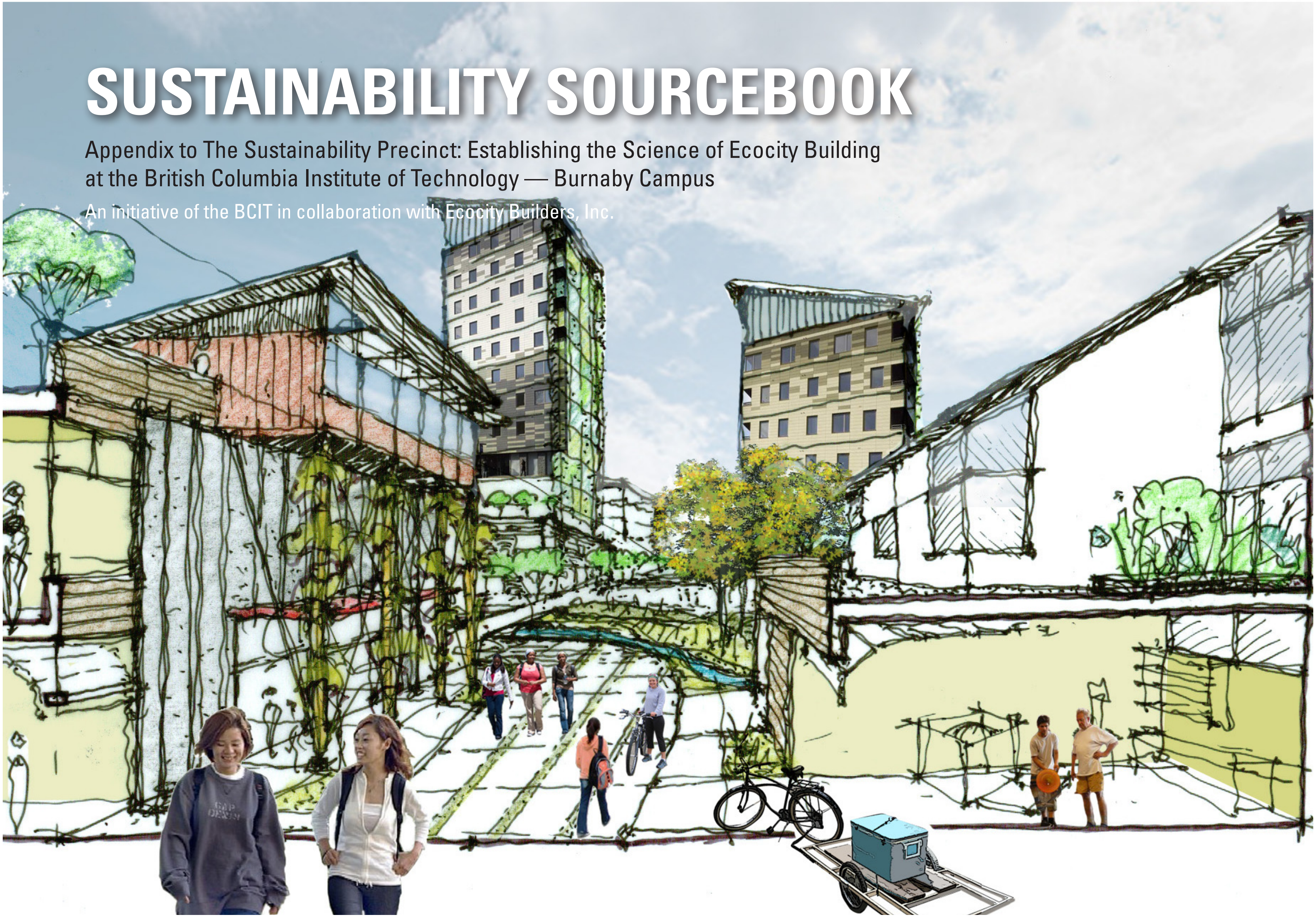
SUSTAINABILITY SOURCEBOOK

Appendix to The Sustainability Precinct: Establishing the Science of Ecocity Building at the British Columbia Institute of Technology — Burnaby Campus

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



SECTION I: QUICK FACTS

BCIT and its Bioregion

Vision

BCIT is integral to the economic, social and environmental prosperity of British Columbia.

Mission

The mission of BCIT is to serve the success of learners and employers:

- By providing high quality technical and professional education and training that supports our graduates as practitioners and as citizens; and
- By advancing the state-of-practice.

Mandate

BCIT's foundation is comprised of certificates, diplomas and degrees – the entry-to-practice credentials that lead to rewarding careers. These are enhanced by programs and courses that are coordinated with career development and growth of the practitioner, and include industry services, advanced studies and continuing education.

BCIT offers experiential and contextual teaching and learning with the interdisciplinary experiences that model the evolving work environment. BCIT conducts applied research to enhance the learner experience and advance the state-of-practice.

BCIT exercises its provincial mandate by collaborating with the post-secondary system and employers in activities that improve learner access and success.

1960s-1970s
BC Vocational School opens, later established as BCIT. First students in 1964 numbered 498; grew to 3200 by 1975.

1986
BCIT merges with Pacific Vocational School.

1989
BCIT mandate is broadened to include applied research.

Demographics	1997/1998	2007/2008	TOTAL CHANGE	% CHANGE
FULL-TIME STUDENTS				
Technology	5,240	4,432	-808	-15
Technology Degree	26	856	830	3,192
Vocational	4,525	5,041	516	11
Apprentices	4,952	5,997	1,045	21
TOTAL FULL-TIME	**14,743**	**16,326**	**1,583**	**11**
% Male		71		
% Female		29		
PART-TIME STUDENTS				
Certificate/Diploma	27,928	30,518	2,590	9
Degree	196	910	714	364
TOTAL PART-TIME	**28,124**	**31,428**	**3,304**	**12**
% Male		48		
% Female		52		
TOTAL ENROLLMENT	**42,867**	**47,754**	**4,887**	**11**
% Full-Time	34	34		
% Part-Time	66	66		

Source: BCIT Facts and Figures 2008

1994

Pacific Marine Training Institute joins with BCIT.

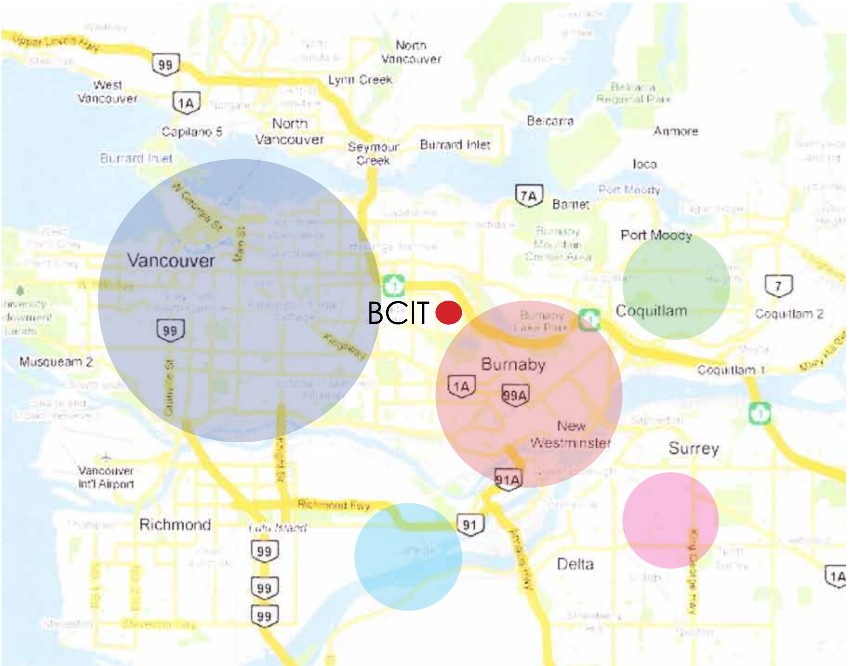
1996

BCIT offers Bachelor's degrees.

2004-present

Polytechnic status enshrined in legislation. Number of students is now more than 48,000. Total alumni number more than 120,000.

Where do Students Come From?



Vancouver 29%

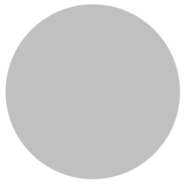
Burnaby/New Westminster 19%

Coquitlam/Port Moody/Port Coquitlam 11%

Richmond/Delta 11%

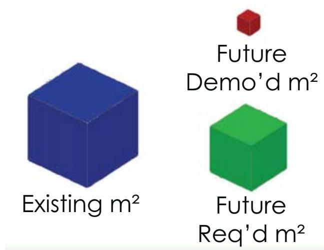
Surrey/White Rock 10%

Other 20%



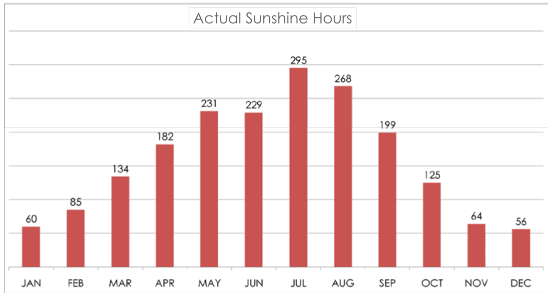
Projected Growth

56	Percent increase in activity levels from 2005 to 2020
151,000	Square meter of existing available space
51,300	Square meter of additional space required
2,250	Square meter of space loss from demolition of poor buildings



Bioregional Almanac

SUN EXPOSURE



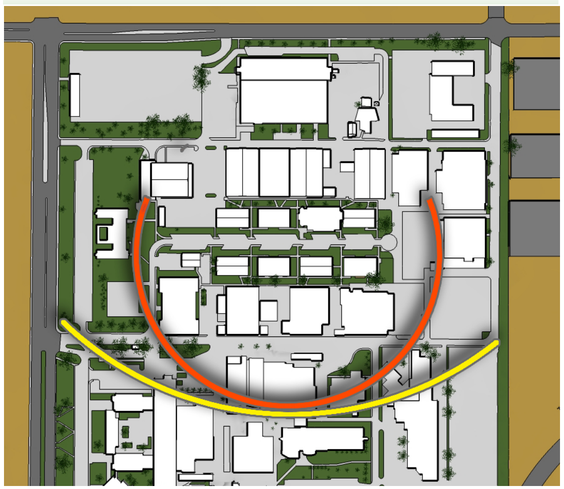
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Sun Rise	(hour)	08:00	07:20	07:25	06:19	05:29	05:06	05:23	06:04	06:29	07:34	07:23	08:01
Sun Set	(hour)	04:43	05:33	07:18	08:05	08:49	09:20	09:12	08:27	07:24	06:21	04:30	04:14

