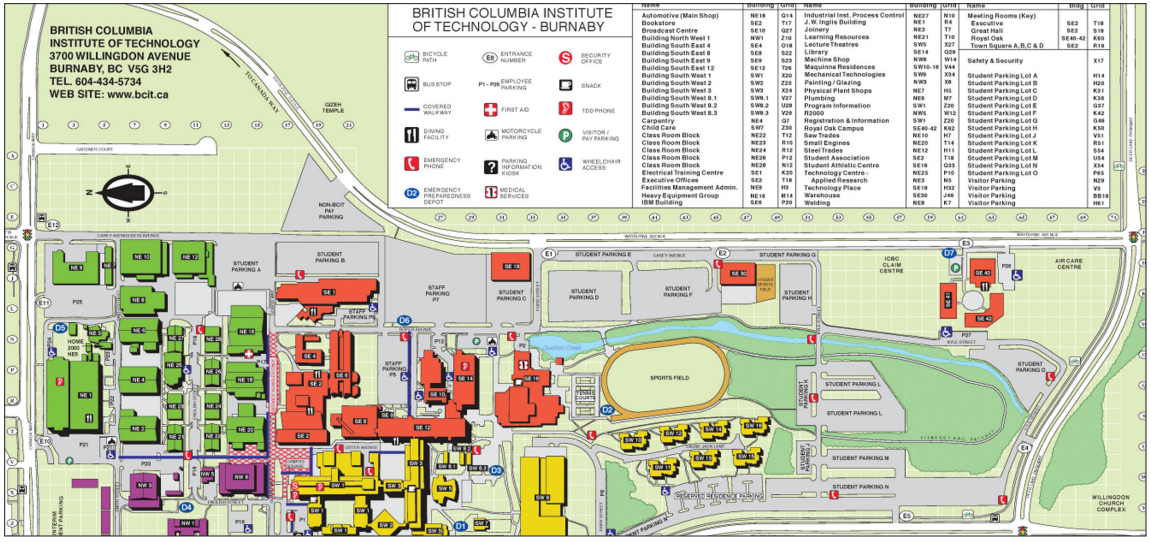
ESTABLISHING THE SCIENCE OF ECOCITY BUILDING AT BCIT

In 2009, BCIT adopted a new vision and mission: To be integral to the economic, social & environmental prosperity of the Province of British Columbia.

BCIT's Burnaby campus Sustainability Precinct project, explored in this document, is a key initiative intended to put the BCIT vision and mission to practice. Building upon pioneering conceptual and theoretical foundations laid by eco-visionaries such as Richard Register and William Rees, and following upon broad initiatives in ecological city design and planning such as Vancouver's "EcoDensity" program as well as innovation in green building criteria such as the Living Building Challenge and LEED, BCIT's School of Construction and the Environment is seeking to demonstrate the 'science of ecocity building'. The objective is to redevelop an existing area of the Burnaby campus as a "living laboratory of sustainability". The project's overall goal is to achieve a site specific 75% (in approximately 5-10 years) and 90% (in 20 years) reduction in energy and materials consumption. These reductions will be achieved through a combined approach focused on the adaptive restructuring of the Sustainability Precinct's built environment, along with corresponding environmental restoration projects, energy and materials systems restructuring, and through social and behavioral change initiatives.

Toward the overall goal, in October 2009 the School of Construction and the Environment, in consultation with Ecocity Builders, a San Francisco Bay Area based nonprofit founded by ecocity visionary Richard Register, produced a three-day design charrette as a shoulder program to the 2009 Gaining Ground conference in Vancouver. The purpose was to explore various scenarios towards the goals of 75% reduction, "Factor 4" and 90% reduction, "Factor 10" in materials and energy reductions, first within the Sustainability Precinct and then campus wide. The outcomes of the charrette, as you will see in this report, begin to suggest an approach, or in fact several approaches, to how these reductions could be achieved through practical applications demonstrating principles of ecocity building, while maintaining a high quality of student services. Prior to the charrette, BCIT's School of Construction and the Environment established inspirational sustainability goals to be used in conjunction with the Sustainability Precinct project. As previously outlined, the overarching goal is to achieve deep reduction in the amount of energy and materials consumed — a four-fold or "Factor 4" reduction leading to a ten-fold reduction or "Factor 10." In support of these overarching goals, they adopted sub-goals help guide their initiatives and serve as "inspirational beacons". The sub-goals are as follows:

- Greenhouse Gas Neutral
- Net Energy Producer
- Zero Waste
- Water Balanced
- Ecologically Restored
- Equitable and Socially Responsible
- Accessible to All Students and Faculty



Both goals and sub goals are currently articulated in BCIT's "Greening Campuses Strategic Plan" as well as under the heading of "Sustainability" in the BCIT Campus Master Plan. Coming out of the charrette and informed by their sustainability goals, BCIT administration, faculty, staff and students have now worked with actual buildings and landscapes, real numbers and real data, applied ecocity concepts, and explored pushing the envelope towards achieving the 75%-90% reduction in energy and materials consumption science says is necessary in order to practically address the serious impacts of global climate change. These insights should help provide information needed to articulate objectives over the next five, ten and twenty year periods. The hope is that BCIT will be able to more fully articulate not only an achievable vision but also will be able to prioritize concrete objectives towards the achievement of their goals, first within the Sustainability Precinct — eventually for the entire campus and beyond.

Moving forward

The School of Construction and the Environment has several research centers that will continue to participate with the Sustainability Precinct initiative. BCIT will also invite a range of talented and knowledgeable faculty from their architectural, engineering, ecological restoration and other departments for further consultation and support. Their aim is to draw upon their own resources as much as possible in order to build a culture of commitment to the initiative, reaching outward as well when needed. One of the advantages of a continued collaboration with Ecocity Builders, an internationally recognized NGO, is that BCIT can directly contribute to, and be acknowledged for, the worldwide advancement of the 'science of ecocity building' as they move through the Sustainability Precinct's phases of conceptualization, design and implementation.

Establishing Baseline Documentation

Data collection leading up to the charrette began several months prior to the event. Under the direction of Dean John English and Sustainability Director Jennie Moore, BCIT made arrangements with architectural faculty Ron Kato and Michel Labrie for a Design Studio that would directly involve BCIT architecture students with the project from the beginning. In coordination with Ecocity Builders' team in the San Francisco Bay Area, efforts began to acquire background information that could be useful for the site analysis and subsequent design phases. Kato and Labrie assigned teams of students to implement a number of investigations pertaining to the Sustainability Precinct site proper, and also to the Precinct as it related to the larger Burnaby campus, campus Master Plan, and surrounding neighborhoods. Research focused on campus history, buildings and structures, seismic studies, water and energy flows, soils, open spaces and parks, pathways and circulation, waste management and recycling, food services, housing, transportation to and from campus, student demographics and behavior, and more. Also informative to the effort was a prior campus-wide Ecological Footprint assessment completed in 2007 by BCIT in cooperation with the Global Footprint Network.

After compiling the data, students began summarizing and quantifying their findings. Final documentation on display at the charrette was displayed as a "talking wall"— a series of boards summarizing the key findings— that provided quick and convenient access to relevant information. Composed of approximately thirty panels, they covered all the above-mentioned research topics pertaining to the project. The panels were constructed out of light foam core and were therefore easy to remove and transport during table work sessions. At the beginning of the charrette, the student teams made introductory slide presentations to introduce the findings summarized on the talking wall. It is not unusual that, in addition to useful information obtained in a research project covering so many variables and over a timeframe reaching back decades into histories of buildings and plans, a typical result is the discovery of what needed data is still missing. This exercise was no exception. In general, the process revealed that due to somewhat antiquated systems and utility networks, it was impossible to determine exact measurements, for example, for energy and water use per building. Additional uncertainties were revealed when it came to measuring other resource throughputs. Overall, the baseline data collection process was a good early step in establishing what was measurable and what still needed to be addressed if the goal of tracking long-term energy and resources savings was to be adequately measured and reported. ■

GUIDING PRINCIPLES

Setting the Larger Context

Five things that would actually work to solve the climate crisis

In 1989 a popular book was published called "Fifty Simple Things You Can Do to Save the Earth." A trenchant retort at the time was, "What about the three or four big things that would actually work?" The climate crisis, along with rapidly degenerating biodiversity and rapid drawdown on limited energy and crucial mineral resources are problems of very large scale. Ecocity Builders is proposing that we must ultimately deal with the "Five Big Difficult Things" if we are serious about solving these multiple crisis. They have now been mostly avoided for decades, while the 50 much smaller and easier to sell to the public things are obviously not solving the problem. Sadly, today's list of easy things to do is almost identical to the list we began with during Earth Day events in 1970. After forty years of little easy things, we are not gaining ground against the biggest challenges facing us.

Ecocity Builders' assessment of the 5 Big Things We Must Do to Save the Earth are as follows:

1. Address Overpopulation - Humanity is overpopulated and must reduce its numbers, and do it peacefully since violence replicates and amplifies itself. That we are overpopulated is massively evident in the fact that human beings constitute more than 100 times the biomass of any other species in our general size range to ever inhabit the planet. Also, approximately 93% of the present land animal biomass on the planet is no human beings and our food animals and pets, leaving only 7% in the form of wild animals.

2. Address the Built Infrastructure – We need to rapidly shift from away from the car, sprawl, paving and cheap energy infrastructure over to compact pedestrian oriented renewable energy and land, materials and energy conserving ecocities.

3. Address Diet and Agriculture- We need to eat lower on the food chain. Among the changes that imply enormous savings and amount to re-investing in long-term sustainability, farming for meat needs to be recognized as highly inefficient. Costing five to ten times the land and energy of eating vegetable foods directly, a diet high in meat is a big part of the geopolitical and energetics problem on Earth, and a diet very low in meat or completely vegetarian is a big part of the solution.

4. Build Generosity - Need needs to replace greed, as Gandhi said. That means we must invest in the future health of the world – not just in our wealth as individuals – by way of supporting solutions to the above three. We need a new wave of generosity, especially as expressed in giving back to the Earth. In other words we have to tax ourselves more and do a much better job of spending the money for the general good.

5. Build Education - Education needs to stop following consumption trends and chasing the money for its own sake and promoting unending growth. It needs to shift away from supporting whatever's coming down the road to maximize prosperity (at the expense of nature's prosperity) while attempting to make the whole enterprise a little "greener," for real or for purely public relations reasons. Education can help preserve or destroy natural systems and biodiversity depending on what is being taught and learned. Beyond reading and writing and arithmetic, education is not per se a virtuous pursuit. It depends on what it addresses and what it creates. The content is all-important. Again, 50 simple things to make the world a little bit better is not enough. We need to prioritize and move to implement the big solutions now.

Guidelines for Ecocity Development

Since 1990, Ecocity Builders has convened the International Ecocity Conference Series in order to build the ecocity movement and further develop and deploy the practice worldwide. First held in Berkeley, California, the series has now convened (with the conclusion of Ecocity 8 in Istanbul Turkey in December 2009) on every inhabited continent. Part of the work has been to begin to define a set of principles and guidelines for ecocity development that can be widely disseminated and applied. The following guidelines are summarized from the Shenzhen Declaration (5th International Ecocity Conference, 2002) in China and readopted in 2008 at the 7th International Ecocity Conference in San Francisco, USA.

Ecocity development is a whole systems approach integrating administration, ecologically efficient industry, people's needs and aspirations, harmonious culture, and landscapes where nature, agriculture and the built environment are functionally integrated.

Ecocity development requires:

- Ecological security–clean air, and safe, reliable water supplies, food, healthy housing and workplaces, municipal services and protection against disasters for all people.

- Ecological sanitation–efficient, cost-effective eco-engineering for treating and recycling human waste, gray water, and all wastes.

- Ecological industrial metabolism–resource conservation and environmental protection through industrial transition, emphasizing materials re-use, life-cycle production, renewable energy, efficient transportation, and meeting human needs.

- Ecological infrastructure integrity–arranging built structures, open spaces such as parks and plazas, connectors such as streets and bridges, and natural features such as waterways and ridgelines, to maximize accessibility of the city for all citizens while conserving energy and resources and alleviating such problems as automobile accidents, air pollution, hydrological deterioration, heat island effects and global warming.

- Ecological awareness–help people understand their place in nature, cultural identity, responsibility for the environment, and help them change their consumption behavior and enhance their ability to contribute to maintaining high quality urban ecosystems. ■

IMMEDIATE INTERVENTIONS

Design Charrette: Day 1

To kick off the first day's agenda, Ecocity Builders presented an introductory slide show and lecture to familiarize charrette participants with a set of working terms and key principles based on the ecocity approach. They also suggested specific applications of this approach for the table work. The initial session was also used to provide an overview of the data collected by Ron Kato and Michel Labrie's studio.

The structure for each of the table work sessions was similar. What did change table-to-table and session-to-session was the first question in the Framework of Inquiry—What are we creating? —depending upon the type of inquiry assigned (i.e. immediate, mid-term or long-term interventions for building NE-1, the Sustainability Precinct, the campus).

The basis of inquiry for table work for this beginning session was, "What can we do immediately to dramatically lower energy and materials use within the Sustainability Precinct specifically, as well as more generally within the Burnaby campus?" Additionally, several tables focused on a small portion within the Precinct itself in order to begin to develop a first project to act as a catalyst for the larger initiative. One building in particular, NE-1, was pre designated as a likely candidate for this initial project for a variety of reasons, including its size, basic structural integrity, location, and overall potential for adaptive reuse. More outcomes for NE-1's potential and suggestions for its adaptive reuse follow in the Recommendations and Outcomes chapter. It is also worth noting that an in depth study on NE-1 completed only one year prior had already further confirmed its potential while accumulating a significant amount of data and information that can be used towards the goal. While "Immediate Interventions" were separated from more long-term goals for the purposes of the charrette, one key point to emerge was that the intentions that lie behind all the more immediately attainable goals would need to be sustained and integrated into all long term campus planning. This will take the form of operations and maintenance policies, purchasing and contract policies with vendors, and school initiated lifestyle transformation policies.