total sunshine hours = 1,928 hours

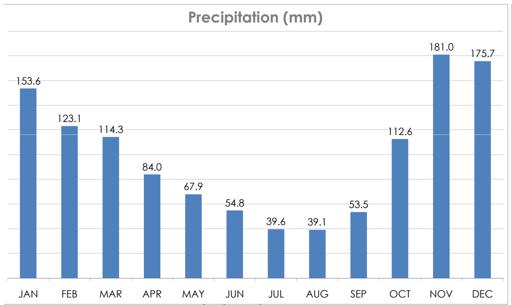
SUN PATH DIAGRAM

JUNE sun angle 64 degree @ noon

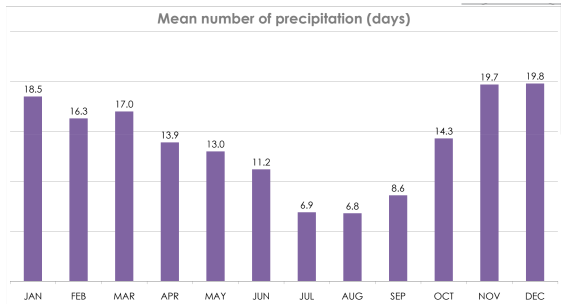
DECEMBER sun angle 18 degree @ noon



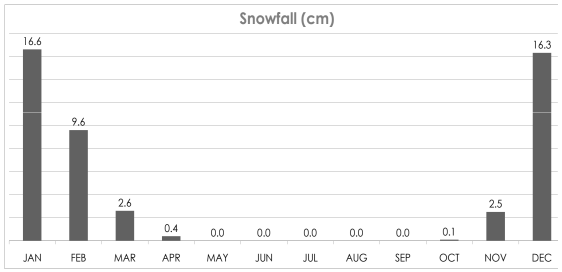
PRECIPITATION, SNOWFALL AND TEMPERATURE



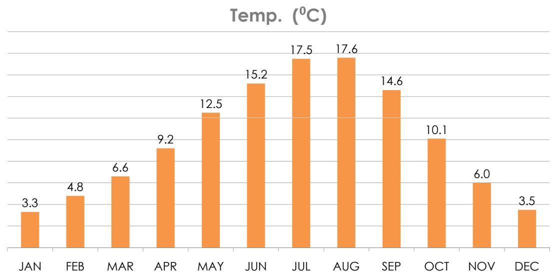
total Precipitation = 1,199mm



total number of precipitaton days = 166 days



total snowfall = 48.2cm

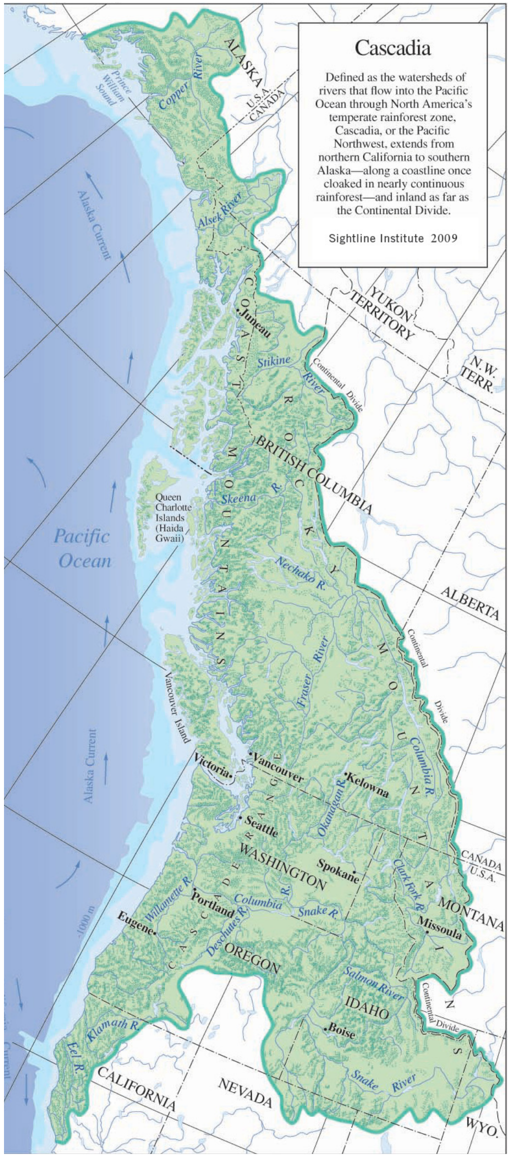


Cascadia Bioregion

Cascadia is a bioregion encompassing the watersheds of the Columbia, the Willamette and the Frazer Rivers with their tributaries and riparian systems around the Cascade Range. Nestled between the Rocky Mountains in the east and the Pacific Ocean in the west, Cascadia's extent ranges from the Alaskan Panhandle to northern California.

The Cascadia bioregion is a complex region formed by ongoing geologic, oceanic, climatic, and socio-cultural processes. The western slopes of the Rocky Mountains catch the moisure of the Pacific. Snow melt in the spring feed the rivers and their tributaries, which in turn cut through basalt and granite rock formations of this region, providing rich alluvium soil and eventually flowing back into the Pacific Ocean. This is a region rich in biodiversity, history and cultures. It is called Chinook Ilahee by the ancient inhabitants and reborn as Cascadia by its youngest offspring.

Credits: Cynthia Thomas, 1995; David McCloskey, 1988



The Fraser River Watershed

The Fraser River is the longest river in British Columbia, Canada, rising at Fraser Pass near Mount Robson in the Rocky Mountains and flowing for 1,375 km (870 mi), into the Strait of Georgia at the city of Vancouver. It drains a 220,000 km² area.

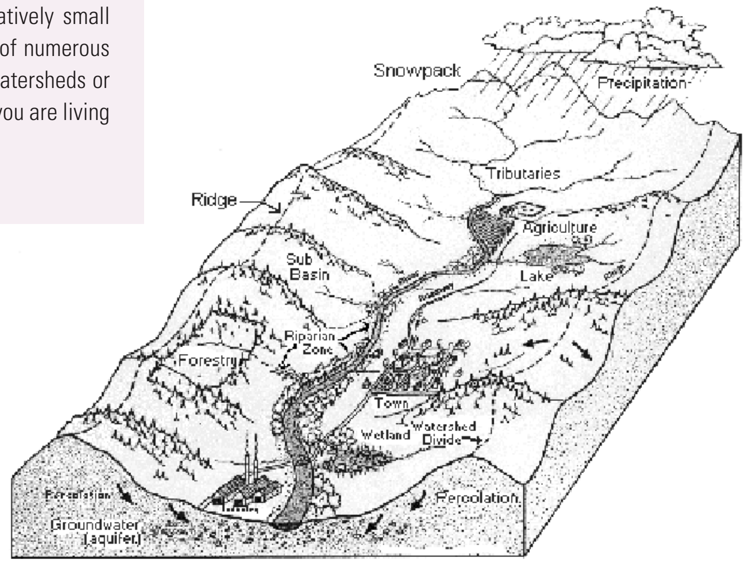
The Fraser Basin boasts one of the world's most productive salmon river systems and is a crucial staging area on the Pacific Flyway for migratory birds. The mouth of the River in particular is recognized as a globally significant estuary. Hundreds of species of birds, reptiles, amphibians and mammals, trees, plants and insects.

Major sustainability issues facing the lower Fraser watershed include its ever increasing population, leading to urban sprawl, transportation congestion, and pollution of air and waterways. Preparing for the next Fraser River flood, ensuring the 2010 Olympic Winter Games are truly sustainable, cleaning up pollution from the Britannia Mine and maintaining a healthy estuary at the mouth of the Fraser River are additional sustainability issues for the region.

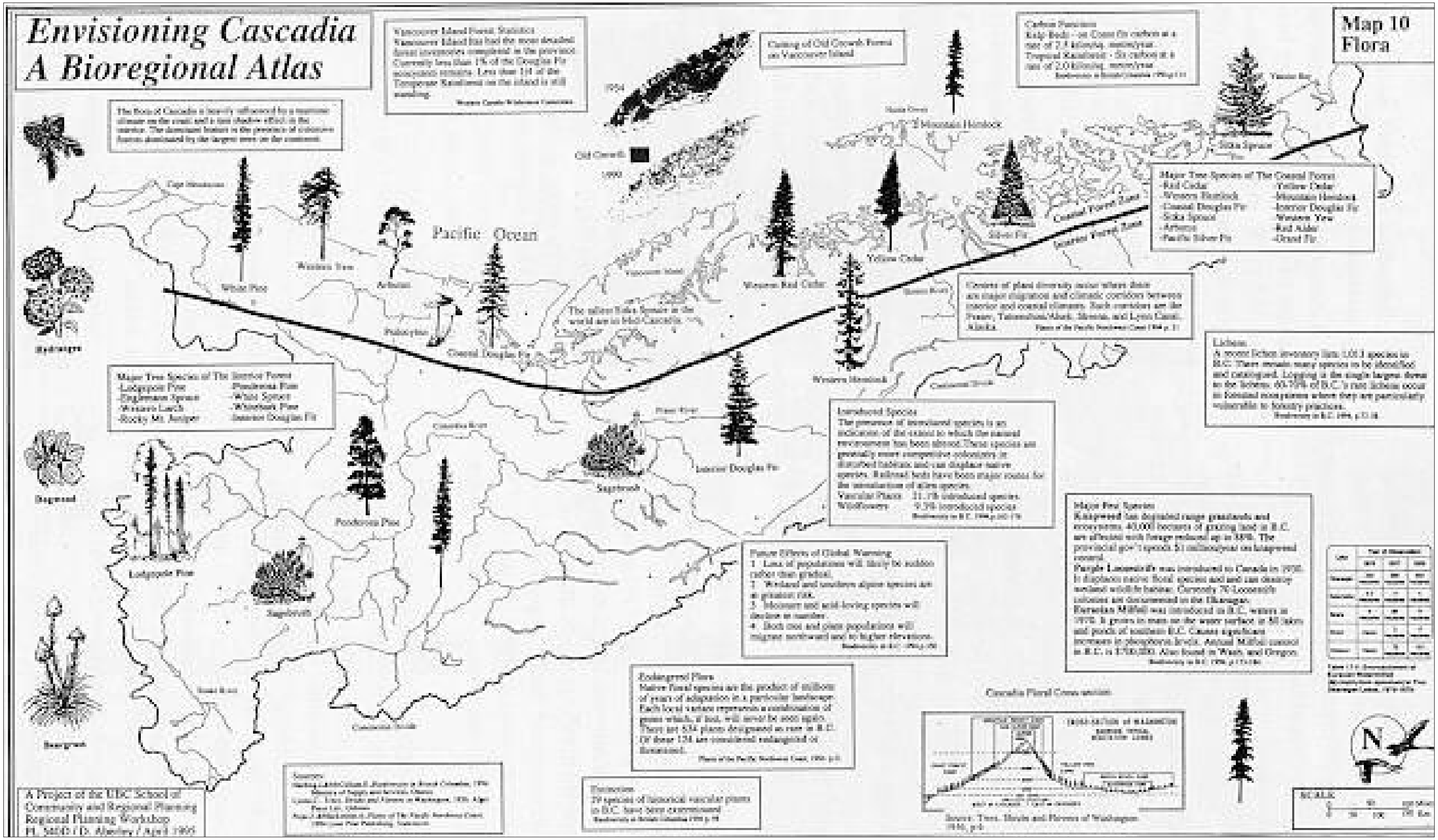
Source: Wikipedia; Fraser Basin Council

What is a Watershed?

A watershed is an area of land drained by a distinct stream or river system and is usually separated from other watersheds by the crest of hills or mountains. Also called a "catchment" or "drainage basin," a watershed can cover a large or a relatively small area. Larger watersheds are made up of numerous smaller watersheds, then called sub-watersheds or sub-basins. No matter where you live, you are living in a watershed!

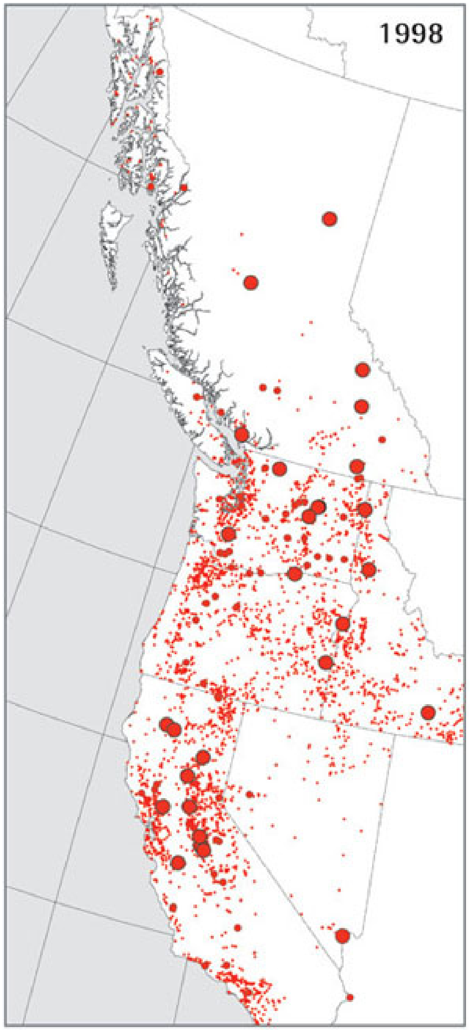


Biodiversity



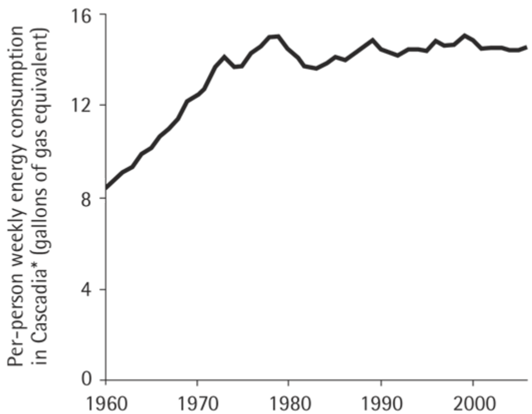
Map by Jain Peruniak

Energy Flows

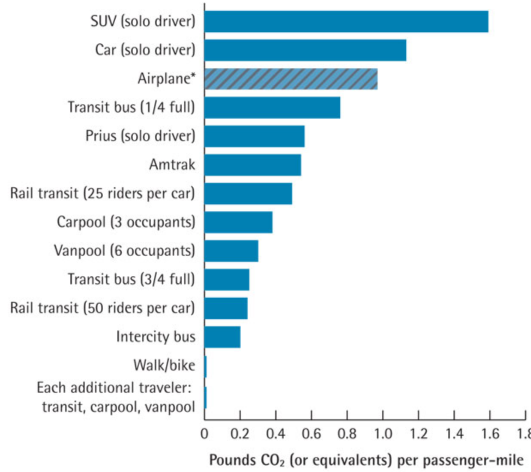


LARGE AND SMALL DAMS

ELECTRICITY TRANSMISSION LINES



INELASTIC ENERGY CONSUMPTION Source: Sightline Institute



Source: Sightline Institute

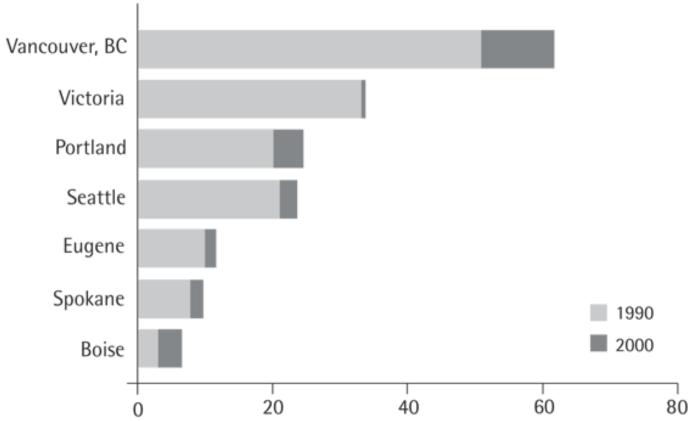
***Airplane emissions can vary greatly.**

TRANSPORTATION HIERARCHY

Driving alone and flying are among the least climate-friendly forms of passenger transportation.