Commissioning and retrocommissioning

An approach to establishing baseline data and tracking systems explored centered on the practice of "commissioning." Commissioning is the process of regularly testing the systems within a building (such as the HVAC system) to ensure that it performs as it was designed to perform. This process ensures the delivery of a functioning high performance building. Although commissioning might seem like a common sense rule that is applied more than not, in fact the opposite is usually true. Studies show that in fact a far more common situation is to find that buildings and systems are not continuously monitored and made "ship shape" on a regular basis. More usual is to find that parts of a building start to underperform for weeks and even years before something breaks down completely and needs to be repaired. This unfortunate situation is also found to be occurring in LEED certified buildings, so that a building that earns a LEED certificate one year might actually not be achieving the same level or even any level of LEED performance within two to five years after the building is first certified.

The ongoing process of commissioning is usually set up to begin just after a building is constructed. However, existing buildings can also be commissioned. The latter type of commissioning is also known as retrocommissioning, and this process would be most applicable to BCIT's existing building stock within the Precinct. Commissioning almost always leads to energy savings, a more comfortable environment in the building, and often reduces the need for capital improvements. The commissioning approach is now being extended beyond building systems to include all integrated systems within a given area: so for example within the Sustainability Precinct, commissioning could address not only building performance but also transportation systems, grounds, natural systems like creeks, and health and safety, to name a few. Software can be custom designed to improve overall operations by continually monitoring the performance data of each building and related system and comparing it to the model performance benchmarks. The software can point out what is not operating, give suggestions of potential causes, and even show the cost to fix the problem and to not fix the problem.

During the first phase of the charrette, these baseline inquiries were considered in detail. It was acknowledged that establishing baseline documentation on one building within the Sustainability Precinct would be a feasible next step to coordinate in cooperation with BC Hydro, the primary utility provider. After the first building is commissioned, the results can be tracked and recorded in order to document data and cost/benefits of sustainability retrofitting and redesign.

Charrette Working Terms

"Ecocity"

A city is the locus of concentrated human habitation and activity. An ecocity is a city that provides such function in the most ecologically efficient way while preserving and enhancing bio-cultural diversity and within the environmental limits of its bioregion.

"Access by Proximity - Ecocity Urban Design Principle"

Being there instead of getting there. That is, providing for a full diversity of activity close together: housing, jobs, commerce, education, nature, energy supply, recycling, networks like public transportation, etc.

"Ecocity Fractals"

Portions of the ecocity that embody the essential functions of the whole city on a smaller scale and relate in a healthy manner to the natural environment (Employ Access by Proximity Principle).

An "ecocity fractal" is a fraction of the whole ecologically healthy city or town that has all essential city components present and well arranged. These necessary components must include housing, work and study space, recreation and socialization space and proper orientation to nature, consideration of local conditions of sun angles, temperature, precipitation, and integration and preservation of natural features such as streams, soils and special views to nature. An ecocity fractal must also have strong networking connections to healthy food, clean water, renewable energy and very low energy transportation, along with assiduous recycling of materials and composting of organic wastes to build rather than deplete soils.

Finally, an ecocity fractal, like the larger eventual ecocity itself, must strategically build, not degrade, natural biodiversity. The ecocity fractal can produce a living and learning community that exhibits and functions as a whole, healthy ecosystem, a place that, by design, embraces the realities of our times. As a small version of a full spectrum ecocity, the ecocity fractal is a much more easily and inexpensively constructed entity than a whole ecocity. It is an excellent place to start, and the smallest scale at which the whole can be exemplified.

Sustainability Goals:

These design targets were used to inform deliberations for each of the three table work sessions during the charrette process. The goals were developed prior to the charrette by BCIT administration in consultation with their sustainability director.

- Greenhouse Gas Neutral
- Net Energy Producer
- Zero Waste
- Water Balanced
- Ecologically Restored
- Equitable and Socially Responsible
- Accessible to All Students and Faculty

Immediate Intervention Key Conclusion 1

An integrated approach to sustainable redevelopment requires multi-stakeholder participation and support.

- Create a multi-stakeholder team or task force including administration, faculty, staff and students who can help plan and guide short and long term initiatives.
- Collaborate with BCIT marketing department to better promote sustainability education and outreach through high profile marketing campaigns.
- Sponsor design competitions that get more students and departments involved in cross collaboration towards building pieces of the sustainability precinct, one idea: inter-departmental design-build competition for covered bicycle parking. The winning scheme to be built.

Immediate Intervention Key Conclusion 2

The goals for reduction of energy and materials use must be verifiable.

- Establish baselines for monitoring within the Sustainability Precinct.
- Engage industry partners such as BC Hydro to develop high performance monitoring systems on a targeted number of buildings.
- Explore how a process of "commissioning" could be established through development of custom software, working in house with several departments working together, including IT.

Fractal Examples

The definition of each fractal is linked to the type of facilities and services (amenities) to be found in each

1. Highly mixed-use building (however most buildings are too small to host enough basic, diverse, essential and complementary components and functions to be true fractals).
2. Pedestrian island (contiguous area that can be walked without crossing a motorized street).
3. Urban village from two or three blocks to whole neighborhood (area that can easily accessed in its entirety by walking - i.e. 1/2 mile).
4. Urban cluster / district (group of urban villages not more than 5 minutes away by public transportation sharing key facilities like hospitals, centers of higher education, recycling center, fire fighters facility, waste treatment facility).
5. City
6. Metropolitan Area

"Amenities Set"

What is being provided within the fractal – with priority to that which is needed by the users on an everyday basis.

Sample Urban Village Amenities Set = Walking Access to

- grocery store
- variety of housing options
- variety of employment options
- public transportation options
- restaurant
- coffee shop
- bars
- movie theatres
- schools
- libraries
- bookstores
- fitness
- drug stores
- hardware stores
- clothing & music
- parks
- natural environments
- food and native plant gardens

Sample Burnaby Campus Amenities Set

Classes and Programs

- Applied & Natural Sciences
- Business & Media
- Computing & Information Technology
- Engineering
- Health Sciences
- Trades & Apprenticeship

Student services

- Bookstore
- IT Services
- Food services
- Health Services
- Housing
- Library
- Medical Services
- Parking
- Recreation

"Ecologically Efficient"

- efficient land use based on access by proximity principle
- efficient water usage and well working within its watershed
- efficient sourcing of food
- efficient sourcing of materials
- efficient waste disposal and processing
- efficient use of energy
- within the limits of the bioregion

"Healthy Bioregional Ecology"

Working within the limits of the bioregion has to do with maintaining and enhancing existing top soil, using not more water than is available in the watershed after the needs of all the existing animal and plant species have been met, using not more of the fibers and wood that can be sustainably harvested, etc. [this does not prevent trading with other bioregions but that the resources of the local and trade partners' bioregions need to be maintained and enhanced] Based on the above terminology, tables were instructed to use the "ecocity approach" as a guide for their various inquiries.

The Ecocity Design Approach is summarized as follows: "Providing Amenities Access in a way that is Ecologically Efficient and supports healthy Bioregional Ecology."

Immediate Interventions Key Conclusion 3

There are easy and relatively inexpensive projects that can be implemented quickly and have high visibility.

- Using "city repair" kinds of approaches, streets can become pedestrian walkways, bicycle lanes can be outlined, park benches, gazebos, kiosks and street furniture can be added to start to create a new sense of place.

- Water fountains and healthier snack foods can replace bottled water and sodas now prevalent.

Immediate Interventions Key Conclusions 4

Catalyst projects can become signature built and landscaping initiatives for the Burnaby campus and the first big steps towards the long-term transformation of the Sustainability Precinct

- Remodel building NE1 a toward an ecocity fractal with added amenities like housing.

- Continue daylighting Guichan Creek, design for eventual integration with the Sustainability Precinct's "ecocity fractal".

FACTOR 4 INSPIRED CHANGES

The Applied Science of Ecocity Building at BCIT

BCIT Sustainability Goals:

- Greenhouse Gas Neutral
- Net Energy Producer
- Zero Waste
- Water Balanced
- Ecologically Restored
- Equitable and Socially Responsible
- Accessible to All Students and Faculty

Design Charrette: Day 2

Day 2 of the charrette moved beyond the immediate interventions proposed during the previous day's table work, with the understanding that these interventions would nevertheless be building a foundation for moving the Sustainability Precinct and the campus towards the larger goals of 75% and 90% reductions that would additionally need to provide for the future campus growth targets. One of the realizations early on was that planning for ambitious targets and long-range sustainability could not happen in any reasonable timeframe without a clear vision and pathway towards the ultimate goal of Factor 10, or 90% reduction in materials and energy. Additionally, in order to achieve the targets necessary, prioritization for changes and solutions offering the biggest impact toward the target should be maintained. Table work from this point on took a planning perspective and the focus shifted away from lists and notes over to maps, plans, designs and sketches.

This next session of inquiry posed a 75% reduction of energy and materials use as a primary design guideline, again, also alongside the BCIT sustainability goals previously established and adopted as campus Master Plan development goals (Greenhouse Gas Neutral, Net Energy Producer, Zero Waste, Water Balanced, Ecologically Restored, Equitable and Socially Responsible, Accessible to All Students and Faculty). The designers (students in particular) were encouraged to "think outside the box" and to be "place conscious"— aware of the larger context within which the Precinct and campus operates— and to consider important relationships such as between the campus and surrounding Burnaby neighborhoods, local climate conditions, relationships to the larger city centers and municipality, and ultimately to the Cascadian bioregion and the sourcing of energy and materials that ultimately arrive at the campus in the form of gasoline for cars, electricity and heating energy, water, food, building materials and the like. Holding all of these complex systems and resources, materials, relationships and integrated pathways in mind as the designers looked to build a sustainable campus proved to be a considerable challenge, one that was tackled with courage and foresight by the table teams.

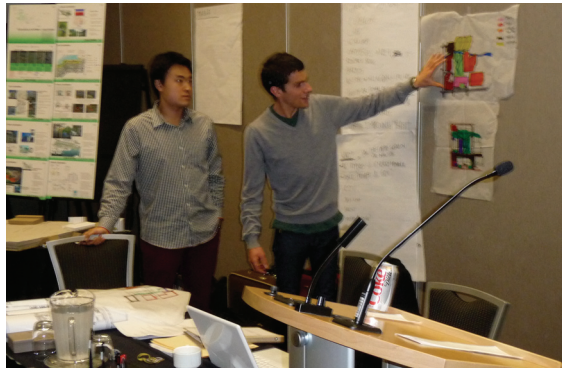
"Sustainability is not just an idea, it can become a lifestyle of this campus if we choose to," wrote one student on his final proposal for a Factor 4 campus master plan (75% reduction in ecological footprint). Among some of the leading ideas coming out of the session, the table teams focused on the major culprits for waste and greenhouse gas emissions. Essential to almost all proposals were initiatives that would start a mode shift away from car commuting over to transit, bicycling and walking. BCIT is currently known as a "commuter campus" and the name is well-earned, as most people who travel there do so by car, making transportation one of the largest contributors to BCIT's unsustainable ecological footprint, at 32% of the current total. The current Burnaby campus configuration has evolved piecemeal and places primary emphasis on utilitarian auto and delivery access to campus buildings at the expense of other modes. Pedestrian and bicycle circulation, as well as

integration of transit riders are all afterthoughts. This problem extends to the campus' central plaza, which often as not serves as a parking lot for delivery and service trucks.

Addressing this imbalance, moving towards more sustainable modes of transit and attempting to re-define a pedestrian oriented "heart of the campus", the table teams worked though ideas for improved networking with city buses, better located and designed bus stops, improved bicycle lanes and connectors from the Skytrain, incentives for commuters to switch modes such as charging more for parking and providing better bicycle parking and showers for bicycle commuters.

Several tables identified the compact area to the east of campus, bounded by Canada Way, Carey Avenue, and Wayburne Drive, as a target for re-zoning. Working with the City of Burnaby, it was felt that BCIT could encourage the emergence of a high density, amenity rich mixed-use affordable residential area here. Such a development could form strong synergies with both the transformed campus and the residential neighborhood further east, encouraging a walking and bicycling oriented student body and faculty and improving the walkability of the current neighborhood by adding much needed retail and cultural amenities.

Landscaping changes were proposed to reinforce a new sustainability minded image for BCIT, for example, several tables proposed that one or more of the necklace of parking lots cur-



Factor 4 Key Conclusion 1

Land use and transit reconfigurations that result in more walking and less parking are key to sustainable transportation.

- Provide a variety of housing options, both on campus and perhaps in nearby neighborhoods, to create amore place based and sustainable environment.
- Work with transit agencies to improve bus and transit options from city centers to campus. Redesign transit stops and shelters and reconsider transit stop locations for maximum ridership.
- Greatly improve pathways and conditions for bicyclists to and from campus and within campus.
- Reconsider parking lots as opportunity sites for more sustainable uses, such as housing, parks and urban gardens.

Factor 4 Key Conclusion 2

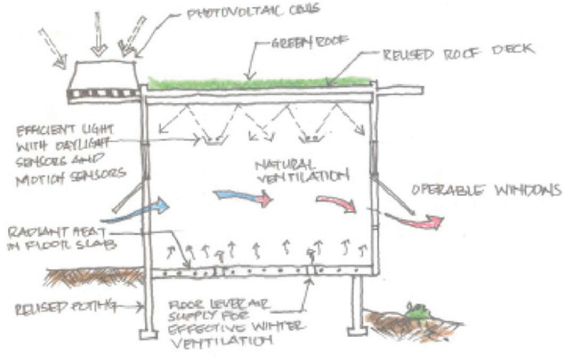
Behaviors and habits can be changed to reduce waste

- By changing vending machine choices, people can start to choose tap over bottled water and healthy snacks over processed foods with lots of packaging.
- BCIT can review and reconsider its sustainability guidelines for procurement and purchasing choices, including choice of food service providers.
- The current operation of BCIT as a "commuter school" which currently generates a large amount of CO2 emissions should be reexamined and likely changed if long-term sustainability is to be achieved.
- Through design changes, such as parking lots into parks and gardens, waste can be reduced, the environment can be improved and people's behavior and attitudes will shift, as a culture of sustainability will start to overshadow the current culture of convenience and waste.
- The library can expand into a full range of ecocity books, exhibits, posters on display, models perhaps.

rently ringing the campus could be converted to mini parks or to student housing so that fewer students would need to commute in the first place. In general, plans tended to see the many surface parking lots as potential locations for a variety of more sustainable uses, including parks, sites for housing as well as urban farm operations that would help provide the campus kitchens and food service with fresh produce and even protein, if aquaponics and chickens along with beans, soy beans and other protein plants were introduced.

Along with the sustainability design trend to provide more housing on and adjacent to campus, it was determined that the current campus amenities set would need to be updated so that additional services would be made available to those staying close by. For example, more retail, entertainment and food services would be needed to supplement the requirements of a more place oriented campus rather than a commuter school.

Analysis has found that the waste flow at BCIT counts for a whopping 47% of the campus' total ecological footprint. Along with the commuter focus, services at BCIT are still skewed towards fast food and disposable materials. It was determined that the practice of selling bottled water, soda and soft drinks, using throw away cups and utensils would need to be addressed if real progress towards the 75% goal is to be achieved. Proposals were made to start phasing out bottled water and to launch a campaign for drinking tap water from water fountains. Additionally, the campus could help market more sustainable choices, like bringing one's own water bottle or mug from home and using a mess kit instead of throw away paper plates and plastic utensils. The food service providers could be reevaluated and contracts could be revised as soon as possible to seek out food service providers whose products reflected the



Anusha Gupta

BCIT sustainability goals. Food could be sourced from within the regional "foodshed" and some could be grown on campus in kitchen gardens, helping to reduce the food miles that add greatly to footprint calculations. Assuming some vending machines will remain, soda, candy and soft drink dispensers could be replaced by healthier vending machines offering nuts, dried fruit, and juices.

Moving to the Factor 4 stage within the Sustainability Precinct and campus wide, it was generally agreed that natural features, including Guichon Creek, need to be appreciated, cared for restored, and taken advantage of as amenities. Daylighting the creek was not only important for environmental restoration efforts on campus, but in many of the plans as a prominent natural design feature. The creek, with its meanders and bends, helped soften the hard lines and edges of the buildings, streets and pathways, providing a much-needed visual balance between gray and green. In may of the schemes, the wooded lot next to Deer Lake Parkway remained as not only a green refuge for people but as a place for water to be naturally recharged into the ground, for trees to help filter the air and provide habitat for wildlife, and for biomass to be potentially sustainably harvested for energy generation.

Last but not least, the question of energy was a main focus of discussion and debate among the tables. It was generally agreed that as new buildings replaced old, passive design would be a top priority in order to keep energy requirements as low as possible. More debatable however, was the question of whether or not BCIT should attempt to generate more of its own lighting, heating and cooling energy on site. Currently the BC Hydro mix delivered by the grid to campus is mostly from hydropower, considered by many to be a fairly "clean" renewable. It was generally agreed that wind conditions were probably not ideal for large amounts of energy generation. Solar PV was a possibility, but climate conditions are not ideal. Solar thermal was seen as more practical in the campus context and other uses for limited rooftop space might be preferable. Firmly on the table throughout most of the discussions was co-generation—reusing waste heat and bio-mass (often in the form of saw-dust) from shops and —and large-scale geothermal exchange. All in all, it was concluded that additional onsite power generation was an important topic that would benefit from more detailed inquiry and analysis. ■

Factor 4 Key Conclusions 3

In heading towards Factor 10, Factor 4 must hold the long-range vision and be bold.

- It is impossible to get to Factor 10 if Factor 4 does not provide a launching pad for large-scale transformation.
- Along with a physical redesign for long-term sustainability, the entire culture of campus and student life will need to be reoriented.
- Most of Factor 4 can be achieved through frugal measures, but in order to maintain levels of service, variety and comfort, more creative and bold design options and creative integrated planning will need to be employed.
- Factor 4 requires BCIT to transition away from being a commuter school and become more like an urban village onto itself, heading all the time in the direction of increasingly place-oriented sustainability solutions.

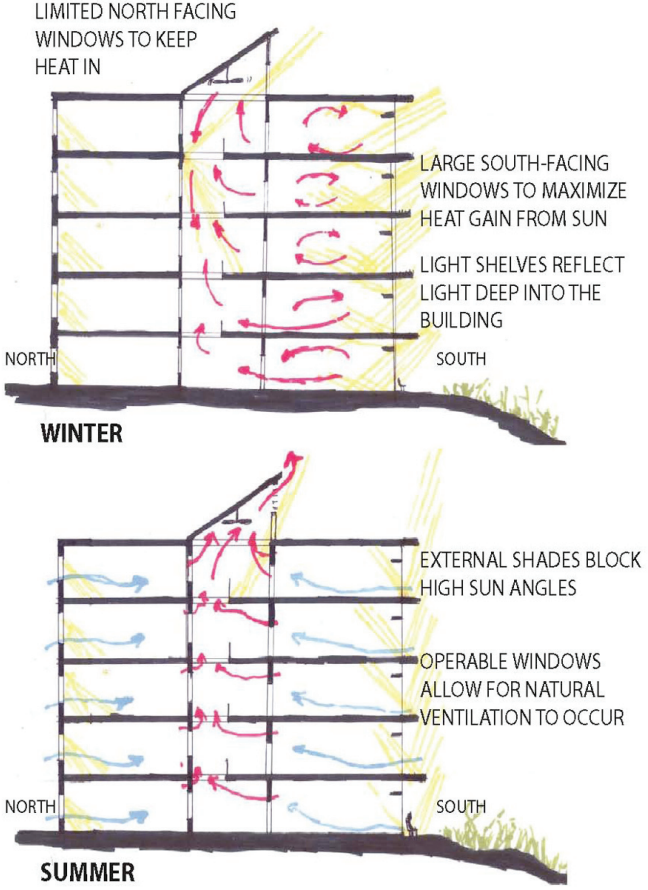
Factor 4 Key Conclusions 4

Nature and natural features at BCIT are valued and appreciated.

- Guichon Creek is a treasured natural system on campus that needs to be cared for and restored as much as possible.
- Guichon Creek is not only an important water system but serves additionally as an important natural design feature in an otherwise rather gray and hardscaped campus environment.
- More greenery, more parks and better placed green spaces will not only help BCIT become a healthier environment overall but will make the campus environment more livable.
- BCIT has the potential to offer stunning views to the bioregion and should not lose the opportunity to create view corridors and rooftop gathering places that provide access to views and nature.
- The campus has a variety of possible natural amenities that could also provide added energy inputs to campus facilities and should be explored in more detail, including potential for geothermal-geoexchange, solar, and biomass.

Student Strategies

Passive strategies incorporated in new and old buildings to take advantage of free heating, cooling, and lighting



Daniel King

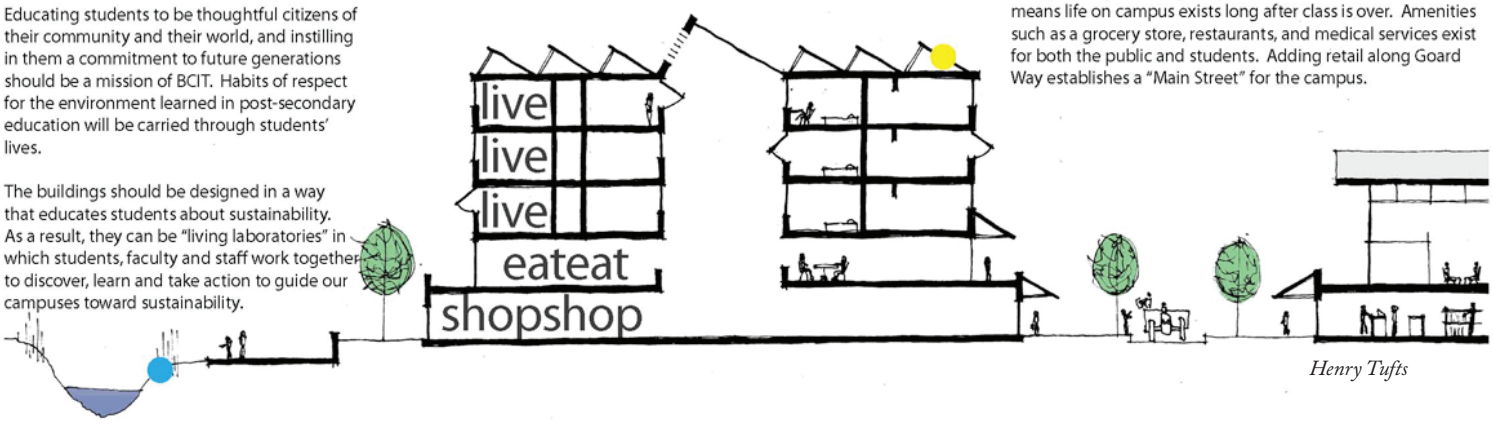
Mixed Use Building Section

GREEN DESIGN

Educating students to be thoughtful citizens of their community and their world, and instilling in them a commitment to future generations should be a mission of BCIT. Habits of respect for the environment learned in post-secondary education will be carried through students' lives.

The buildings should be designed in a way that educates students about sustainability. As a result, they can be "living laboratories" in which students, faculty and staff work together to discover, learn and take action to guide our campuses toward sustainability.

MIXED USE COMPLEX



Incorporating dorm-style style residences within the core means life on campus exists long after class is over. Amenities such as a grocery store, restaurants, and medical services exist for both the public and students. Adding retail along Goard Way establishes a "Main Street" for the campus.

Henry Tufts

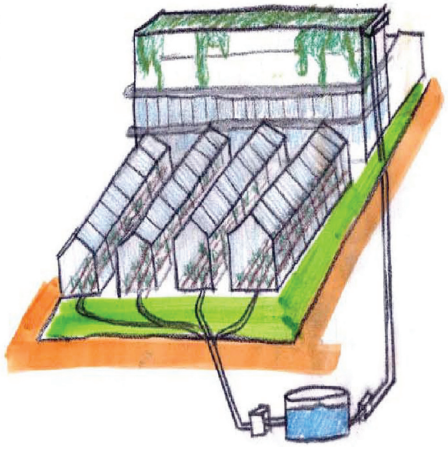
Denser Campus/More Open Space

Over 75% of parking eliminated, campus and green space restored

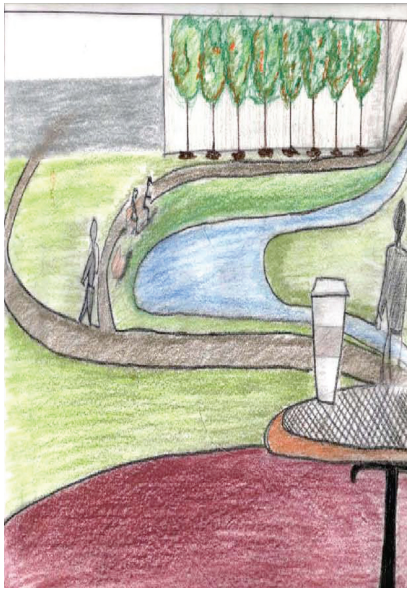
Mark Grimsrud

Factor 4 Design Elements

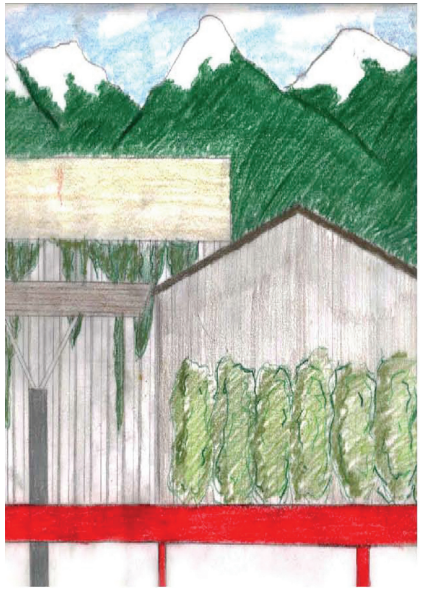
View heading into the new Health Sciences building courtyard. This area provides a very social friendly area where students can study in the sun or take shelter under large covered walkways.



This rain water collection and distribution system collects the rain water from the roofs of the new school of transportation buildings, filters and stores the water before using it to irrigate the on campus food production program.



This covered throughway/patio is an ideal place for students to take cover and still enjoy campus greenery and the flowing water of daylit Guichon Creek.