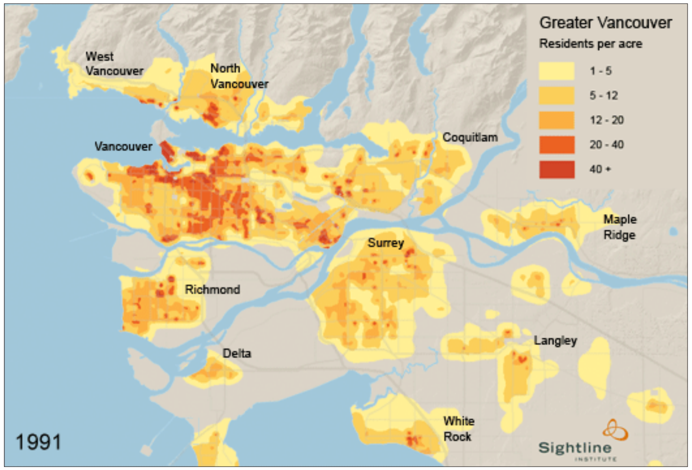
`

Built Environment



PERCENT RESIDENTS LIVING IN "COMPACT" NEIGHBORHOODS)

Source: Sightline Institute



RESIDENTS PER ACRE

Source: Sightline Institute

DENSITY

Among Cascadian cities, Vancouver leads the way in smart growth, with the highest percentage of residents living in "compact" neighborhoods.

Benefits of compact urban development

CLIMATE STABILITY

By easing car dependence, compact neighbourhoods can help British Columbia fight climate change

ECONOMIC SECURITY

Fostering many transportation options, compact neighbourhoods can cushion residents from the rapid run-up in fuel costs.

HEALTH

By promoting walking, they can foster regular exercise habits that promote long, healthy lives.

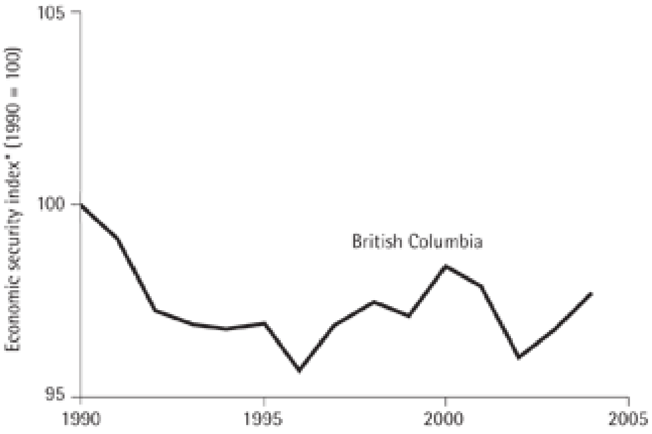
QUALITY OF LIFE

By putting jobs, stores and services within easy reach, they give residents choices, convenience and freedom that are not available in more sprawling suburbs.

Economy

INTERGENERATIONAL DIP IN ECONOMIC SECURITY

Despite two years of consecutive gains, British Columbian economic security lags behind 1990 level.

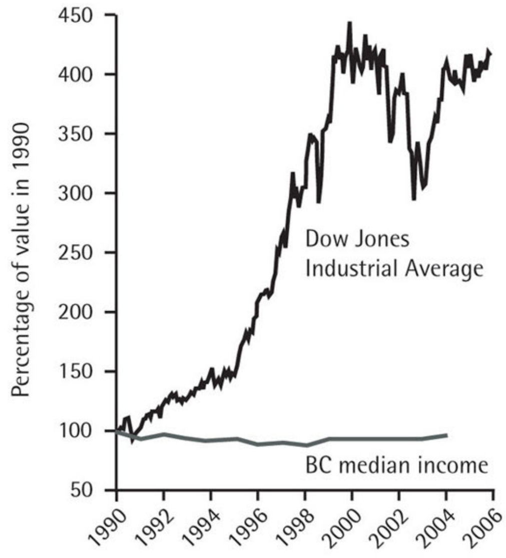


Economic Security Index comprising median income, unemployment, poverty, and child poverty.

Source: Sightline Institute

WIDENING SOCIO-ECONOMIC GAP

Two decades of so-called progress have seen the Dow Jones soar but British Columbian middle-class incomes barely budge.



Source: Sightline Institute

SECTION II: BCIT MASTER PLAN

Setting the Stage for the Next 50 Years

Planning Principles

- Sustainability: Educational and cost-savings
- Natural Environment: Restore natural beauty and integrate with built environment
- Commuter Campus: With residential options for students from outside lower mainland
- Surrounding Community: Improve campus connection to adjacent areas
- Industry Partners: Funding and industry relations
- Physical and Virtual Facilities: Facilitate interaction and collaboration

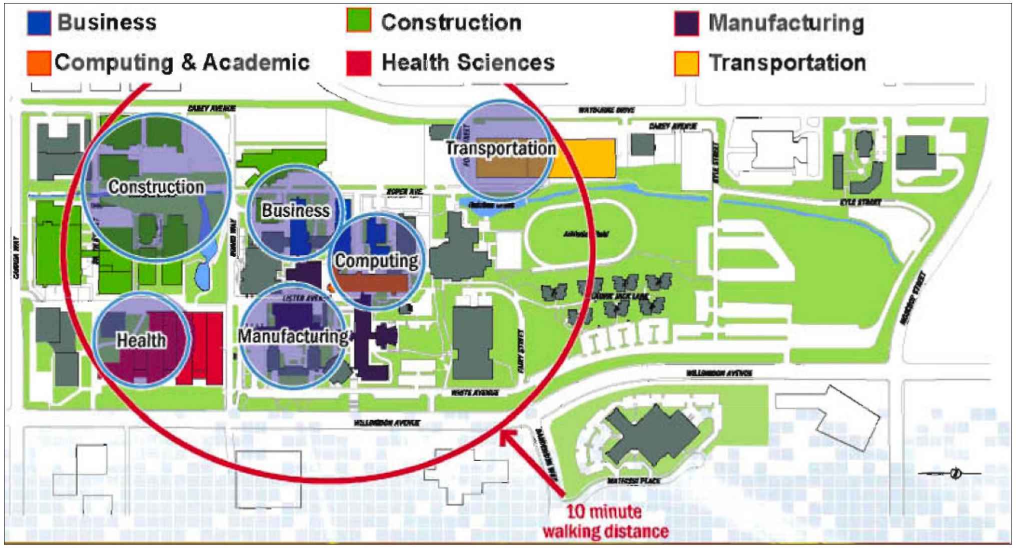
Development Objectives

- Develop a Campus Gateway: Provide visual orientation, access, stronger connections to surrounding community, and improve overall image
- Invest in Learner Support Infrastructure: Better library services, more flex study spaces, central consolidated information, improve technology access
- Landmark Buildings: Foster School identities, advanced technology complex, motive power complex, health/life sciences complex
- Integrate Training, Academic and Applied Research Activities
- Renew Existing Buildings

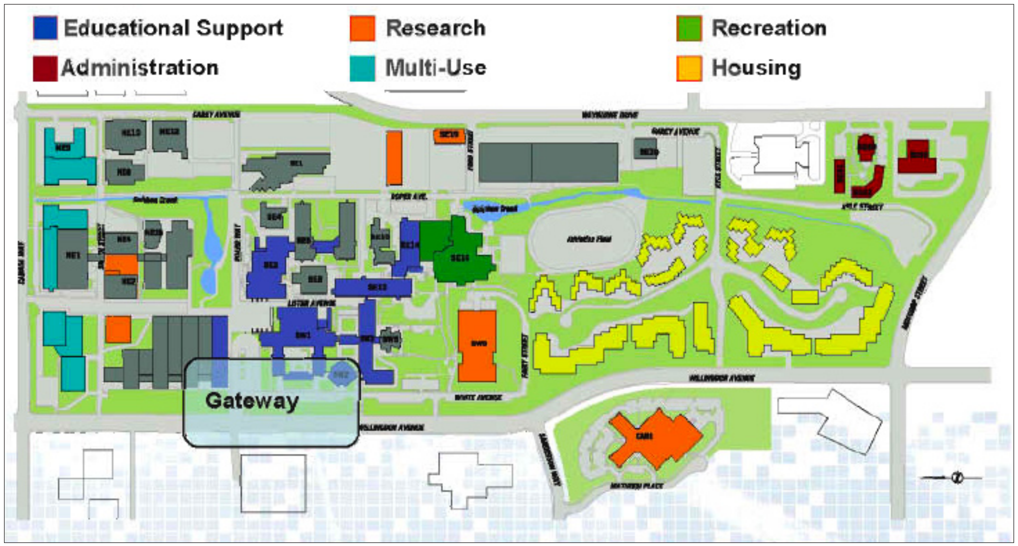
Sustainability Goals

- GHG Neutral
- Net Energy Producer
- Zero Waste
- Water Balanced
- Ecologically Restored
- Equitable and Socially Responsible
- Accessible to all Students and Faculty

Questions	Preliminary Answers	Notes/Ideas
Should Sustainability Principles Lead Planning?	Yes, this is critical.	- Should be driver of planning principles - BCIT should lead in demonstrating, educating, and developing applied and cost effective strategies to sustainability - Reducing car commutes is key.
What of its Natural Environment?	Needs attention	- Bring out natural beauty - Feature Guichon Creek - Rethink parking lots - Green space needed - Integrate with built environment, e.g. courtyards, green roofs, - Benchmark is 25% green space on campus
BCIT as a Living Laboratory	Yes, the sustainability precinct intends to showcase this.	This approach is key to BCIT's vision to be integral to the economic, social and environmental prosperity of British Columbia, by demonstrating emerging technologies and set an example by using the campus itself to showcase.
Commuter or Residential Campus?	Both, but BCIT is known as a commuter campus	- Alternative transportation solutions needed, e.g. better bus service, Skytrain station connections, bicycle and electric vehicle infrastructure, better parking strategies - Most full time students live off campus - International students residential complex - Apprentices may need short-term accommodations
Should BCIT be an Integrated Part of the Surrounding Community?	Yes, but students' needs come first.	Perception is that BCIT is a closed community.
What about Physical versus Virtual Facilities?	Need a mix of learning spaces and types of technologies.	



Educational Core



Support Clusters

PLEASE NOTE

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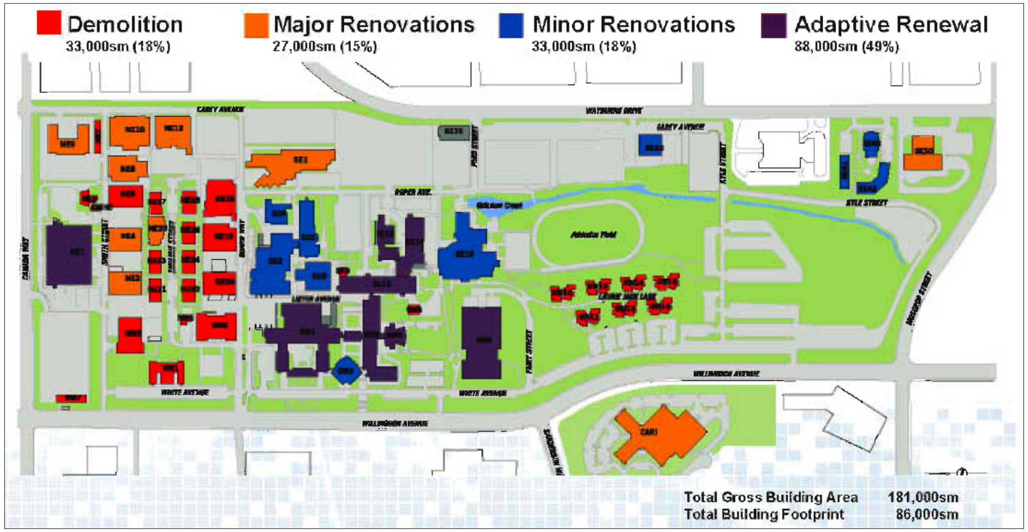
Guichon Creek