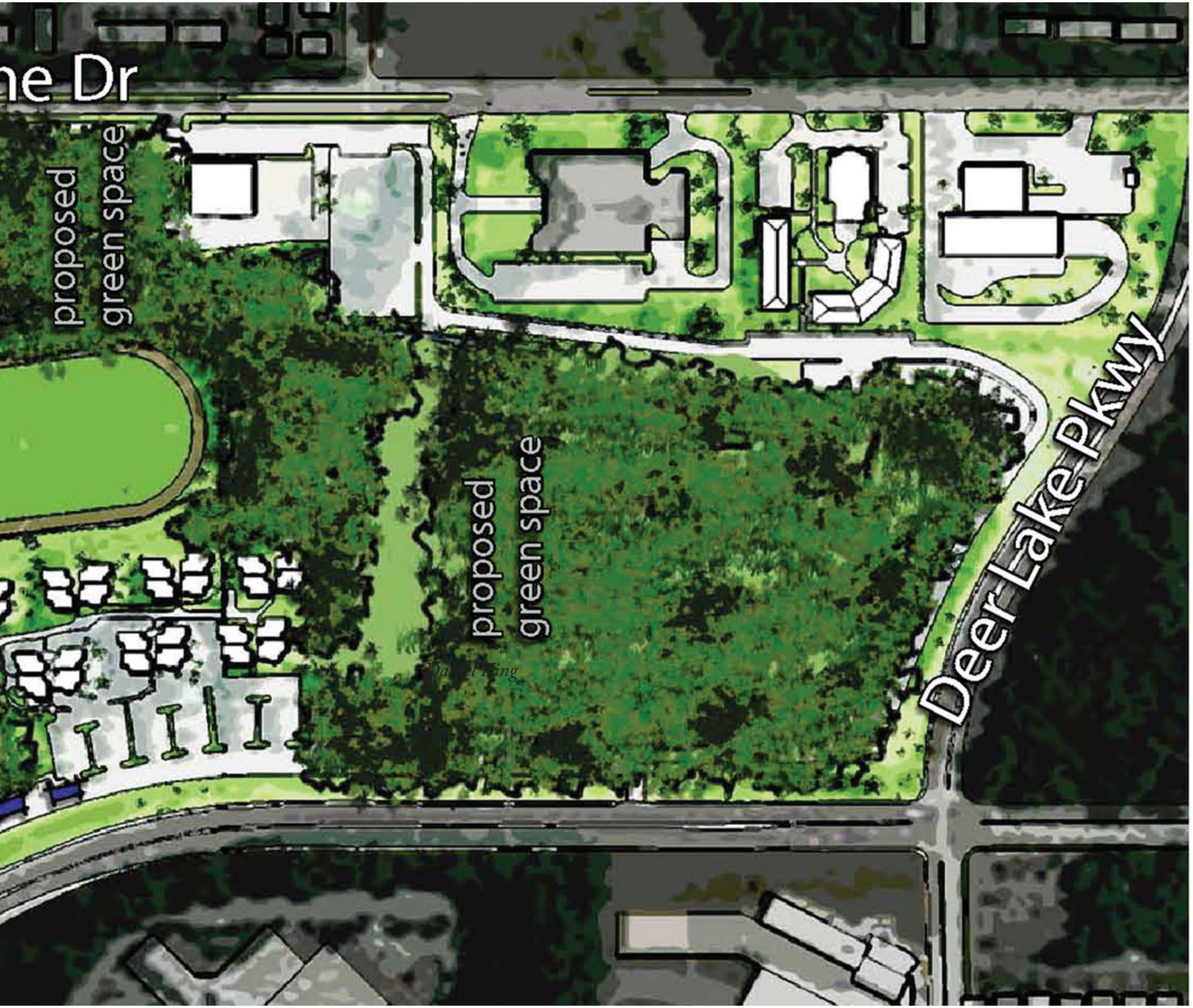


The roof of this schol of transportation building will have a food outift featuring "grown on campus foods." The rooftop eating area has a great view of the North Shore Mountains.

The new campus square features a large covered outdoor space. The slant of this structure faces south optimizing sunlight exposure to the PV panels on its roof.

Illustrations by Taylor Shaak

Example of a Factor 4 Masterplan


ne Dr
proposed green space
proposed green space
Deer Lake Pkwy

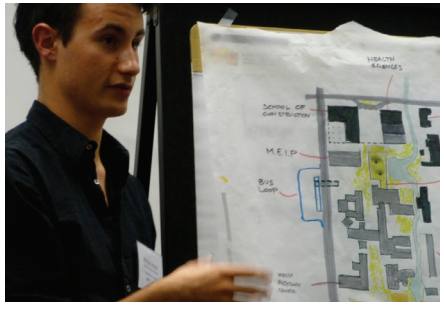
Daniel King

FACTOR 10

What the Science is Saying We Need to Aim For

BCIT Sustainability Goals:

- Greenhouse Gas Neutral
- Net Energy Producer
- Zero Waste
- Water Balanced
- Ecologically Restored
- Equitable and Socially Responsible
- Accessible to All Students and Faculty



Design Charrette: Day 3

The final inquiry, "Factor 10", was both challenging and inspiring. Moving boldly beyond "Factor 4", students and charrette participants had to let go of previous assumptions and self imposed limits in order to conceptualize what a 90% reduction of energy and materials use for the Sustainability Precinct and campus would look like. Ideas and solutions that might have not been put on the table because they were previously deemed politically impractical or "too radical" were now fair game. As in the Factor 4 scenarios, land use and prioritization was key in laying a foundation that would support low footprint usage while maintaining quality of education and services — while also accommodating growth. The high footprint sectors— transportation, energy, and waste— had to be aggressively dealt with or there would be no possibility of getting to a Factor 10 situation.

In most Factor 10 schemes, cars were completely eliminated and land uses shifted towards high density, compact environments that were walkable and extremely accessible. Shrinking the physical building footprints corresponded to lowering the ecological footprint as well, because in closer proximity, massing of buildings would help conserve energy and heat, and less energy is needed for transport. In the higher density designs, ecocity features came into more prominence, such as rooftop cafes and gardens, living walls, bridges between buildings, buildings that are bridges, terraces, courtyards and other more intimate human scale design features.

A general consensus emerged to encourage the densification of the north part of the campus (including the identified Sustainability Precinct). As parts of the campus increased in density and intensity of uses others were "de-developed". In many of the design solutions, land currently covered in concrete, asphalt and low-density buildings were converted to open up space for urban agriculture, energy cultivation, natural habitat, waterways and recreational areas. The Sustainability Precinct took on characteristics of an urban village, with more fine-grained mixing of uses. Living, learning, working and recreation were all within walking distances, and a significant portion of the campus meals were grown in greenhouses and in kitchen gardens on the grounds.

Because Factor 10 buildings were strategically oriented towards sun angles and geared to best adapt to local weather conditions as well as taking advantage of proximity to each other, the overall need for heating and cooling could be brought to very low levels. For several groups, electricity was still assumed to be mostly grid delivered hydro power, but in some scenarios all energy for the Precinct and campus was eventually generated on site through co-generation, geo-exchange, solar, biomass and various combinations of all four.

In the Factor 10 scenario, behaviors and habits of students, faculty and staff are significantly different. The concept of "lean" living is employed, which does not mean harsh, but does imply consciousness and frugality. For example, whereas currently "turning up the heat" is a solution to "getting rid of a chill," in the Factor 10 lifestyle, putting on a sweater is the answer to the problem. Likewise, the wind on campus might not be strong enough to generate electricity, but it does adequately dry laundry, and in the Factor 10 environment, electric and gas dryers are

not used. When things break, when clothes tear or are worn out, care is made to repair them if possible for reuse, or for recycling into other forms of useful products. Small commercial ventures providing these services can become part of the diverse mix of uses in the Factor 10 campus plan. Possessions are fewer, but the opportunity for personal interaction is increased, as is access to nature and open space.

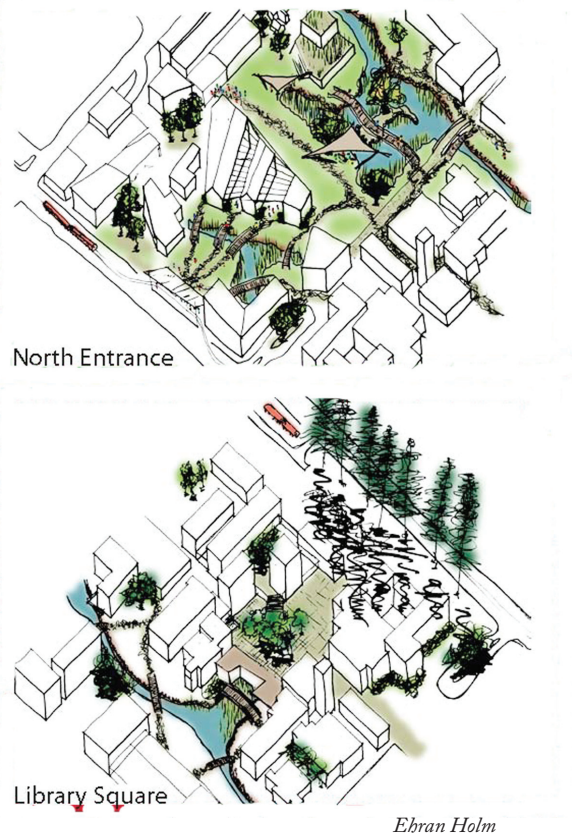
Ultimately, Factor 10 takes us from the place we are now and transports us to a future that would ultimately not take more from living systems that can be regenerated, and would work to restore, rather than destroy, the environment. The journey from business-as-usual at BCIT to Factor 4 and 10 was one that will likely be long remembered by all charrette participants. The exercise sparked a hopeful sense that the necessary changes towards true sustainability are in fact doable and ultimately practical. Following upon this report, BCIT now has some well-conceived ideas for how to move forward towards their sustainability goals. Ideally, some significant progress can be made within the first year after the charrette in order to maintain the positive energy and momentum generated. It is worth noting that at the end of the charrette, it was posed to the participants whether or not they would want to attend a Factor 10 BCIT.

Almost everyone raised their hands to signal that they indeed would. ■

Factor 10 Key Conclusion 1

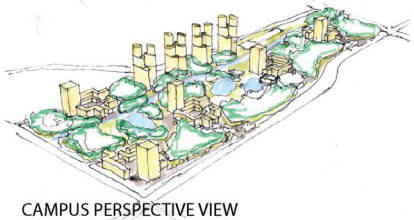
Factor 10 cannot occur without significant land use and construction materials changes.

- Nearly all students, faulty, staff and their families would need to live in campus housing or within walking distance of campus in order for the required reductions in transportation to be effective.
- To lower energy and materials requirements for the long term, buildings would need to be high density clusters of mixed uses, allowing the sharing of heat and mass, walls and flexible spaces.
- Surfaces now paved for cars would be transformed into more sustainable uses or "depaved" so that water falling on top of it could seep back into the soil.
- Some buildings would need to be removed in order to return space for more agriculture and cultivation of resources and raw materials.
- Low embodied energy building materials or very long term amortization of well-protected strong materials for higher density structure to serve many more people through time.