Building Conditions



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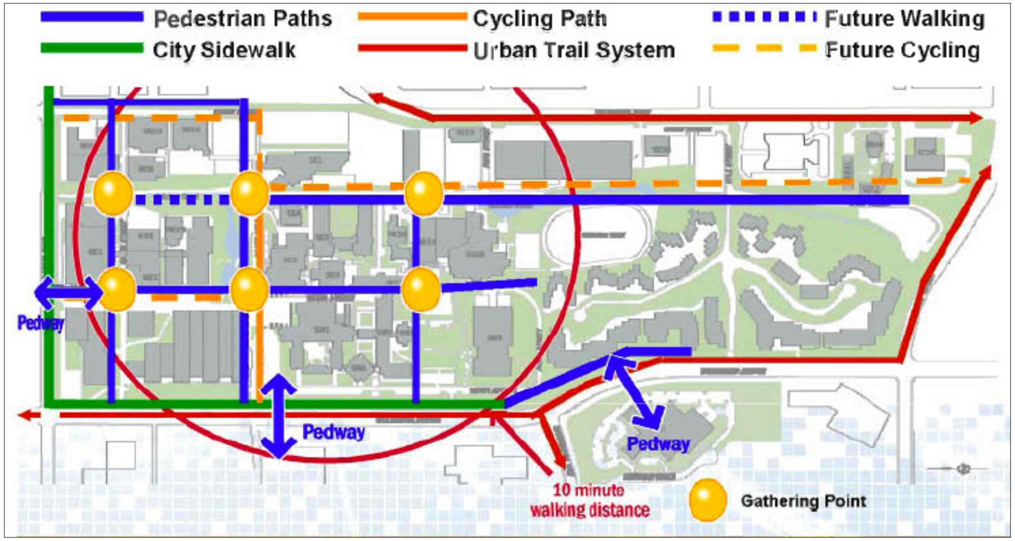
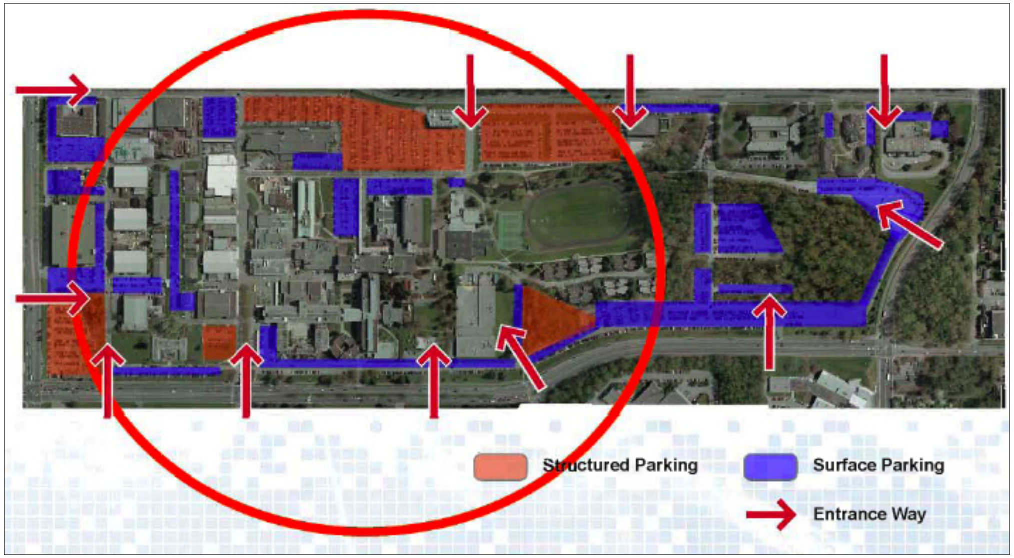


Transportation Network



Existing surface parking and future structures

PLEASE NOTE

Draft plans and proposals on this page have not been finalized.

BCIT's Ecological Footprint

BCIT strives toward One Planet Living, within the footprint of what our planet can sustain, while improving the quality of life on campus and growing to its potential. It conducted an ecological footprint analysis to begin setting sustainability goals. For the academic year 2006/2007, its total ecological footprint was 16,590 global hectares.

Some actions proposed to reduce BCIT's ecological footprint and move towards sustainability include:

> Retrofit buildings to be restorative
> Increase renewable energy use
> Increase public transit ridership
> Increase composting
> Allow for local garden/herbs
> Build retention ponds
> Grey water recycling
> Bring your own mug, bottle, utensils

Area covering 16,590 hectares, BCIT's ecological footprint in 2006/2007.

The Ecological Footprint

The ecological footprint is an indicator of the impact of humans' individual and collective consumption, relative to the earth's ability to regenerate natural resources. It is measured in global hectares, representing the area of biologically productive land needed to support humanity's demands for food, fibre, waste generation and infrastructure.

In 2005, humanity demanded resources the resources and services of at least 1.31 planet earths, meaning we are living beyond our means. The same year, each Canadian's ecological footprint was about 7 global hectares. If the whole world's population consumed like Canadians, it would require over 3 planet earths to support us.

Major Components of BCIT's Ecological Footprint

FOOD, DRINKS AND PACKAGING

47% Brand name juice, pop and bottled water
24% Meat
13% Milk products
11% Other
4% Packaging

ENERGY

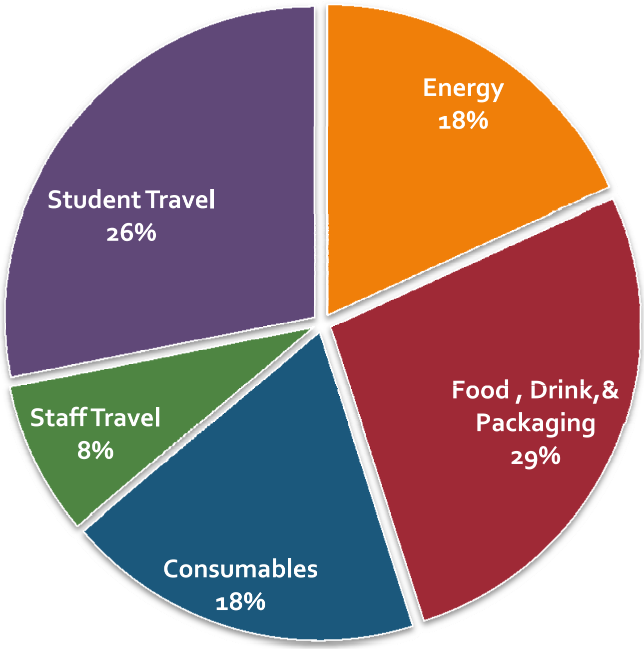
86% natural gas
14% hydro-electricity

STUDENT TRAVEL

70% drive
30% public transit
9% walk
0.01% bicycle

STAFF TRAVEL

50% Drive to work
50% Air travel



Other Facts

WATER RESOURCES

444ML: Total average annual rainfall on Burnaby built area

208ML: Total average water delivered to Burnaby campus

$ 35,230: Amount saved per year by using grey water recycling for just toilets

All stormwater that leaves campus is untreated

Bio-filteration on-site can reduce contaminants in watershed

WASTE PRODUCTION

192 tonnes: Total annual waste sent to landfill, which fill up four Boeing 707 planes!

21: Percent of waste to landfill from food packaging

Sustainability Precinct

The School of Construction and the Environment has adopted a Sustainability framework to inform all educational programs, research and operational activities. It has taken the initiative to demonstrate the framework in its Sustainability Precinct.

The Sustainability framework recognizes that production starts with ecosystems from which we derive natural resources. Natural resources are turned into the commodities used to construct and operate built environments with the help of engineered systems. The wastes from these activities are absorbed by ecosystems to re-produce natural resources.

Scientific research has identified that drastic reductions in our ecological footprint are both necessary and possible. The strategic vision of the Sustainability Precinct initiative is to reduce our consumption of natural resources by 75-90%.

Six themes have been established to guide the School in its implementation of the Sustainability Precinct framework. These themes reflect the inter-relatedness of ecological, social and economic interests needed to meet the challenge of sustainability.

These themes are:

- Protect and strengthen assets
- Balance use and renewal of resources
- Account for all costs and benefits
- Reduce waste and eliminate toxics
- Ensure safety and access to services
- Support opportunities for improvement and enjoyment

Precinct Building Inventory

NE1

NE3

NE7

NE8

NE2 & NE4

BUILDING ID	NE1	NE2	NE3	NE4	NE6	NE7	NE8
USE	Construction - Various	Construction - Joinery	Net Zero Home	Construction - Carpentry	Construction - Plumbing	Facilities Management	Construction - Welding
AREA	18,793 sm	1973sm	484 sm	1853 sm	2443 sm	413 sm	1961 sm
YEAR BUILT	1973	1959	1971	1959	1960	1964	1982
HEIGHT	4 storeys	2 storeys	2 storeys	2 storeys	2 storeys	1 storey	2 storeys
MASTER PLAN STATUS	Adaptive Reuse	Major Renovations	Demo	Major Renovations	Demo	Demo	Demo
SEISMIC DEFICIENCY	Deficient	Severe (Assumed)	Deficient (Assumed)	Severe (Assumed)	Severe (Assumed)	Difficient (Assumed)	Deficient
CONSTRUCTION TYPE	Precast Concrete	Steel	Wood	Steel	Steel	Concrete (Assumed)	Steel
FOUNDATION TYPE	Spread Footing	Spread Footing	Spread Footing	Spread Footing	Spread Footing	Spread Footing	Timber Piles

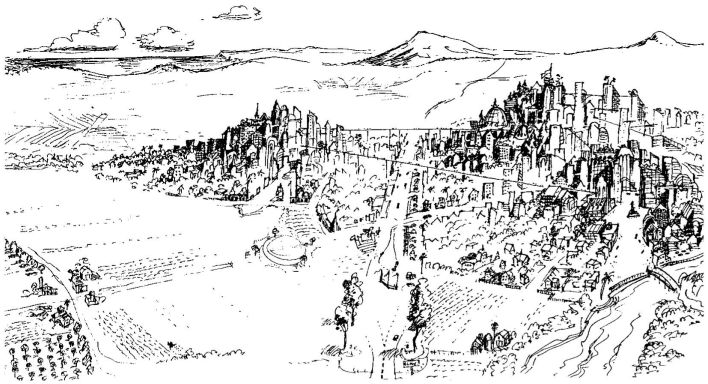
SECTION III: ECOCITIES

What is an Ecocity?

If 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 by preserving and enhancing biocultural diversity largely within the environmental limits of its bioregion.

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 to meet the needs of all the existing animal and plant species, and using not more of the fibers and wood that can be sustainably harvested. This does not preclude trading with other bioregions, but that the resources of the bioregion need to be sustained and enhanced over generations.

Lean, efficient, and compact urban development allow for a ecologically rich and restored bioregion



Ecocity Fractals

Ecocity fractals are portions of a city embodying all essential parts and functions of a whole city on a smaller scale, well co-ordinated, and relating successfully to the natural environment and bioregion, are called ecocity fractals.

Ecocity fractals can be on a range of scales:

- Bioregion
- Metropolitan area
- City

- District / Urban cluster:

A group of urban villages not more than five minutes away by public transportation, sharing key facilities like hospitals, centers of higher education, recycling center, fire fighters facility, waste treatment facility

- Urban village:

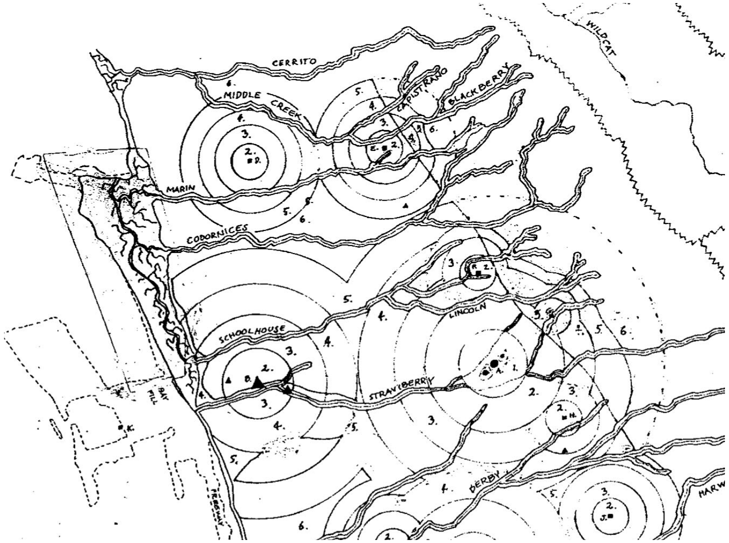
Area of balanced development that can easily accessed in its entirety by walking approx. 1/4 to 1/2 mile

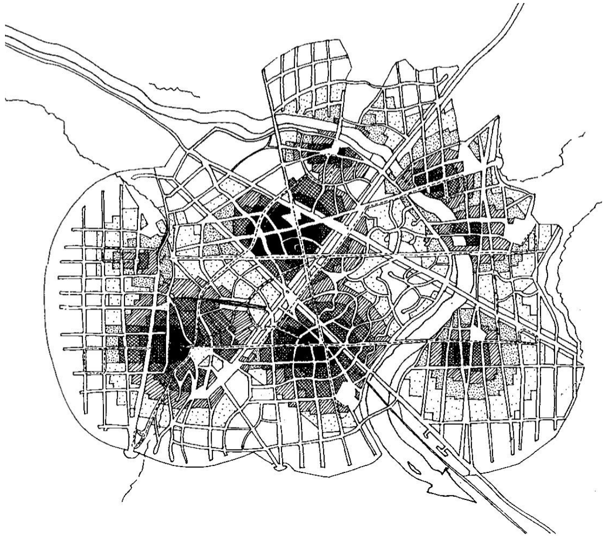
- Pedestrian island:

Approx. 2-block contiguous area that can be walked without crossing a motorized street

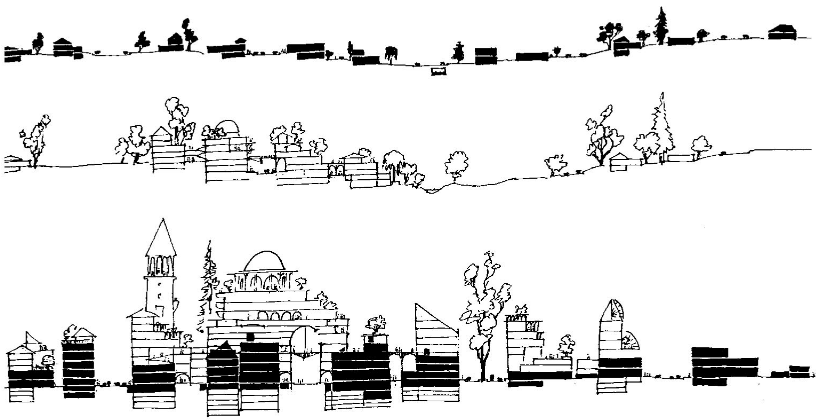
- Building

Ecocity Design Elements



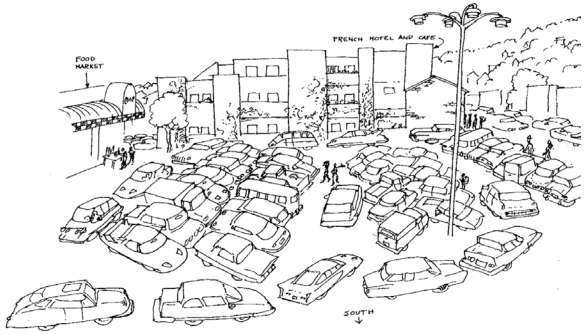


Ecocity mapping for urban villages

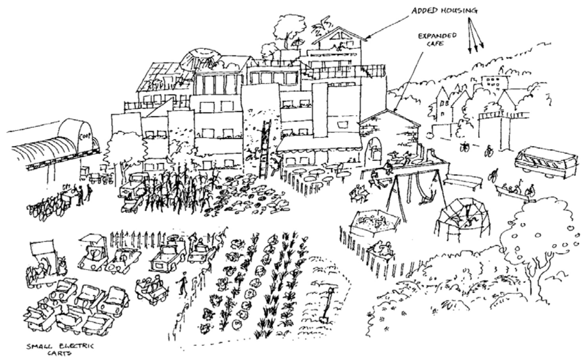


Cities over time

Close-ups

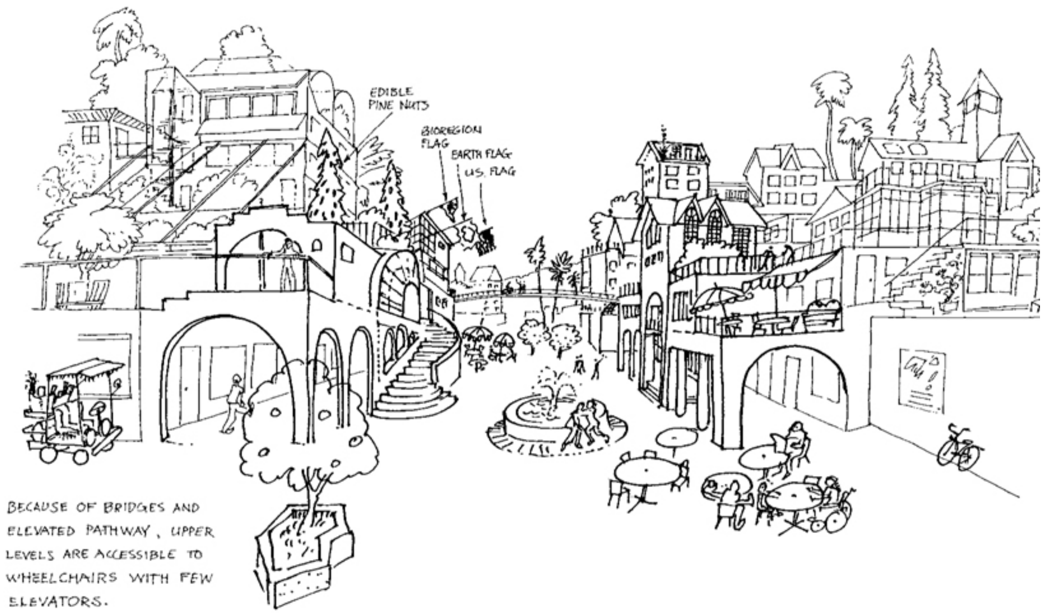


BEFORE
Parking lot with a sea of cars

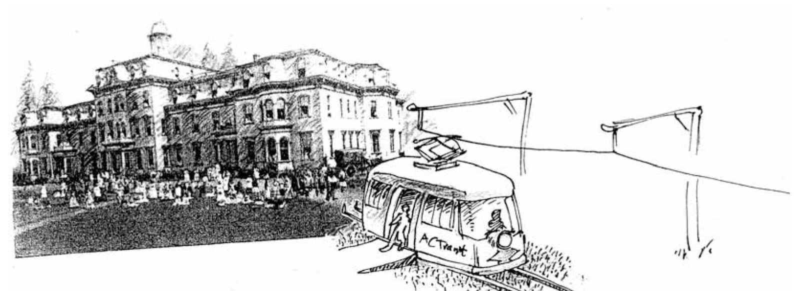


AFTER
Public open spaces, more users of transit and bicycles

Density and diversity
of uses near centers

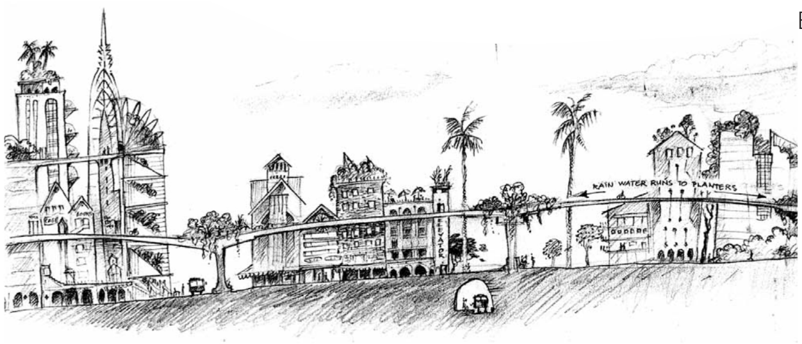


Lightrail

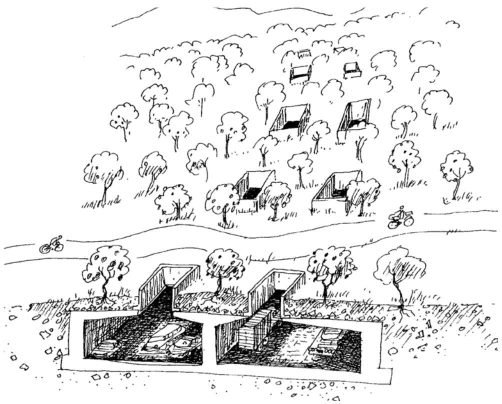


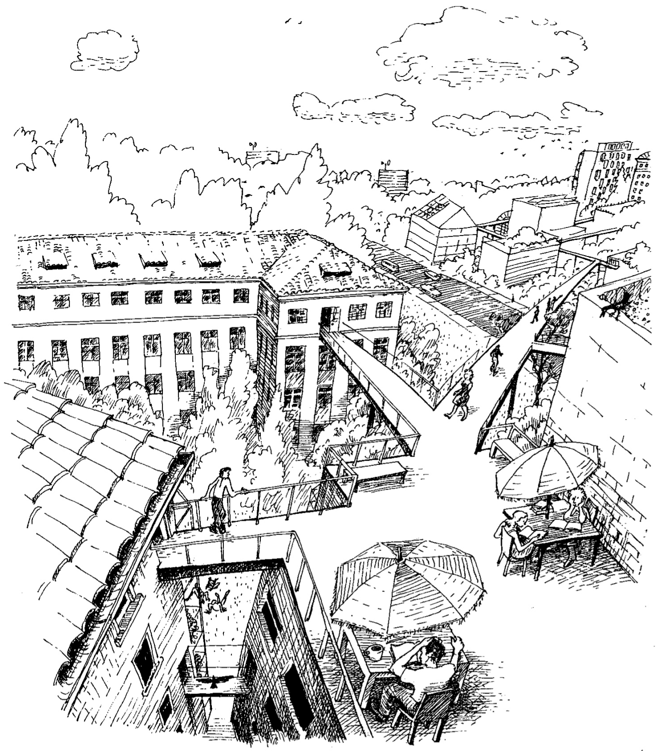
Light rail - the best transit fit with ecocities.
Streetcar arrives at Mills Hall, central campus of Mills College, Oakland, California, for which an ecocity green plan has been written.

Bike flyway

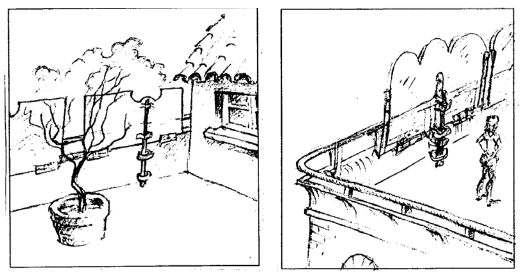


Underground roadways

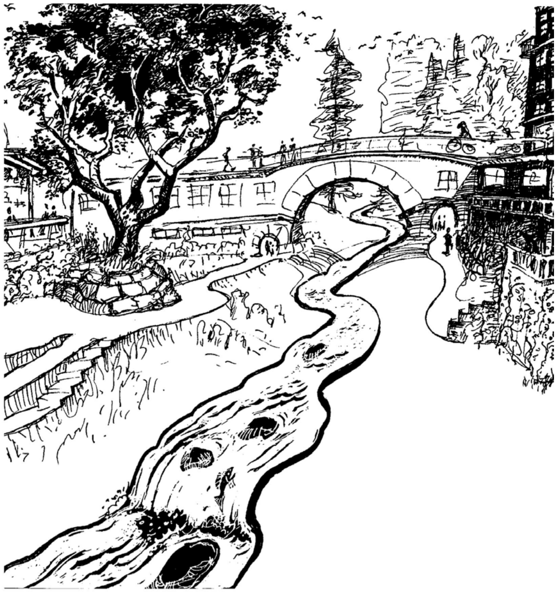




Bridges between buildings and rooftop terraces



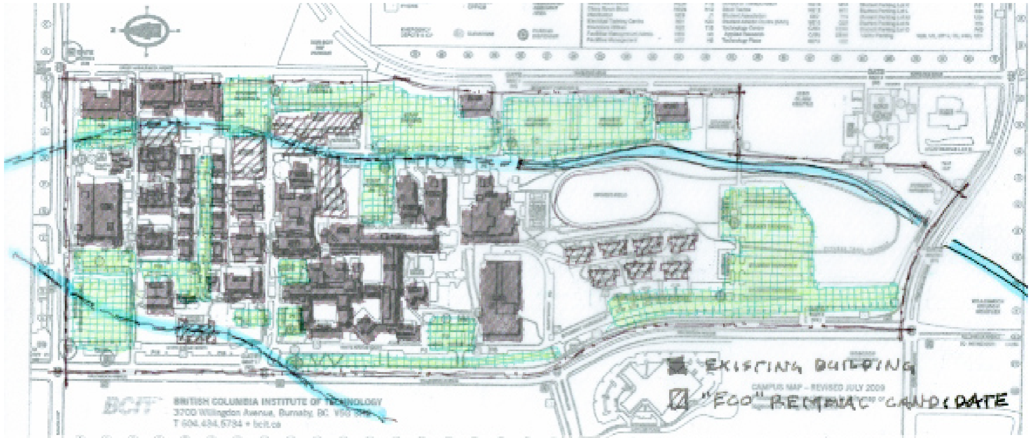
Windscreens for rooftop gathering places



Urban area with restored creek and greenways

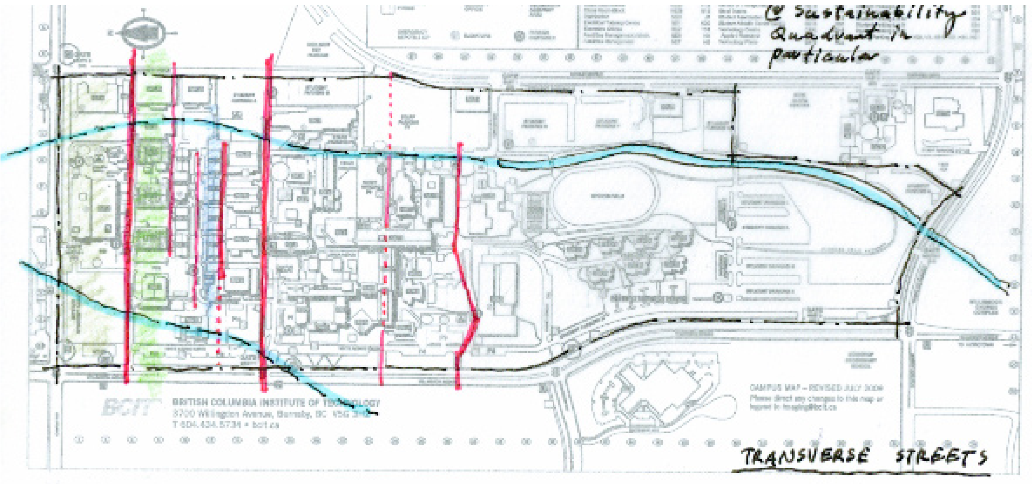
Restored urban canopy

BCIT Ecocity Design Analysis & Ideas



"PARKING ORCHARDS" AND BUILDING FOOTPRINT ANALYSIS

Existing parking lots in green. Hatched buildings are potential candidates for "Eco-Renewal" of removal. Guichon Creek above and underground.