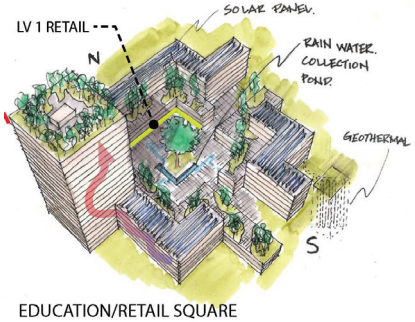


Ehran Holm

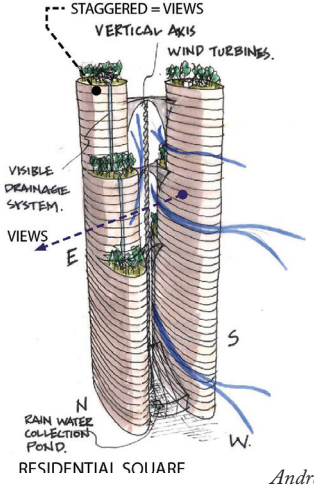
ELEVATION VIEWING EAST



CAMPUS PERSPECTIVE VIEW

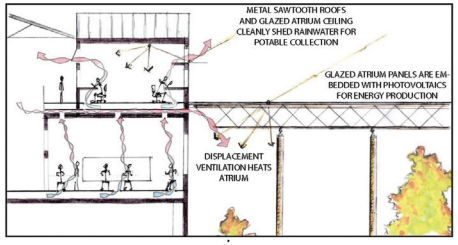


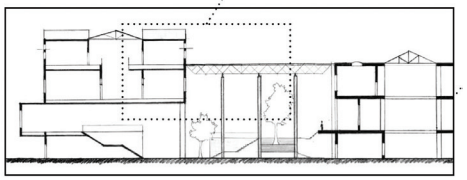
EDUCATION/RETAIL SQUARE

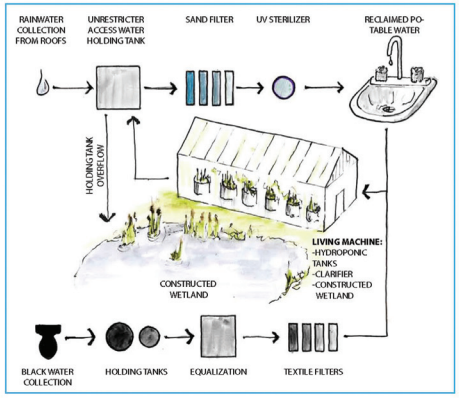


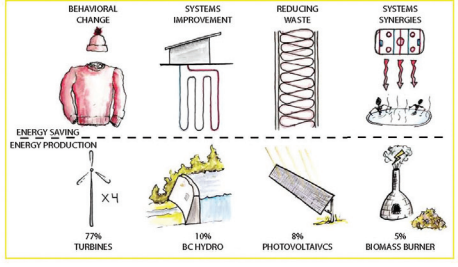
RESIDENTIAL SQUARE

Andrew Hsu









Dan Guenter

Factor 10 Key Conclusions 2

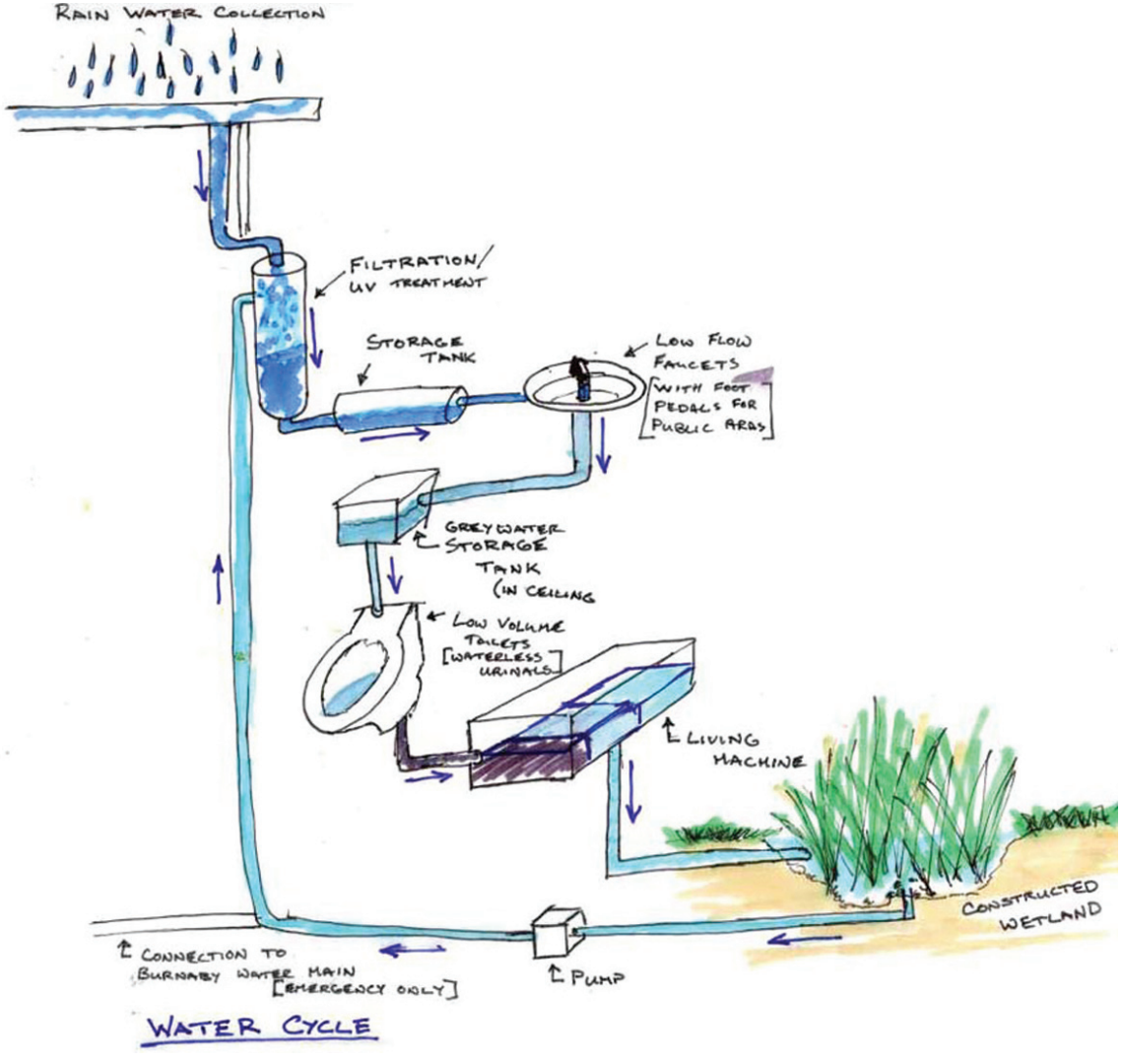
A regional sourcing for food, energy, and materials is necessary

- The campus would need to grow as much food as possible on site; the reminder would need to be sourced within the local food-shed.
- Building materials would need to be sourced locally or regionally and/or recycled from other structures.
- Fossil fuels would need to be phased out and replace with clean and renewable sources including hydropower, geo-exchange, solar and some biomass from the woodlot on campus.

Factor 10 Key Conclusions 3

Behaviors and habits would necessarily change dramatically in a Factor 10 environment

- A culture of "frugality" and "thrift" would need to replace the throw away and impulsive lifestyles currently thought of as "normal" for North Americans.
- Nothing would be wasted in a Factor 10 situation.
- Everything would become more local, including entertainment, relationships, business, work and learning.



Doug Turner

Factor X Key Conclusions 4

A bold plan, leadership and serious investment are needed.

- Piecemeal and easy solutions will never add up to the Factor 10 changes that science is saying is necessary, therefore we must plan boldly and lead the way.
- One of the key issues blocking meaningful and timely progress towards true sustainability is lack of long range planning, so setting the sites of Factor 10 today will make all the difference tomorrow.
- Students can and should be part of the solution, but they need to be given permission to "think outside the box" otherwise they don't feel confident to strive towards the visionary and creative solutions that we need them to aim for.
- Employees come and go, but if a plan and a vision is strong it will outlast its creators and continue, therefore in order for BCIT to actually achieve its sustainability goals it will need a very compelling vision with a detailed plan in place.
- Stingy investing will never suffice for major change, including in grants and contracts from government and philanthropy. More planning and higher investment for long life of buildings, grounds and technological systems to be amortized over long periods of time and many users is needed.

MASTER PLAN AND RECOMMENDATIONS FROM ECOCITY BUILDERS

Perspective view of Guichon Creek Plaza: *This view of the daylighted portion of Guichon Creek from the third floor roof garden of the proposed Health Sciences building highlights the keyhole plaza that links restored natural habitat with campus activities and retail and commercial links to the residential neighborhood to the east. Also visible are the renovated NE.1 to the left, rainwater storage tanks at the center of the image, pedestrian bridges linking student housing to academic buildings both at grade and at the roof garden level, as well as new buildings and additions to NE.1 that will provide "living laboratory" opportunities for BCIT's Center for Architectural Ecology*

The BCIT Sustainability Precinct was in itself an exercise designed to lead toward a new synthesis of design fitting for the coming realities of a world in need of recovery, recovery from dangerous over-consumption and short-sighted design of the largest thing human beings create: the built environment of cities, towns and villages. That we've gone too far is evident in global heating, continued extinctions of natural species and rapid draw down not only of fossil fuels and famously degraded soils and water, but also of ever more scarce metal and mineral ores of decreasing purity requiring ever more energy to make available to human uses. This is a world situation crying out for local solutions – of the sort that the BCIT Sustainability Precinct could well exemplify at a critical time. More than that, could use to take world leadership.

That we need to deal with the arrangement of our constructed home in sensitive relation to our home that is our planet Earth and our bioregions is becoming ever more evident. Furthermore, after the United Nations Climate Change Conference in Copenhagen the situation continues typical of the earlier conferences in the series: none have dealt with the built environment and if you don't deal with the largest creation of the species one might wonder how we might solve this largest of looming problems called climate change.

Further, from the experience of charrette leaders from Ecocity Builders and its eight International Ecocity Conferences now having been held on all continents, we can see that Vancouver and BCIT have a powerful opportunity to take the world urban sustainability lead. We can report from experiences abroad speaking in, together, 30 countries, that the one time leader in the ecocity field, Curitiba, Brazil has been coasting on its laurels for almost 20 years now with few if any recent innovations and advances, that Frieburg, Germany with many of the best innovations is very small and in a rich and stable population country and not facing the large city needs common around the

rapidly urbanizing world. Dongtan, China, designed with great fanfare by the giant British engineering firm Arup was aborted without explanation by its Chinese government-invested developer, the Shanghai International Investment Company, just as it was about to be launched two years ago. Tianjin Ecocity, just in from the coast directly east from Beijing that was presented at the Eighth International Ecocity Conference in Istanbul in December, is in early stages of construction but reported a target of only 20% renewable energy when complete. Such a low commitment to energy sustainability shocked most of the delegates enough to declare they didn't believe the project should be considered a candidate for an ecocity designation at all.

What is equally evident is this: there is nowhere that all the pieces of the ecocity, even in small scale, come together in a full spectrum project. That could happen with the Sustain-

1. Masterplan Goals Established during the Charrette
(Factor 10 Reduction)

- Accommodate required growth while housing 75 % of faculty and students on campus
- Foster master-planned connection to residential neighborhood to the east of campus.
- Improved economic vitality
- Opportunities for student and faculty housing
- Reduced commute distances
- Take full advantage of the natural assets of the campus (Guichon Creek, woodland preserve)
- Revive nature in the city
- Consider within networks of potential wildlife corridors in the region.
- Food production
- Guichon Creek as restored habitat, campus circulation, and public space amenity.
- Work with City of Burnaby to re-zone area bounded by Canada Way, Wayburne Drive, and Carey Avenue as mid-rise market rate and affordable housing with mixed uses, retail, cultural and institutional buildings (Ecocity fractal as model).

Perspective View of Campus Entry: *This view of the campus core, looking northeast illustrates a newly established "heart of campus" plaza linking the sustainability precinct with the current central campus. A photovoltaic canopy marks the campus entry and provides rain cover for student gatherings. Bus drop-off is brought deep into the campus, at-grade transitions to inhabited roof gardens radiate out from the plaza to the north and east, lined with open, flexible structures for student organizations and activities.*

ability Precinct Project at BCIT. There could be designed and built there an ecocity "fractal," buildable because of smaller scale of investment long before whole ecocities can be built. Also, Vancouver has an "EcoDensity" program promoting many of the more important features of urban sustainability and has already constructed many buildings with terracing, rooftop gardens and trees and in arrangements to celebrate views of its local mountains, bays and ocean in a high density, mixed use format. The ecocity mapping that guided the charrette is also a first in that it systematizes not just added density and diversity of uses where these should go but also where ill-advised development – often automobile-oriented – should be removed. In the Great Downturn, by whatever name eventually sticks, cities like Flint, Michigan and Cleveland, Ohio parts of their suburbs are being deserted and going back to nature and farming while centers are being developed in a direction moving slowly away from car-dependence. But whereas the process is happening relatively chaotically and seen as making the best of a bad situation – making lemonade out of lemons – the ecocity mapping that informed the thinking in shifting infrastructure in the BCIT Sustainability Precinct Charrette can be seen as heading toward a genuine ideal, a conception of excellent and sustainable development patterns that open up landscapes while at the same time strengthening centers of increased vitality. This should well constitute a major leadership step, if we can take further steps.

Section Perspective of Sustainability Precinct "Main Street": *Looking east along the new pedestrian street created between the renovated NE.1 (to the left) and new buildings for the Center for Architectural Ecology (to the right), this view emphasizes street level shop spaces where students and faculty will be encouraged to develop projects, fostering an energetic street life that builds upon BCIT's culture of making. Daylighted Guichon Creek is seen in the middle distance, with the keyhole plaza providing retail and cultural amenities for the adjacent residential neighborhood. New faculty offices top NE.1, opening off a roof garden and creating a green pedestrian arcade along the street.*

Highlights

The spirit of the event was perhaps the most striking highlight, the enthusiasm for exploring truly significant new thinking about a whole system that could be a large fraction of an entire campus of advanced learning. But in terms of thinking through the details, the careful differentiation of short and longer term goals in the context of such larger patterns as very high degree of mixed uses and balanced development, seen largely in the emphasis on getting more people living in and near campus, was also an unusual and leading approach.

That is, we need major land use changes and strong ecocity architectural features intentionally pursued and not postponed while easier sustainability steps are taken, such as replacing light bulbs and recycling more thoroughly. Another highlight was the focus on the "integral project" or "ecocity fractal project" in which all essential major components are present in a design – and it can be easily seen that they are. We need the model of such a whole system and the understanding that it is a model exploring a healthy future. From sun angles and views that make sense for energy conservation and that express the importance of nature to pedestrian bridges and the presence of elements of nature in the public realm such as the creek flowing through, such a complete design actually built would be an international first, the first truly complete piece of an ecocity.

2. BCIT Masterplan Organization Strategies

- Increase built density while maximizing solar access for both building interiors and exterior spaces
- Foster connection between grade level campus access and circulation (public transit, bicycles, pedestrian) with inhabitable upper levels.
- Build upon primacy of current "campus heart". Improve usability, diversity of uses, vitality. Bring busses into heart of campus.
- Build upon existing east-west grain of access and circulation. Transform to bands of built and open spaces, with pedestrian and bicycle circulation and limited service and emergency vehicle access.
- Increase campus density and built floor area through staged shift to maximum density along Canada Way and Willingdon in the northwest campus. (Benefits: depaving of the south campus for agricultural research, food production, habitat restoration.
- This densified campus core fits well the roughly 0.5 kilometer recommended breadth of an ecocity vitality center.
- Daylight and restore Guichon Creek
- Locate mid-rise student housing along Carey Avenue / Wayburne Drive
- Mixed-use pedestal or terrace level provides neighborhood retail, genuine live-work.
- Transform Carey Avenue to narrow, vital, high-density pedestrian corridor at interface between campus and community (antidote to Willingdon)

Recommendations

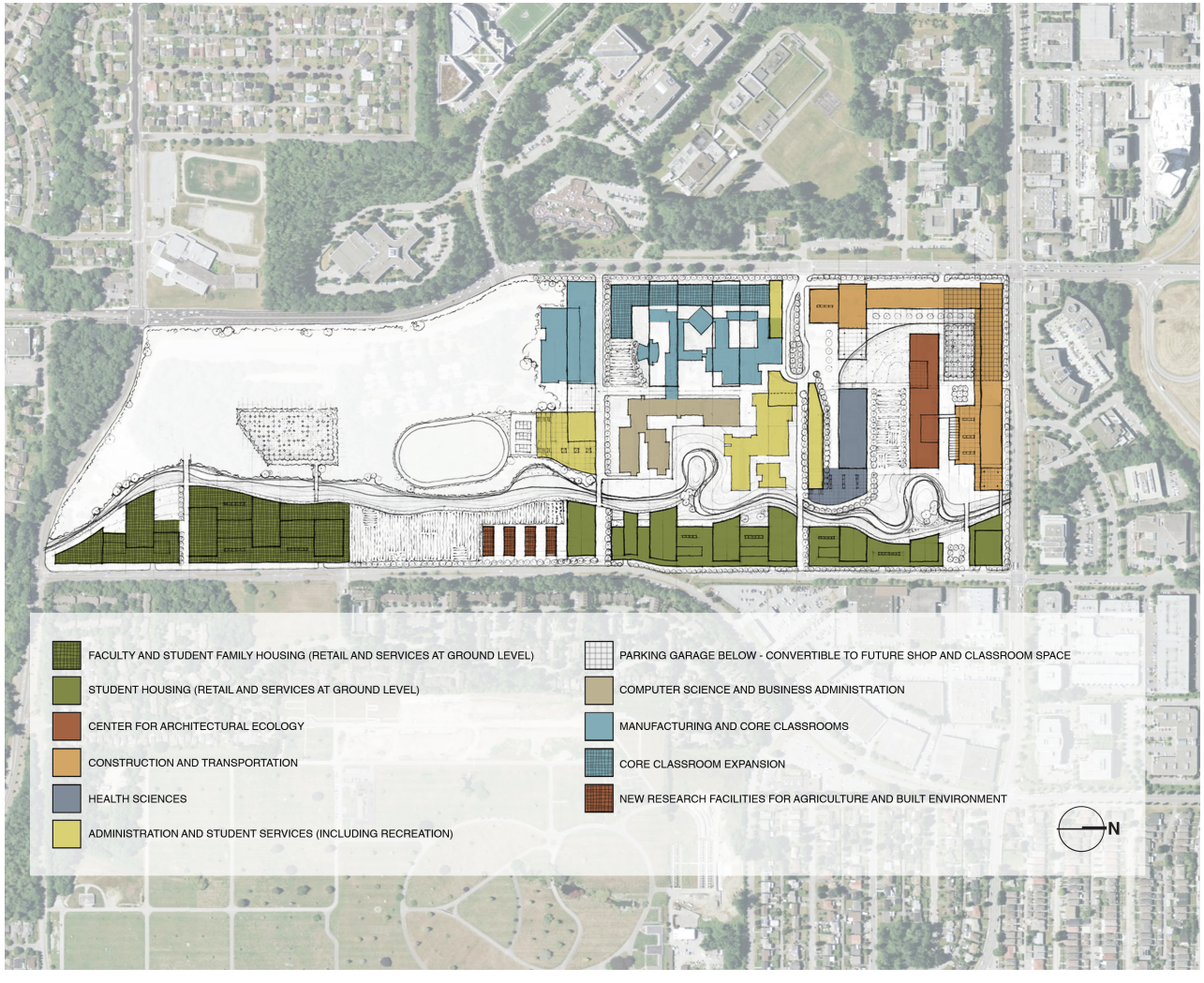
The organization leading the charrette has a couple recommendations that rise above the others in importance. First, commitment needed – at last. Ecocity pioneer Paolo Soleri, whose contribution was described in Richard Register's introduction slide presentation at the charrette, has pointed out that, despite having basic principles for ecocities well worked out, there has been interest but not commitment. The time has to be now or never for commitment, given the stakes raised by climate change and the other crises gathering together today and compounding their destructive impacts. Commitment means investing money and personal energy from any sources available. There has to be a consciousness flowing out of projects such as the BCIT Sustainability Precinct that serious investment is needed for this crucial high leverage approach. Money should cease subsidizing highways and sprawl development and be shifted to very vigorous support for moving projects like the Sustainability Precinct forward and to it specifically for the unique advances it offers. That's an educational component of the project aimed at fast tracking while we may still have time.

Further charrettes or development of the basic ideas from Charrette Number One need to be developed into a best solution design that comes out of the process refining the ideas reflected in this booklet. That could be done by setting up the ongoing committee, perhaps called a task force or perhaps an implementation organization as suggested earlier in this report and deciding soon if another more in-depth design event is needed soon or who to actually fund raise for and hire as an architect planner, as soon as possible. Whether we have time to go the route of a student competition, Ecocity Builders doubts. Perhaps a competition for more experienced architects and planners with openings for extraordinary student contribution would be good, but the committee, task force or on-going organization might actually be constituted that could actually write the program for an architect's design very soon. Ecocity Builders, of course would want to participate in that on-going process including selection of eventual project designer charged with carefully considering the points presented here in this report. Other members would include the conveners of the charrette and Vancouver regional sustainability and development leaders.

Among the specific details we recommend are those that were offered in the charrette and recounted here in this booklet – high density, mixed uses, creek restoration and so on in considerable detail. But perhaps one step that should be emphasized in closing: education of both students and public about the project itself. That could proceed through promulgation of this small book, exhibits at the library, outreach of the on-going committee to publicize the solutions herein and explanations why the approach is important and how people may participate in the unfolding process in supportive roles. A full on effort at public education and seeking debate in regional media around British Columbia should happen – another reason for a standing and growing committee to further the Sustainability District project at BCIT. We need coordination of objectives and strategy at a core somewhere. The knowledge of crucial current events – and opportunity for ecocity development opportunity.

It's important. ■

Schools, Departments, Potential Building Uses
Including Future Expansion



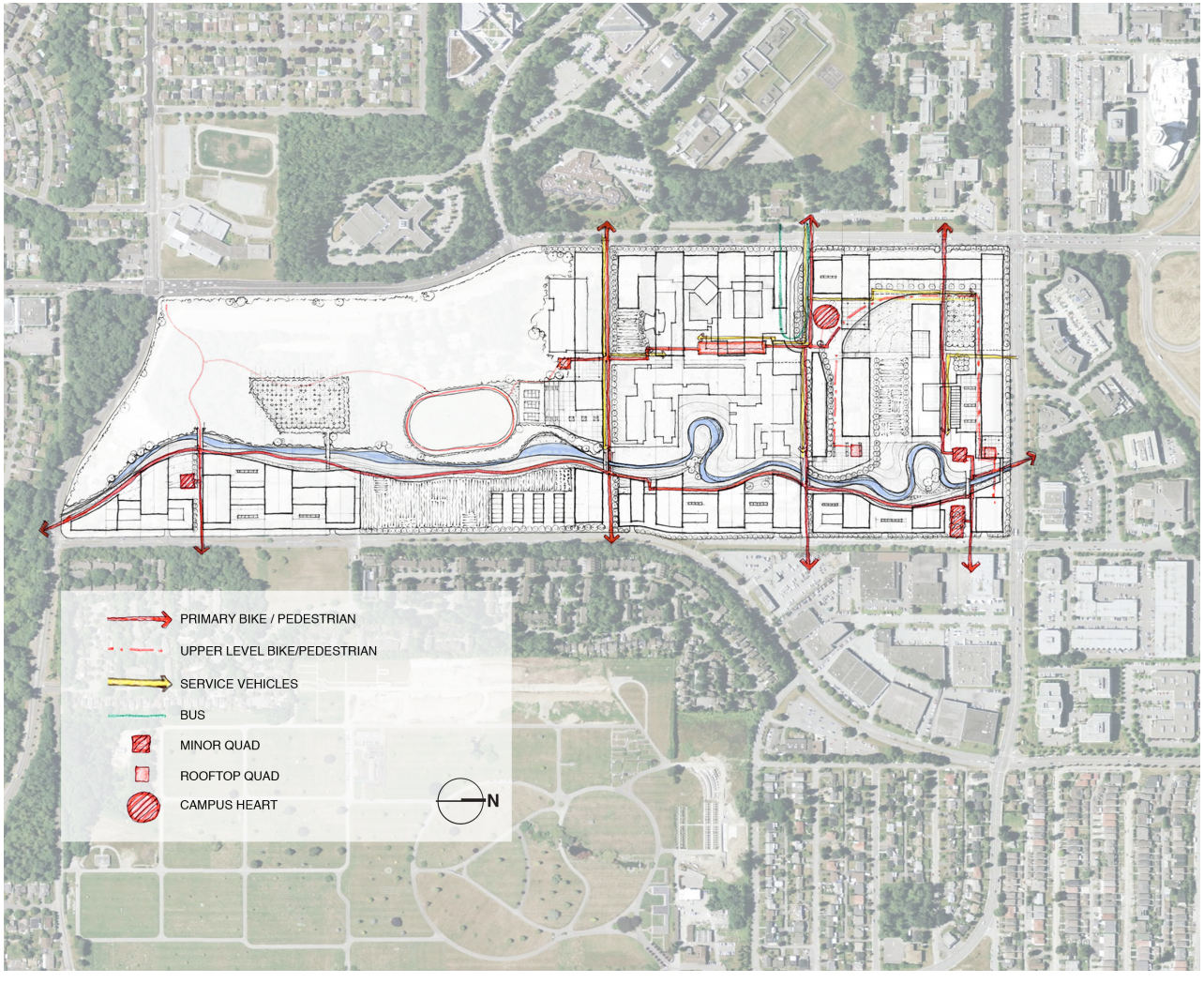
Key findings from the charrette include the importance of developing student and faculty housing in the band between Guichon Creek and Wayburne Drive. This will reinforce connections to the adjacent neighborhood, support retail and services in the proposed Eastside rezoned area, and maximize enjoyment of the creek corridor for residents. Long term planning of the Sustainability Precinct should present the best possible face for BCIT to the major Willingdon/Canada Way intersection, while creating a sense of sanctuary and community within. We recommend shops, labs and studios for the schools of Construction and transportation be placed along Willingdon, Transparently showcasing BCIT's hands-on approach to learning and research.

NE-1 should be extensively retro-fitted in the first phase of work as a flagship green project, and integrated into future expansion and densification of the Sustainability Precinct, while new flagship facilities for Health Sciences and the Center for Architectural Ecology flank a central community garden/green.

Current discussions have included a large parking garage at the corner of Willingdon and Canada Way. Such a structure could be integrated into the campus as a base level for future buildings. It could perhaps also be designed to facilitate future transformation to other programs, as automobile use is phased out on the campus.

Transformations and new construction in the central campus will be more incremental. Emphasis should be placed on co-generation and bio-fuel upgrades to the existing central heating plant and underground utility network, increased density and institutional presence along Willingdon, and careful placement of future structures to preserve solar access, pedestrian circulation, and a thriving creek habitat.

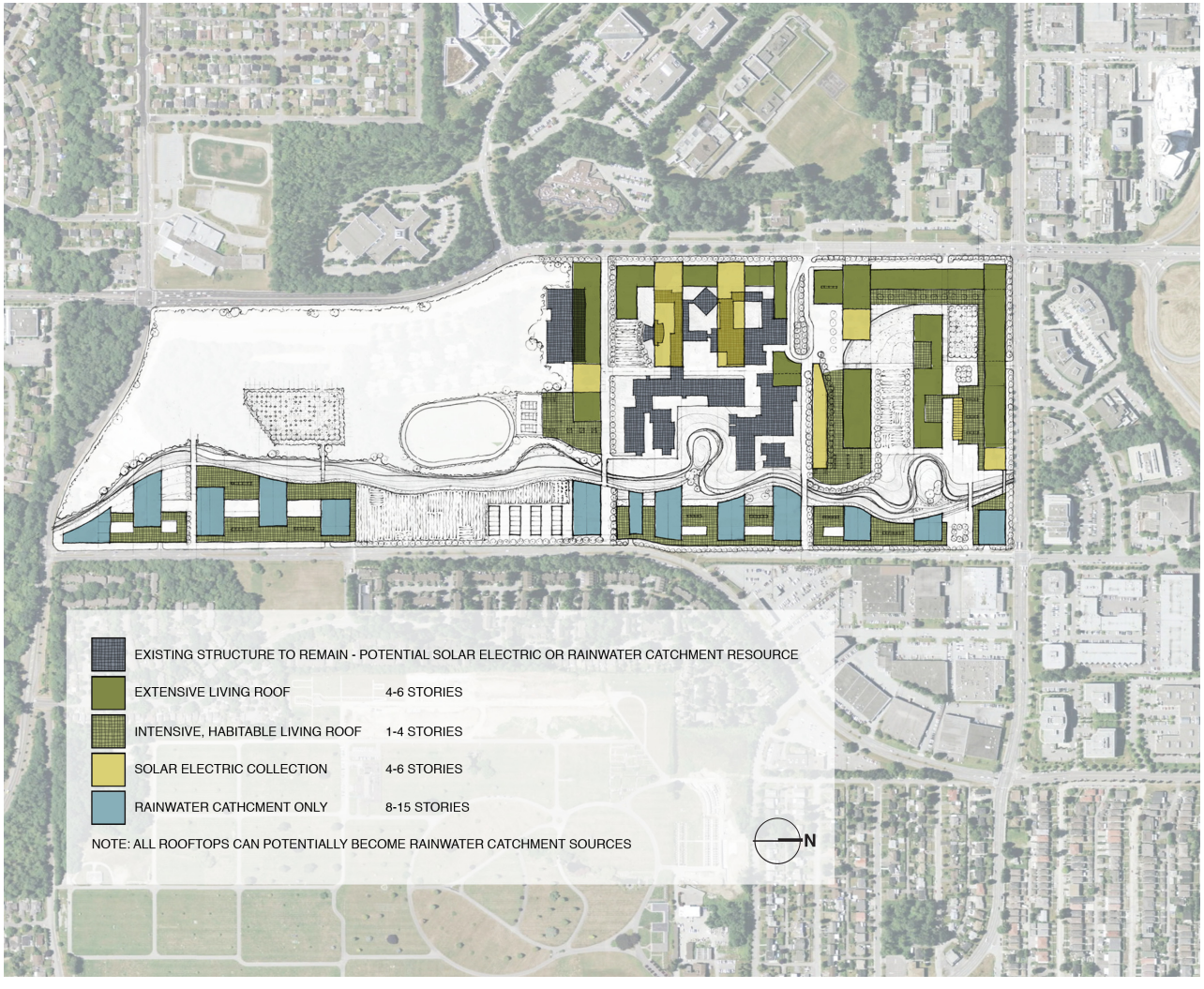
Site Circulation and Public Spaces



Future campus planning should take advantage of Guichon Creek as the primary north-south circulation. This will allow for more efficient and enjoyable north-south movement and will weave the restored creek habitat into the day-to-day experience of students and faculty. Primary east-west circulation should build on existing patterns, with emphasis placed on service access and pedestrian connections to the rezoned Eastside neighborhood. The current campus heart should shift slightly north, to the point where the Sustainability Precinct, central campus, and bus loop can be most effectively woven together. We also recommend Guichon Creek Plaza be developed where Guichon Creek passes near NE-1. This quad could include a mix of retail uses and services to draw pedestrian traffic from both the campus and the rezoned Eastside neighborhood.

Finally, we propose that ground level site circulation be brought up onto building roof terraces at several strategic locations. Taking advantage of the campus' gentle slope, two primary recommended points for roof access originate at the new campus heart, inviting campus life and activity to rooftop quads on the new Health Sciences and Construction buildings, where views of mountains to the north can be enjoyed.

Rooftop Resource Allocation
For New and Existing Buildings



The campus of the future must take full advantage of its rooftop resource. BCIT has been an innovator in this area with its living roof and wall research. The development of the Sustainability Precinct presents an unprecedented opportunity to further this research in a living laboratory.