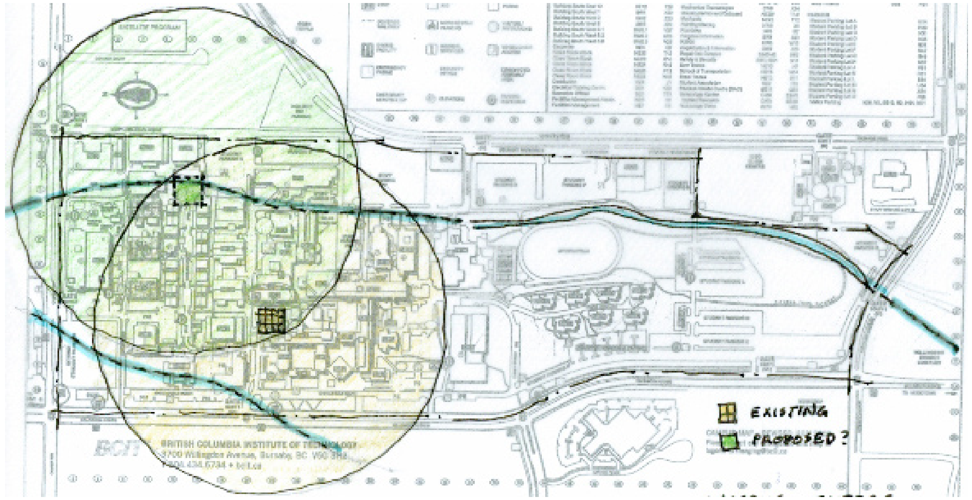


TRANSVERSE STREETS

East-West trending streets define the grain of the campus built environment, subtly favoring car use over pedestrians and bikes.

CAMPUS CENTERS

Each School could be served by a distinct “Village Center” with its own food retail, services, and study and gathering areas. Here the existing Campus Square and a proposed center for the Sustainability Precinct is shown.



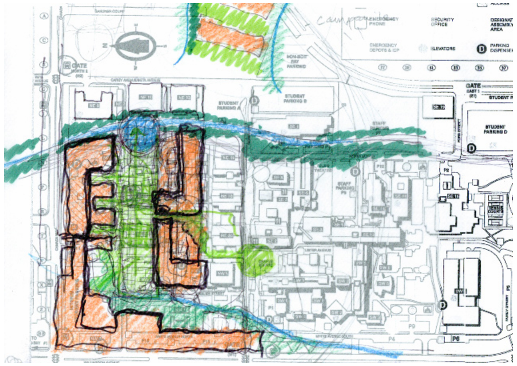
DECONSTRUCTING TRANSVERSE STREETS

Linkages between and formed by transverse streets generate cross grain and link the two creeks.

Extend daylighted creek to adjacent neighborhoods to serve as wildlife corridor.

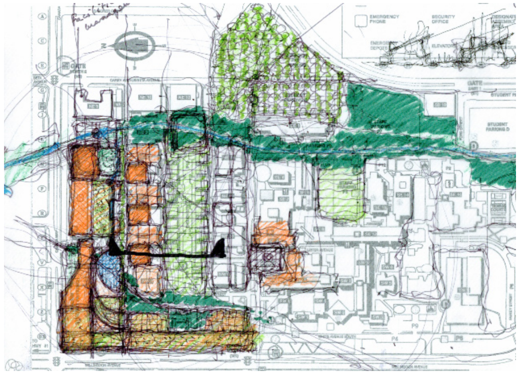
STUDY OF HIGH DENSITY MIXED USE DEVELOPMENT

Around a central green at site of current NE2, 4 and 6. Water catchment feature at Guichon Creek. Linkage to current Campus Square. Possible view corridor towards northern mountains to be further explored.



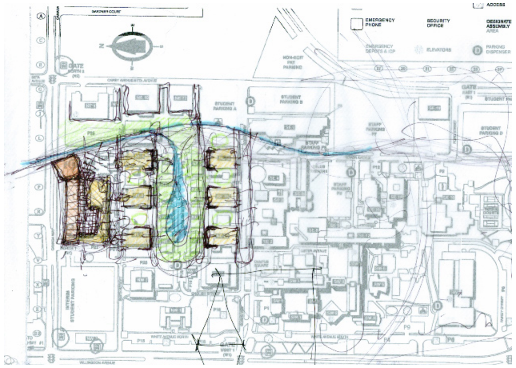
STUDY OF HIGH DENSITY MIXED USE DEVELOPMENT

Around a central green at site of current NE21 through 28. Water catchment feature at west plaza. Transformation of NE1 to new signature building. Re-use of NE2, 4, 6 as accessory structures for new residential college units. Wall of housing toward Willingdon Ave. Possible view corridor towards northern mountains to be further explored.



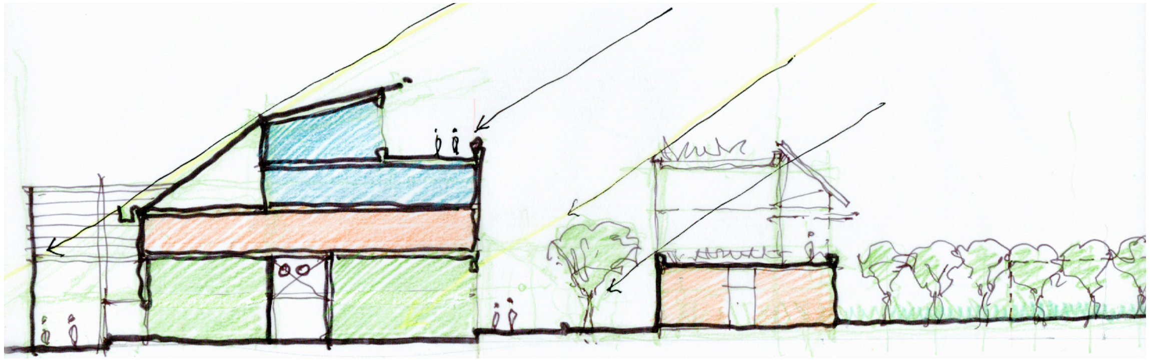
STUDY OF HIGH DENSITY MIXED USE DEVELOPMENT

Around a central green at site of current NE21 through 28. Central stormwater catchment feature. Transformation of NE1 into new signature building. Possible view corridors towards northern mountains to be further explored.



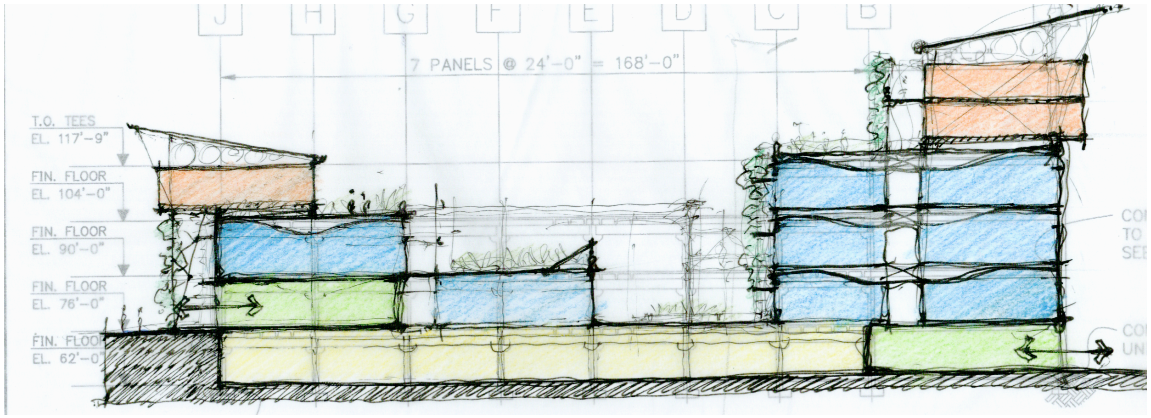
SECTION THROUGH NEW SUSTAINABILITY PRECINCT LOOKING EAST

New residential college units on the left. Showing multi-use building types, inhabitable roofs, building forms encourage solar access for public spaces and green façades.



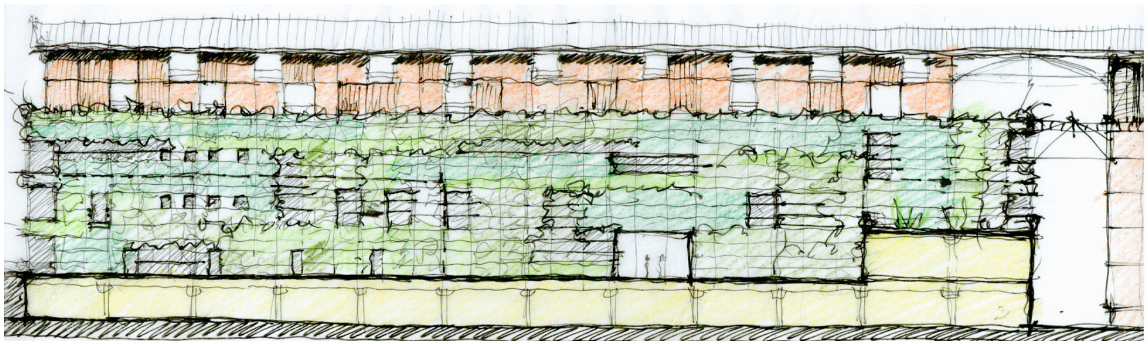
SECTION THROUGH PROPOSED TRANSFORMATION OF NE1, LOOKING WEST

Showing subtractive courtyard and multi-use ecocity fractal configuration, including classroom and lab space, start-up incubator/live-work space, faculty offices, student rooftop housing and inhabitable living roofs.



SECTION THROUGH PROPOSED TRANSFORMATION OF NE1, LOOKING NORTH

Showing subtractive courtyard and multi-use ecocity fractal configuration, including green façade, student housing and inhabitable living roofs.



Sustainable Building Materials

CRITERIA FOR SELECTING BUILDING MATERIALS

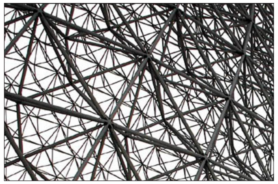
In general, when selecting building materials and systems, prefer materials that:

• Have inherently low or positive environmental impacts, i.e. locally abundant, have low embodied energy, sequester carbon, etc
• Can be used efficiently, high strength-to-weight ratio
• Can serve multiple functions, such as finish, fire resistance and insulation
• Are durable and/or can be readily recycled or reused
• Provide indirect sustainability benefits, ranging from cultural appropriateness, to health benefits.

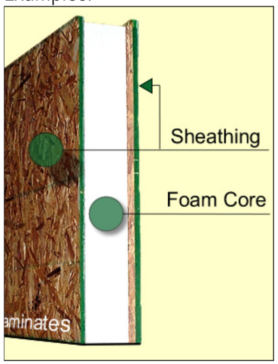
Based on the above considerations, we recommend that institutional buildings at BCIT be built of wood, with foundations of concrete with low-cement content. Steel can be used for unique or high-performance structures.

The other materials on the following list can and should be used on a more limited basis because of various limitations which may include: low strength, durability concerns, lack of standardization and familiarity, and cultural acceptability. However, these alternative materials also have great advantages, especially for smaller structures such as homes, including: Being powerful symbols and examples of sustainability, and the potential that research and development may eventually make them standardized and mainstream.

Material	Pros	Cons	Uses
WOOD 	Locally available, renewable, low embodied energy Carbon sequestration Structure also works as finish material	None IF harvested sustainably, sourced locally, protected from deterioration, and used efficiently. Certain types of wood construction (light frame) are more sensitive to fire than others (heavy timber)	In its many forms, wood can be used for almost all functions, however, for foundations, durability usually becomes an issue.
LOW-CEMENT CONCRETES  **HEMCRETE**  precast hollow concrete	Locally available Strong, durable, can be reused as aggregate Can sequester industrial byproducts (i.e. flyash, slag) Excellent thermal mass Precast/prestressed concretes can realize high material efficiencies (weight to mass ratios) Structure also works as finish material	Even with reduced cement content, the amount of Portland cement needed still has a substantial environmental impact Aggregate quarries may have negative impacts Poor insulator	Excellent choice for foundations and basements due to its durability and moisture resistance. Above ground use is recommended only in special circumstances such as seismic upgrades or structural changes to existing concrete buildings.

Material	Pros	Cons	Uses
STEEL  	Excellent strength to weight ratio Ease of connections Very durable when properly protected Flexibility when designing unusual, complex or multi-use structures.	Large environmental impacts even though in most cases has substantial recycled content Poor thermal properties, including thermal bridging, no insulation value, and low thermal mass, sensitive to fire/heat	In tension applications and advanced structures, such as space frames and tensegrity structures, extreme strength-to-weight efficiencies can be realized.
DECONSTRUCTED OR SALVAGED MATERIALS (e.g. demolition salvage, auto tires, shipping containers)  earthships	Best overall when available for reuse	Quality control needs to be considered Labor intensive and thus may not be cost competitive.	

Material	Pros	Cons	Uses
STRAWBALE 	Excellent insulator Variety of uses, Reuse of agricultural waste material Carbon sequestration Local (check availablility) Fairly inexpensive when built by volunteer labor	Weak, can carry only small loads Must be well-protected from moisture Large footprint Labor intensive and thus may not be cost competitive.	Strawbale wall construction consisting of stacked straw bales and reinforced plaster skins can be used in as a load bearing masonry, an infill and shearwall for a gravity load carrying post and beam structure, or as a non-structural insulating infill for moment resisting frame construction.
EARTH-BASED MATERIALS (e.g. rammed earth, shot earth, adobe, earth bag, etc) 	Completely or mostly natural (i.e. unprocessed) materials, consisting mainly of clay, sand, straw, and water. Easy and fun to work with and may be sourced on or near campus. (Soil types in vicinity of campus should be checked.) Strong symbol of sustainability.	Some are weak and not as durable as conventional materials Usually need small quantities of Portland cement to improve quality Lack of standardization	Mainly recommended for small, one-storyauxiliary, temporary, or landscape structures.

Material	Pros	Cons	Uses
BAMBOO 	Lightweight Strong, durable, highly renewable, somewhat resistant to decay. Could be grown on or near campus	Lack of standardization Difficult to connect to, therefore difficult to build enclosure Decay characteristics in weather similar to wood Check local availability	Great for canopies, sheds, and otudoor structures, as well as interior finishing and furniture
NEW AND INNOVATIVE MATERIALS AND SYSTEMS High- or low-tech materials recently on the market, or could be developed by BCIT, including: • Structural Insulate Panels (SIPs), or composites of structural panels (e.g. plywood, wheat board, styrofoam) • Oryzatech, or compressed straw blocks • Various lightweight concretes and concrete-like materials, some aerated and provide good insulation. • Various forms of composite, pre-manufactured, panelized, and modular systems	Can leverage BCIT buildings project to develop and popularize new technologies Can provide great benefits if successful Examples:  SIPs	Risks involved when using technologies that have not been fully tried and tested.  Stakblocks	

SECTION IV: ESTABLISHING BASELINES

Sample Audits & Checklists to Establish Baselines & Measure Progress

Sustainablity Strategic Planning

Before you start making changes, it is critically important to take the time to carefully measure where you are starting from. The key is to remember: "If you can't measure it, you can't manage it." And if you can't manage it you will have no way to gauge success. Establishing accurate baselines will allow you to set reasonable goals and to develop the plan for how you will achieve them.

A number of assessment tools are available, some online, that measure resource use and environmental governance. Use these resources in-house to spell out what baseline data to collect, how to calculate relevant data, and customize templates for reporting. This process, depending on the scope of your operations, can be resource intensive and time consuming, but it is crucial to be thorough. You want to have a clear and comprehensive understanding of the impacts of your operations. If out-sourcing this task is an option, there are many companies that specialize in sustainability auditing and reporting. In some campuses, students have been involved in the collection of baseline data for course credit. This approach saves money and develops a sense of stewardship among users.

Once you have established your baseline information you can begin to develop a sustainability strategic plan. As you gather data, you develop a clearer picture of where you are already approaching your sustainability goals, and where you will need to make changes.

Some of the changes may be to existing infrastructure, others may focus on the need to increase efficiency, and yet others will suggest innovative ideas or technology or the need to educate users. Your sustainability strategic plan describes your vision for sustainability, sets short and long-term goals and provides the roadmap on how to achieve them.

The following checklists are meant to outline the kinds of audits that will begin to create a baseline for a comprehensive sustainability strategic plan:

> Building Documentation
> Site and Landscape
> Water Use Efficiency
> Materials and Waste Flows
> Energy Efficiency

Checklist I:
Building Documentation or "As-Built" Drawings

Building documentation, or "As-Built" drawings provide baseline documentation on a building's architectural, structural, and mechanical conditions. They also provide information on the building's layout and uses, which allow us to think creatively about improving its performance and resource efficiency. Such information is also critical for the Building Commissioning or other building performance evaluation and maximization processes.

Ceilings and walls likely need to be opened up to document the structure. This should mostly involve removing small sections of the interior gyp board sheathing.

If as-built drawings are already available, students should still follow the above steps to verify conditions are as documented.

Construction details of modular trailer units do not need to be determined; however, ground-bearing locations need to be documented.

DRAWINGS NEEDED:

o Floor and Roof Plans
o Exterior Elevations
o Building Sections: 2 per building, one in each direction

RECOMMENDED SCALES (METRIC UNITS):

o Plans at 1:100 scale or larger
o Sections at 1:50 scale or larger

INFORMATION NEEDED ON DRAWINGS:

o North arrow
o Dimensions:
o Room layouts, uses
o Layouts of modular trailer units in shops
o Major equipment layouts
o Exits/Circulation/Elevators
o Windows and doors
o Framing member layouts, including sizes
o Wall Sections
o Dimensions, Insulation, Sheathing
o Mechanical systems:
o HVAC layout, type of system
o Lighting layout, types

PHOTOGRAPHS NEEDED:

o Examples of things working well, high performance, good design, etc
o Anything that is suspect, damaged, etc.
o Panoramic photos of buildings from critical locations (3-4 panoramas minimum)

Checklist II:
Site and Landscape

Site plan analysis helps us review existing conditions and evaluate opportunities to maximize the performance and resource efficiency of project sites.

INFORMATION NEEDED ON SITE PLAN:

- Site perimeter
- Geographic features surrounding site
- North arrow
- Topography
- Landscape features e.g. sidewalks, etc

RECOMMENDED SCALES (METRIC UNITS):

- Approximate scale is fine, about 1:200

CLIMATE INFO NEEDED:

- Total annual rainfall
- Average and record winter low and summer high temperatures
- Solar exposure and orientation
- On site plan, identify:
- Areas of shade and solar exposure at 4 different times during the day
- South and west facing slopes and walls
- Potential heat islands
- Trees that provide shade
- Opportunities for shading:
- South and west facing walls, structures
- Walkways, sidewalks
- Any correlation between solar exposure and congregations of users?
- Prevailing winds flows through the site
- Microclimates (pockets of warmer or cooler conditions relative to typical site climate created by existing or proposed site infrastructure, topography, vegetation, etc)

PLANTING, NATIVE VEGETATION, AND HABITAT

- Planting Zone (Possible sources: USDA, Agriculture and Agri-Food Canada Plant Hardiness Zones 2000, or Sunset Garden Book)
- Primary soil type (clay, silt, or sand)
- Native plant communities, existing and opportunity to restore
- Opportunities to create, maintain, or connect to existing wildlife corridors?
- Top 5 most prevalent plant species by biomass
- Presence of invasive species
- On site plan, identify:
- Large trees
- Vegetation clusters
- Habitat zones

STORMWATER, WATER QUALITY, EROSION, AND FLOOD MANAGEMENT

- Storm drains network, including inlets and outlets
- Paths of aboveground water flows through the site, including permanent and seasonal (e.g. during a rain storm)
- Any erosion patterns created by flowing water
- Areas vulnerable to erosion during construction
- Areas that retain water or flood in the rainy season
- Potential for infiltrating stormwater (e.g. swales, bioretention, planters)
- Name of waterbody receiving storm runoff from site
- Soil infiltration rate
- Potential for rainwater harvesting and storage
- Is site within 100-year floodplain?
- Any plans or opportunities for creek restoration?
- Pervious/impervious areas:
    - Total size of site
    - Area of impervious surface, incl. rooftops
    - Opportunities to include pervious paving?
- Pesticide and fertilizer use, opportunities for modification to protect water quality?

Note: Water use efficiency data needs are listed under water use.

SITE UTILITIES/INFRASTRUCTURE

- Maps of electric, gas, telecommunication and other utility systems (some may be underground)

PHOTOGRAPHS NEEDED:

- To visually describe of site conditions, adjacent vegetation, etc
- Examples of things working well, high performance, good design, etc
- Anything that is suspect, damaged, wasteful, etc.
- Panoramic photos of site from critical locations (3-4 panoramas, more is great)

Checklist III:
Water Use Efficiency

BACKGROUND INFORMATION NEEDED

- Local water provider
- Where does the water come from?
- Water conservation plan and measures in place? Include awareness/education measures.
- Water bills over a 2-year period (longer, if possible)
- Number of users per day
- Water pressure, in psi
- Water balance or leak check (This involves turning off all known water outlets. If meter records any water use, there is a leak or undocumented consumption.)

ON A BUILDING OR SITE MAP, IDENTIFY:

- Locations of all water outlets such as toilets, showers, sinks, indoor and outdoor taps and irrigation sprinklers
- Size, type and location of water and wastewater meters
- Location and capacity of any on-site water and wastewater treatment facility

USER ATTITUDE INFORMATION (can be approximated through informal interviews)

- Do faculty, student, and staff have basic water conservation awareness and habits?

TOILETS
- Number of toilets
- Single-flush or dual-flush
- Estimated volume of toilet cistern
- Number of leaking/running toilets
- Average water consumption in liters per flush (lpf)
- Total water consumption per day from toilet flushes; assume 4x per person per day

URINALS
- Number of urinals
- Average liters per flush
- Type of urinal: pull chain/motion sensor/continuous flush and fill
- Estimated volume of urinal cistern
- Number of leaking/running urinals

HANDBASINS
- Number of taps
- Type of taps: twist/spring loaded/lever
- Average tap flow rate in liters per minute (lpm)
- Number of leaking/dripping taps
- Aerators fitted?
- Number of other taps/cleaner's taps/hose tap

SHOWERS
- Number of showers
- Number of leaks
- Showerhead flow rate (lpm)
- Type of showerhead: normal/water-saving

DRINKING FOUNTAINS
- Number and and location of drinking fountains
- Fountain flow rate
- Leaks

CLEANING
- How often are the toilets cleaned?
- How many times a week are the amenities blocks hosed out?

KITCHEN/CAFÉ/RESTAURANT/CAFETERIA

- Number of taps, including spray rinse valves
- Type of taps: twist/spring loaded/lever
- Aerators fitted?
- Flow resistors
- Number of leaking/dripping taps
- Number of dishwashers, water consumption per load
- Number of refrigerators that use water coolant systems, water consumption

UTILITY/Store Rooms

- Number of taps
- Type of taps: twist/spring loaded/lever
- Aerators fitted?
- Number of leaking/dripping taps

OUTDOORS/IRRIGATION

- Number of outdoor taps
- Type of taps: twist/spring loaded/lever
- Average tap flow rate
- Number of leaking/dripping taps
- Aerators fitted?
- Signs of vandalism, vandal-proofing
- Location and method of irrigation: Hose/portable sprinkler/automated sprinkler/drip irrigation
- Irrigation frequency
- Time(s) of day of irrigation

OTHER USES

- Cooling towers, pool, laboratories, laundry rooms, etc
- Note capacity and water consumption as appropriate

Checklist IV:
Materials and Waste Flows

BACKGROUND INFORMATION NEEDED

• Waste management service provider
• Recycling service provider, if applicable
• Compost service provider, if applicable
• Janitorial service that collects waste from trash, recycling, compost receptacles
• Location of the "last dumpster(s)" at the building before getting hauled off-site, for trash, recycling, and compost
• Where does waste go after getting hauled off-site?
  o Location of landfill, incinerator, etc
  o What is done with "recyclable" and "compostable" waste?
• Waste prevention plan and measures in place? Include awareness/education; does it include the 4Rs: Reduce, Reuse, Recycle, Rot, others?
• Waste disposal and recycling bills over a 2-year period (longer period, if possible)
  o Weight of garbage
  o Charges
• Number of building users per day, weekday and weekend
• Is building use contributing to unusual amounts and/or types of waste?