To reach a Factor 10 reduction of the campus ecological footprint, we recommend that new buildings be planned at high density, with intensive, habitable living roofs at heights of up to 4 stories, and extensive living roofs on taller buildings. The Factor 10 campus plan also recommends locations for solar electric generation based on criteria of visibility, ease of maintenance, relative lightweight and potential transparency. All roofs can also be used for rainwater collection, including roofs of the tallest housing towers.

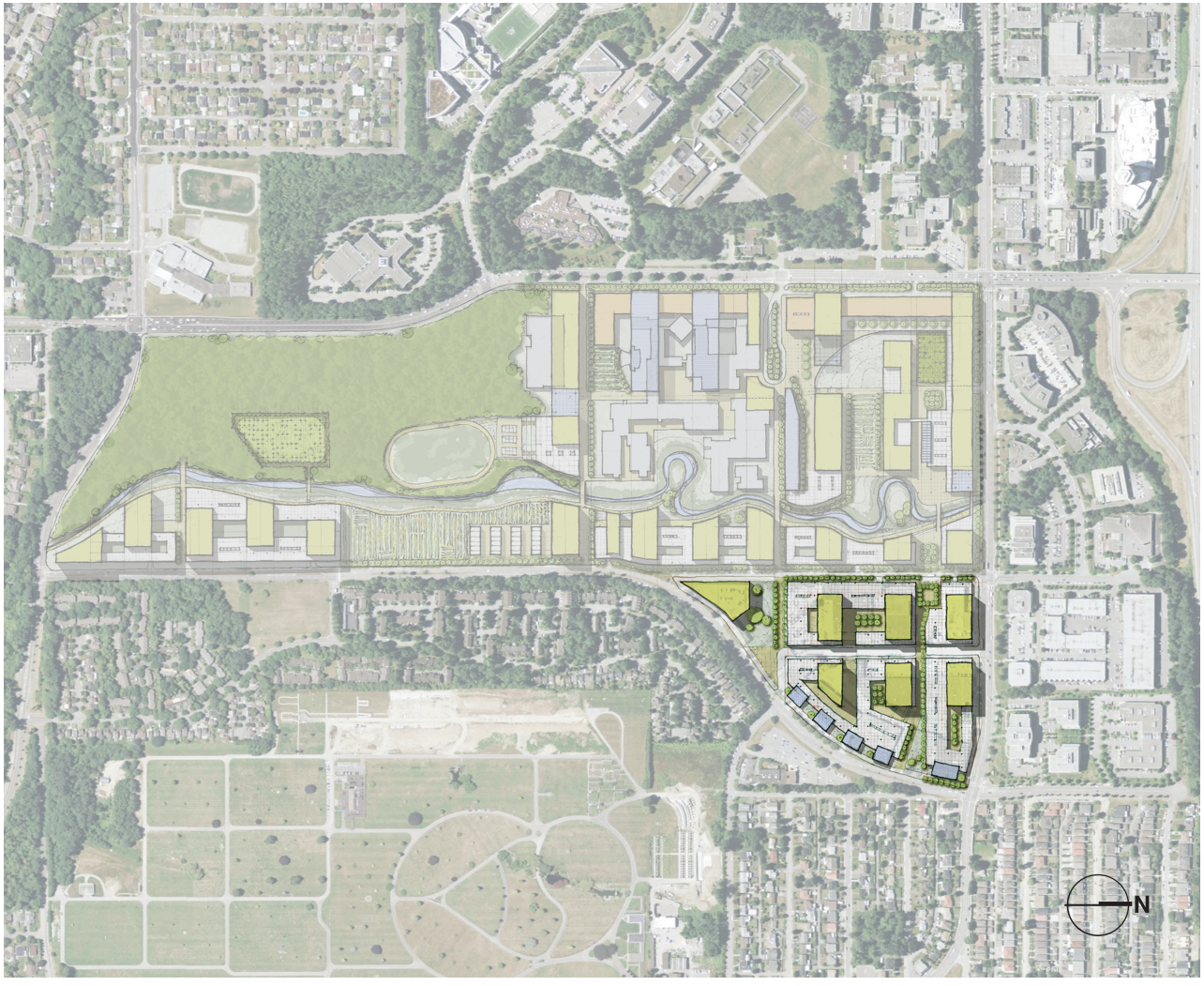
Green Space Distribution and Uses

Nature should be strategically restored and intricately woven through the fabric of the Factor 10 campus plan. We recommend that lands south of the campus core and west of Guichon Creek be encouraged to return to their prior forested state. This strategy will increase wildlife habitat, sequester increased amounts of carbon, and potentially provide opportunities for innovative research in balancing forest management and engineered lumber technology. Along the creek itself, the riparian corridor is restored, with particular emphasis on creek bank and streambed configurations to maximize salmon and other fish habitat. These forest and creek restorations must be seen within the context of the larger cityscape and the Still Creek watershed. We encourage the BCIT community to take a comprehensive view of this restoration, beyond the bounds of the campus, and to form necessary alliances to truly weave nature back into this part of the Lower Mainland.

Based on the strong emphasis of students during the charrette, community green space and food production are central in the Factor 10 plan. Two community gardens are located to allow convenient access and a sense of ownership for faculty and students, regardless of which part of the campus they frequent. In addition a large agricultural area is set aside in what is now parking lots along Wayburne. Building on the current work of the Center for Architectural Ecology, this can potentially be an area for research on integrating food production into green architecture.

Finally, building roofs will become a useful amenity and a part of the campus green space.

Eastside Neighborhood Connection



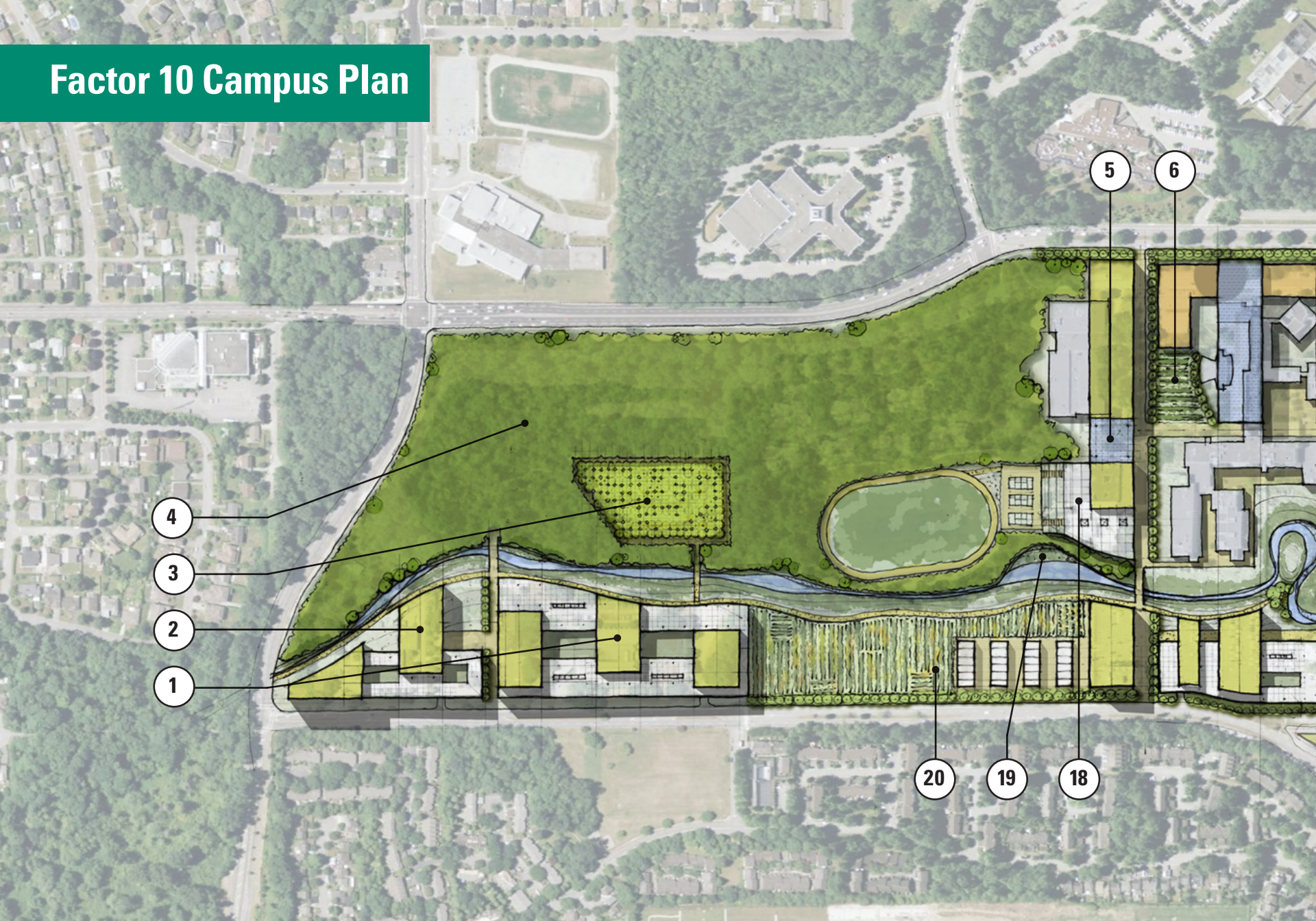
Eastside Neighborhood Connection: One of the most emphatic findings of the charrette was that in order to achieve a factor 10 reduction in ecological footprint, it is critical for the BCIT Burnaby campus to become primarily residential and for most, if not all students and faculty to walk, bike, or take transit to school.

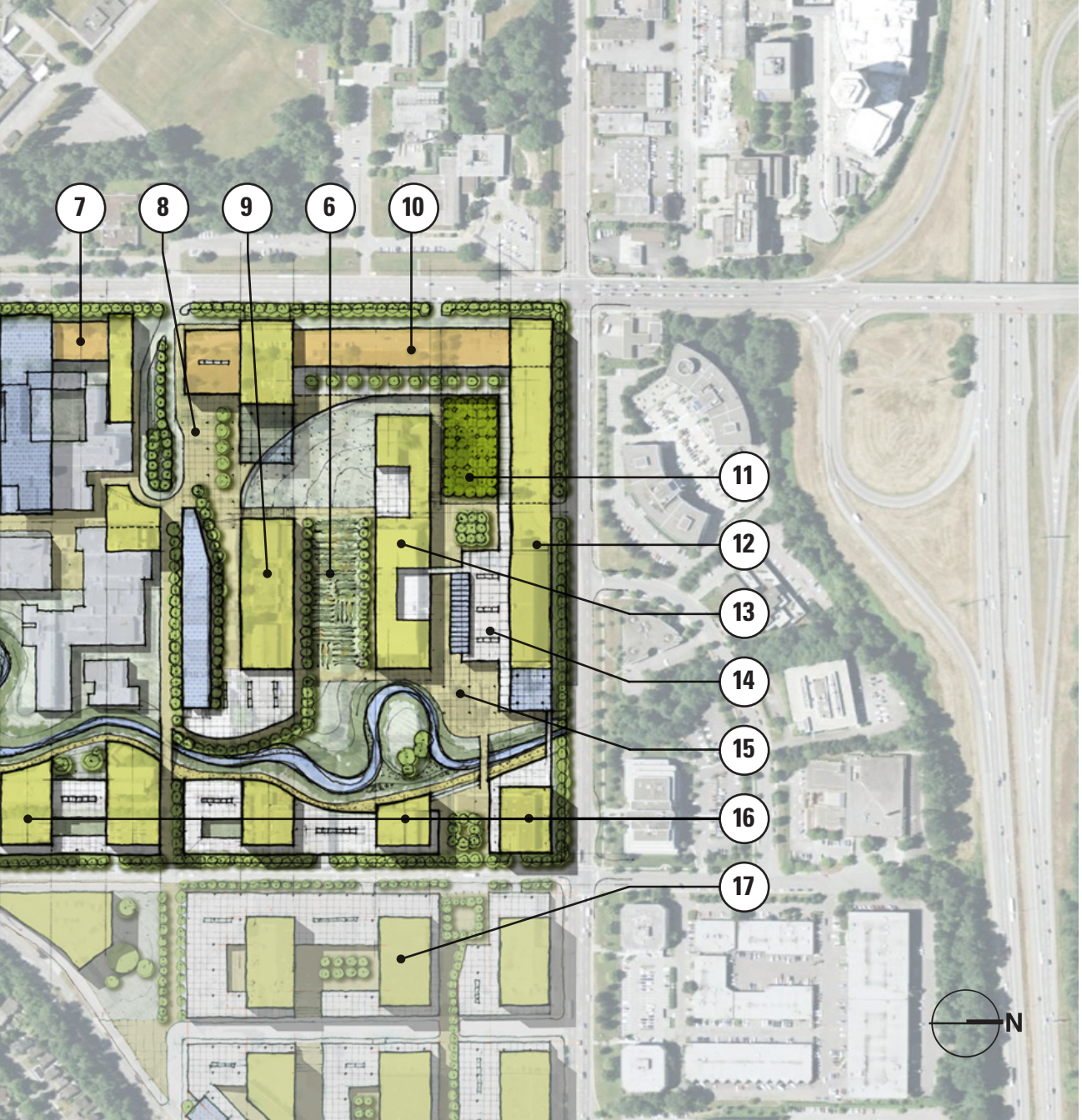
A key opportunity to accomplish this goal lies in the area of warehouses and light industry to the east of campus, just south of Canada Way. We have dubbed this area "Eastside" in the hope that the moniker will spark the imagination of the coming generation of students and campus planners in seeing this area as inherently linked to BCIT.

We propose that BCIT initiate a dialogue with Burnaby planning officials about re-zoning this area for high-density mixed-use development. Emphasis should be placed on a mix of housing to serve students and other communities, with neighborhood amenities on the lower floors that will attract pedestrians from immediately adjacent neighborhoods further east (these could include groceries, restaurants, retail shops, office space and civic amenities like branch library, post office etc). This diagram offers an initial vision of a possible form for such a development.

In this way, the new Eastside area can invigorate both the BCIT campus, and adjacent neighborhoods to the long term benefit of both and in the service of the Factor 10 goal.

Factor 10 Campus Plan





1. STUDENT FAMILY HOUSING
2. FACULTY HOUSING
3. ORCHARD OR OTHER CROP TREES
4. RESTORED AND MANAGED FOREST
5. SOUTH CAMPUS PLAZA (FOREST'S EDGE)
6. COMMUNITY GARDEN
7. CORE CLASSROOM EXPANSION
8. CAMPUS HEART
9. NEW HEALTH SCIENCES BUILDING
10. TRANSPORTATION DEPARTMENT EXPANSION
11. ROOFTOP ORCHARD
12. CONSTRUCTION DEPARTMENT EXPANSION
13. NEW CENTER FOR ARCHITECTURAL ECOLOGY
14. RENOVATED NE.1
15. GUICHON CREEK PLAZA
16. STUDENT HOUSING
17. EAST SIDE RESIDENTIAL DEVELOPMENT
18. NEW STUDENT RECREATION FACILITIES
19. RESTORED GUICHON CREEK CORRIDOR
20. AGRICULTURE / RESEARCH

ADDITIONAL RESOURCES

BUILDINGS

Lawrence Berkeley National Laboratory (LNBL),
Building Commissioning: A Golden Opportunity for
Reducing Energy Costs and Greenhouse-Gas Emissions.
http://cx.lbl.gov/cx.html
Building performance often strays from the intent at the time of design, resulting in deficiencies, such as design flaws, construction defects, malfunctioning equipment, and deferred maintenance. These lead to a host of ramifications, ranging from equipment failure, to compromised indoor air quality and comfort, to unnecessarily elevated energy use or under-performance of energy-efficiency strategies. An emerging form of quality assurance—known as "building commissioning— detect and remedy most deficiencies. LBNL maintains the world's largest database of actual commissioning projects and associated costs and energy savings.

Canada Green Building Council
www.cagbc.org
Canada Green Building Council's mission is to lead and accelerate the transformation to high-performing, healthy green buildings, homes and communities throughout Canada. The Council works to change industry standards, develop best design practices and guidelines, advocate for green buildings, and develop educational tools to support its members in implementing sustainable design and construction practices. Leadership in Energy and Environmental Design (LEED) Canada rating systems are available for new construction, commercial interiors, core and shell, existing buildings, homes and neighbourhood development. The "Resources" section of the Council's website provides a wealth of information on green building economics, building performance, and other technical and general information.

Homeowners Protection Office, British Columbia
http://www.hpo.bc.ca/Research/Projects/index.php
http://commons.bcit.ca/bsce/bsceDb.php
The Research Database is a comprehensive listing of books, reports and research articles with a focus on the design, construction, performance and maintenance of the building envelope. It also includes relevant research topics that reflect current trends in the industry such as green buildings, sustainability and durability. The HPO is involved in a wide range of building science research projects. Browse through the list of projects that are completed or underway, and download project summaries and reports.

George Brown College School of Design,
Canada Innovates: Sustainable Building, 2008
Canada Innovates: Sustainable Building is the result of a research project conducted by the School of Design at George Brown College in Toronto and includes essays on the history of sustainable design and its future directions by architects, constructors and practitioners involved in the construction of sustainable buildings. Over 50 projects are featured in detail from across Canada including institutional, residential, commercial, community planning and educational buildings. The book also contains extensive resources on sustainable design and building.

Whole Building Design Guide (WBDG),
Building Commissioning
http://www.wbdg.org/project/buildingcomm.php
The Whole Building design approach asks all members of the building stakeholder community, including the technical planning, design, and construction team to look at the project objectives, and building materials, systems, and assemblies from many different perspectives. In practice, it also requires an integrated team process, which draws from the knowledge pool of all the stakeholders across the life cycle of the project, from defining the need for a building, through planning, design, construction, building occupancy, and operations.

LANDSCAPE/SITE

Thompson, J. William, Sorvig, Kim, Sustainable
Landscape Construction: A Guide to Green Building Outdoors,
November 2000
Sustainable Landscape Construction re-evaluates the assumption that all built landscapes are environmentally sound, and offers practical, professional alternatives for more sustainable landscape construction, design, and maintenance. Packed with clear concepts and never-before-compiled resources on "green" landscape work, the book is an inspiring overview of important practices and concerns. Organized around ten key principles of sustainability, the book offers specific methods that can help accomplish those principles.

Techniques and materials of landscape construction, both alternative and conventional, are evaluated, using criteria such as energy savings or non-toxicity and renewability in manufacture. More than 100 projects from around the world are described and illustrated, proving that sustainable methods are viable today, economically, functionally, and aesthetically.

Agriculture and Agri-Food Canada National Land and Water Information Service, Plant Hardiness Zones of Canada 2000
http://nlwis-snite1.agr.gc.ca/plant00/

Bay-Friendly Landscaping and Gardening Coalition, Scorecard and Rating System
http://www.bayfriendlycoalition.com/download/bflcivic_commercial_landscape_scorecard_final.xls
Based in the San Francisco Bay Area, the Bay-Friendly Landscaping & Gardening Coalition works in partnership to reduce waste and pollution, conserve natural resources, and create vibrant landscapes and garden. The principles and practices of Bay-Friendly landscaping and gardening provide tools for home gardeners, landscape professionals, and public agencies to make informed decisions about sustainable landscaping in their communities.

Sunset Climate Zones
http://www.sunset.com/garden/climate-zones/sunset-climate-zones-pacific-northwest-00400000036321/
These zone descriptions will guide you in choosing the right plants for your landscaping needs, in the Pacific Northwest region including British Columbia.

WATER

Environment Canada, Water Efficiency and Conservation
http://www.ec.gc.ca/WATER/en/manage/effic/e_weff.htm
The quantity, quality and economic problems we face as a result of our use of water are complex but at least one of the causes of these problems is easy to manage – the way we waste water. And, the solution is straight forward – water conservation. This website outlines the way water is supplied, water infrastructure, water quality issues, and suggested solutions.

Canadian Water and Wastewater Association, Water Efficiency Experiences Database
http://www.cwwa.ca/WEED/Search_e.asp
Jointly developed by Environment Canada and the Canadian Water and Wastewater Association, the Water Efficiency Experiences Database is a repository of water conservation stories and experiences. Users are able to submit a story or search for submitted experiences by geographic location and by sector, such as residential, landscaping, infrastructure, technology, regulation, and public education.

Kansas Green Team, How to Conduct a Waste Audit
http://www.kansasgreenteams.org/how-conduct-waste-audit
A bakery generates different wastes than an automotive shop or an elementary school. It's important to know what materials make up your waste so that you can develop a plan to reduce it. Follow these steps to determine what makes up your waste, how much you are throwing away, and how much it is costing you. This website provides an example of a waste audit checklist.

University of California, Santa Cruz, Water Efficiency Survey Final Report, December 2007
http://ppc.ucsc.edu/cp/projects/9000-021/planning/WES.pdf
The Water Efficiency Survey inventoried UC Santa Cruz' existing facilities' water use and assessed operations to determine the current level of water conservation practices, and derive potential water saving projects for implementation. Implementation of the combined high priority water conservation projects is estimated to result in a 15% savings in total annual water use (approximately 112.8 million liters per year) and save approximately USD $500,000 (or CAD $538,150 in 2009 dollars) per year after all the high priority projects are completed as a result of lower water, sewer, and energy bills.

City of Tampa, Water Efficiency Checklist for Office Buildings
http://www.tampagov.net/dept_Water/information_resources/Efficiency_checklists/

These checklists will help facility managers evaluate the appropriateness of water-saving adjustments for improving the efficiency of your business. Remember, water savings often bring energy savings, too. This information is based on the results of water use evaluations of 26 industrial, commercial and institutional (ICI) facilities throughout the Tampa Bay area.

WASTE

Waste Reduction Week in Canada
http://www.wrwcanada.com/
Since 2001, Waste Reduction Week in Canada has been organized by a coalition of non-government, not-for-profit environment groups and governments from each of the 13 participating provincial and territorial jurisdictions across Canada. WRW is currently held the third week of October each year.

State University of New Jersey, Rutgers
Solid Waste Policy Group, Waste Audits
http://www.cook.rutgers.edu/~envpurchase/basics_cycle_audits.htm
Waste audits are a hands-on approach to waste reduction. Conducting a waste audit will help meet campus waste reduction goals and saving on the cost of waste disposal. The website also offers a wealth of resources including an analysis of perspectives from various waste management stakeholders, and materials best practices.

Immacutec Systems Technologies Inc.
http://www.wasteaudit.ca/waste_minimization.htm
Immacutec is a for-profit company based in Toronto, ON specializing in waste minimization through facility waste assessment and packaging audits while ensuring clients comply with all local, regional and federal legislation relating to waste reduction initiatives in Canada while adhering to the ISO 14000 standards.

University of New South Wales Facilities Management, Resource Recovery and Waste Handbook
http://www.facilities.unsw.edu.au/index.php/download_file/-/view/135
The campus handbook on waste minimization and resource recovery describes in detail the university's policies and programs, including the reuse of computers, furniture, and stationery, recycling e-waste, batteries, and paper, reducing packaging, and minimizing hazardous waste materials.

ENERGY

Washington State University Energy Program,
Energy Audit Workbook
http://www.energy.wsu.edu/documents/rem/energyaudit/audit2.pdf
This workbook offers an example of an energy audit for a university campus in the Pacific Northwest. Audit forms cover building information and characteristics, electricity, heating, and water use. Operations and maintenance auditor checklists provide guidance in ensuring performance in building envelope, HVAC, power, and ancillary systems.

University of Colorado Buff Energy Star
Program, Energy Audit Checklist
http://www.colorado.edu/facilitiesmanagement/about/conservation/documents/EnergyAuditChecklist.pdf
An example of an energy audit as part of a university campus energy conservation program, the University of Colorady Energy Audit Checklist office equipment, lighting, heating/cooling, building envelope, and water use. Easy-to-fill worksheets facilitate audits and encourage action by facility managers and other building stakeholders.

Alliance to Save Energy, Resources for Educators
http://ase.org/section/_audience/educators
Schools spend more on energy than on computers and textbooks combined. Reducing energy use is an effective way to help cash-strapped schools funnel more money into the classroom instead of the local utility. Just as important, the concept of energy efficiency provides multidisciplinary learning opportunities in math, science, and language arts. The Alliance to Save Energy offers educators a wide range of tools and resources to bring energy efficiency into the classroom to save energy while helping students build vital real-world skills.

University of New South Wales, Photovoltaic Info Point
http://www.energy.unsw.edu.au/NewsInfoLiveData.shtml
The University of New South Wales in Sydney, Australia recently installed a 42kWp photovoltaic array on one of its main buildings. To coincide with this project, a multimedia software presentation called the "Photovoltaic Info Point" has been developed. The software shows live and historical PV system performance data and explains how the system works. It also addresses other issues including the advantages of utilizing renewable energy technologies such as photovoltaics.

SUSTAINABILITY AND PLANNING

University of British Columbia Design Center for Sustainability, Sustainability by Design: A vision for a region of 4 million Province of British Columbia, Climate Action Plan, June 2008
http://www.livesmartbc.ca/government/plan.html
The Climate Action Plan is B.C.'s roadmap to a new, prosperous, green economy for the province. It outlines strategies and initiatives to take B.C. approximately 73 per cent towards meeting the goal of reducing greenhouse gas emissions by 33 per cent by 2020.

Register, R; Ecocities-Rebuilding Cities in Balance with Nature, Gabriola Island: New Society Publishers, 2006.
Most of the world's population now lives in cities. And in the short one hundred years of building cities for cars, humankind is destroying the basis for life on Earth as we know it. Now, with Peak Oil on the near horizon, it is time to build cities for people, not cars. EcoCities is about re-building cities and towns based on ecological principles for the long term sustainability, cultural vitality and health of the Earth's biosphere. Generously illustrated with the author's own inspired visions of what such rebuilt cities might actually look like, EcoCities aims to galvanize action on behalf of a planet in harmony with its citizenry.

M'Gonigle, M; Starke, J; Planet U: Sustaining the World, Reinventing the University, Gabriola Island: New Society Publishers, 2006.

McDonough, W; Braungart, M; Cradle to Cradle: Remaking the Way We Make Things. North Point Press ed, 2002.

Chambers, N, Simmons ,C, Wackernagel, M; Sharing Natures Interest: Ecological Footprints as an Indicator of Sustainability, London: Earthscan, 2000.

Wackernagel, M; Rees, W.; Our Ecological Footprint, Gabriola: New Society Publishers, 1996.
Greater Vancouver Regional District, The Social Components of Community Sustainability: A Framework
http://www.gvrd.bc.ca/growth/pdfs/SocialComponentsofCommSusFramework.pdf

Students for a Greener Berkeley
http://sgb.berkeley.edu/
Students for a Greener Berkeley (SGB) is a graduate student group focused on improving environmental policies and practices on the University of California, Berkeley (UC Berkeley) campus. It aims to reduce UC Berkeley's environmental footprint, be it energy use, paper consumption, water usage, or waste, ultimately putting UC Berkeley as a showcase for sustainability. Projects include a campus waste audit, British Columbia Institute of Technology links.

BCIT School of Construction and the Environment Sustainability Framework
http://www.bcit.ca/construction/sustainability/

BCIT School of Construction and the Environment Centre for Architectural Ecology
http://commons.bcit.ca/greenroof/

BCIT School of Construction and the Environment Centre for Infrastructure Management
http://commons.bcit.ca/infrastructure/

BCIT School of Construction and the Environment Centre for Energy Systems Applications
http://commons.bcit.ca/energy/

BCIT School of Construction and the Environment Building Science Centre
http://commons.bcit.ca/bsce/

BCIT Sustainability Pages
http://www.bcit.ca/sustainability/

BCIT Sustainability Pages focused on Campus Operations
http://www.bcit.ca/sustainability/operations/

BCIT Burnaby Campus Master Plan
http://www.bcit.ca/planning/masterplan/