USER ATTITUDE INFORMATION (can be approximated through informal interviews)

• Do faculty, student, and staff have basic waste reduction awareness and habits?
• Have recycling, composting, and/or reuse programs been successful?
  o Why or why not?

TRASH

• Characterize waste at the "last dumpster" by weight and type (feel free to customize, as appropriate):
  • Recyclable plastics
  • Non-recyclable plastics (plastic bags, cutlery, etc)
  • Glass
  • Aluminum
  • Other metal
  • Newspapers
  • Corrugated cardboard
  • Paper towels
  • White paper
  • Mixed paper
  • Compostable food
  • Non-compostable food
  • Liquid
  • Styrofoam
  • Other

Special use (feel free to customize, as appropriate):
• Food packaging and related waste
• Workshop/studio materials
• Plastic bags, etc

RECYCLING

• Materials sent for recycling: Paper/Cans/Glass bottles/Plastic bottles/Other plastic
• Number of recycling receptacles (deskside, room, hall, building, outdoor space, dumpster)

COMPOSTING

• Number of compost bins, appropriate locations?

PRINTING/OFFICE EQUIPMENT/WORKSHOPS

• Number of printing equipment in each building
  o Copy machines
  o Fax machines
  o Printers
• Number that have duplex printing capability
• Number of trays for single sided paper
• Are used electronics (e.g. computer, printer, toner, etc) recycled?
  o Where are they sent off for recycling?
• Percent recycled content of paper purchased for office or computer lab
• Reuse of supplies, equipment, furniture

BATHROOMS

• Is bathroom tissue and/or paper towels composted?
• Percent recycled content of bathroom tissue and paper towels

CHEMICALS/HAZARDOUS WASTE

• Labs or workshops producing hazardous waste
  o Where is the hazardous waste disposed of?
  o Any special concerns?
• Does janitorial service use green cleaners? What kind?
• Does landscaping and maintenance service(s) use green chemicals, less toxic alternatives to paints, fertilizers, pesticides, and other chemicals?

KITCHEN

• Disposable plates, cups, eating utensils, stirrers? If so, what kind (e.g. styrofoam, plastic, paper, bio-plastics..)
• Food packaging: Identify unnecessary individual packaging e.g. tea, sugar, creamer, etc.

Checklist V:
Energy Use

BACKGROUND INFORMATION NEEDED

- Local energy provider
- Types and sources of energy (Electricity/gas/solar/others, renewable vs. nonrenewable sources)
- Energy conservation plan and measures in place? Include awareness/education.
- Energy bills over a 2-year period (longer period, if possible)
- Number of users per day
- Building operating hours
- Energy consuming equipment/functions in building
- On a building or site map, identify:
    - o Location of electricity and gas meters
    - o Location and production of capacity of alternative energy sources (e.g. solar, wind...)

USER ATTITUDE INFORMATION (can be approximated through informal interviews)

- Do faculty, student, and staff have basic energy conservation awareness and habits?

OFFICE EQUIPMENT

- Number of equipment in each building
    - o Computers (CPUs and monitors)
    - o Copy machines
    - o Fax machines
    - o Scanners
    - o Printers
    - o Servers
    - o Telephones
- Are they shut off or put on sleep mode at the end of the day?
- Are they energy efficient (e.g. Energy Star)?

LIGHTING

- Number of incandescent light bulbs
- Number of fluorescent light bulbs
- Number of halogen light bulbs
- Number of exit signs (are they LED?)
- Appropriate number of light switches, for control over large areas?
- Unessential light fixtures
- Location of inappropriate light usage (e.g. too much light, lights turned on when no one is using the room, weekends, etc) – Indicate on building plan.
- Percent of lights shut off after hours/weekends
- Outdoor lights: number of incandescent vs. fluorescent lights
- Special lighting needs or concerns
- Map out inappropriate or wasteful light usage

HEATING/COOLING

- Is the building generally too hot or too cold, or just the right temperature?
- Is heating/cooling control centralized?
- Is central controlling computer appropriately scheduled/timed with occupancy?
- Thermostats installed?
- Temperature thermostat is set to (should be 70 degrees F or lower)
- Number of air conditioners (should be between 73-75 degrees F)
- Number of fans
- Number of portable electric space heaters
- Number of large fans or motors in building?
- Hot water piping insulation
- Temperature setting of hot water
- Restroom exhaust fans on/off when not in use?
- Other exhaust fans in building?

BUILDING ENVELOPE

Identify locations on building/site plan:

- Are windows/doors kept close when air-conditioning or heater is on?
- Weather stripping around windows/doors sufficient?
- Solar films on windows to block excessive sun exposure?
- Windows double paned?

OTHERS

- Number of elevators, escalators
    - o Characterize their use over stairs
    - o Energy consumption
- Cleaning: How often are vacuum cleaners used, for how long? Other electrical cleaning equipment?
- Number of refrigerators
- Number of food/drink vending machines
    - o ON all the time or put to sleep mode?
- Other equipment/energy use/issues not covered in this checklist?

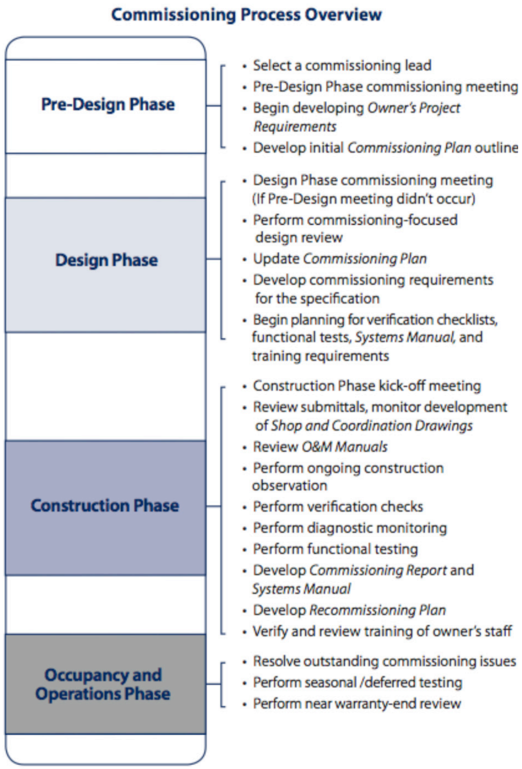
What is Building Commissioning?

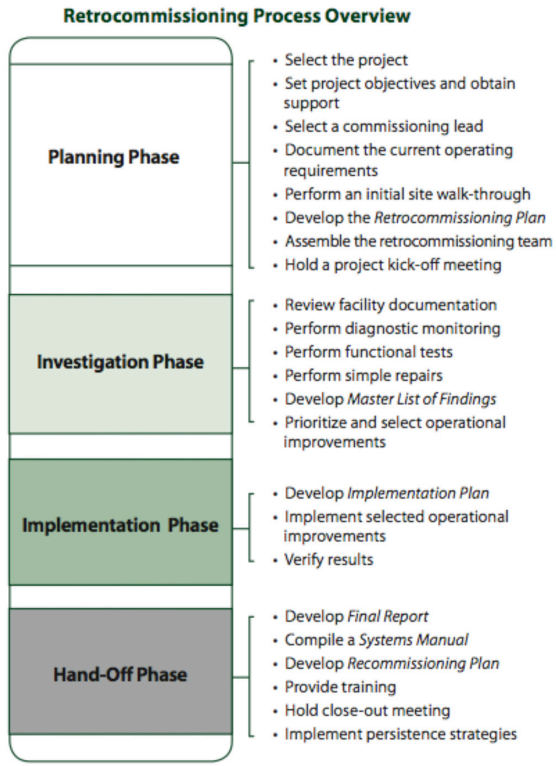
Drawing its terminology from shipbuilding, building commissioning is an intensive quality assurance process that begins during design and continues through construction, occupancy, and operations. Commissioning ensures that a new building operates initially as the owner intended and that building staff are prepared to operate and maintain its systems and equipment.

Retrocommissioning is conducted on an existing building, can often resolve problems that occurred during design or construction, or address problems that have developed throughout the building's life. In all, retrocommissioning improves a building's operations and maintenance (O&M) procedures to enhance overall building performance.

Source: California Commissioning Collaborative, 2006

The Process for New & Existing Buildings





Building Commissioning Payback Times

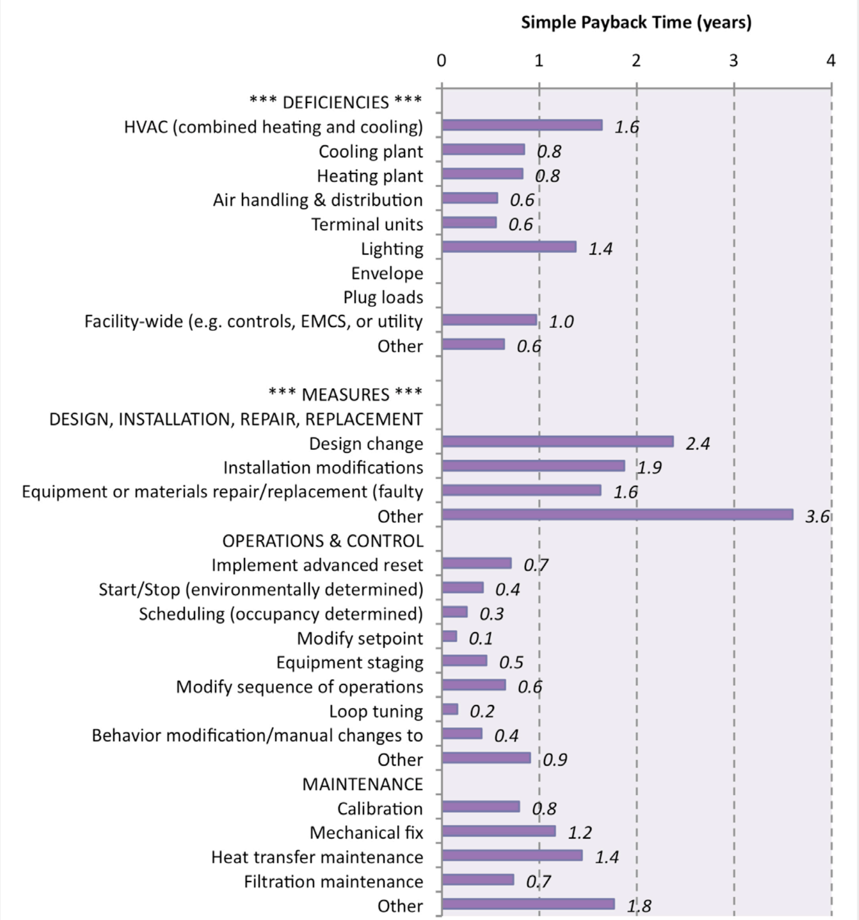
BY BUILDING TYPES

	Pre-Cx EUI (kBTU/ft^2-year)	Source Energy Savings (%)	Simple Payback Time (PBT - years)	Number of buildings (by PBT)
K-12			3.3	19
Higher education	250	11%	1.5	165
Food Sales	510	12%	0.3	10
Food Service				
Inpatient	532	15%	0.6	15
Outpatient	764	10%	0.1	13
Cleanrooms				
Data Center				
Laboratory	600	14%	0.5	50
Lodging	48	12%	1.5	38
Retail			1.4	9
Service				
Office	141	22%	1.1	145
Public Assembly			1.0	6
Public Order and Safety	229	16%	3.2	15

Values only shown when the sample size is five or more buildings.

Source: Lawrence Berkeley Laboratory, 2009

BY PROBLEM ("DEFICIENCIES") AND RESOLUTION ("MEASURES")



Documented Benefits and Costs

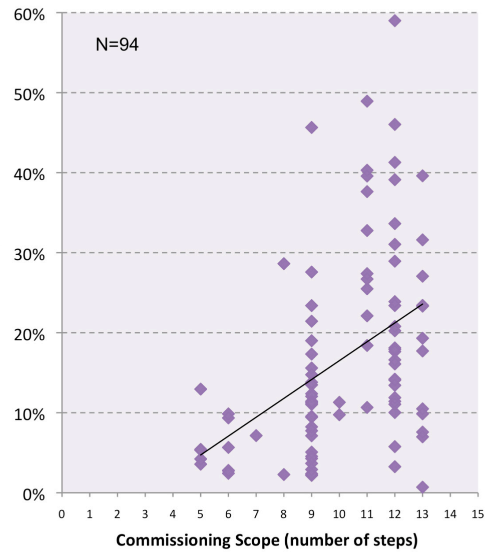
A study based on data on 643 buildings, representing 99 million square feet of floor space found that these benefits quickly offset project costs. Project commissioning costs represent just 0.4% of total costs for new buildings. Other non-energy and non-greenhouse gas benefits include jobs and economic development, greater user comfort, and lower demands on Operations & Maintenance.

	EXISTING buildings	NEW buildings
Median benefit-cost ratios	4.5	1.1
Median payback times	1.1 years	4.2 years
Median commissioning costs	$0.30 per square foot	$1.16 per square foot
Median whole-building energy savings	16%	13%
Very considerable reductions in greenhouse gas emissions	-$110/tonne CO2-equivalent.	-$25/tonne CO2-equivalent.

Source: Lawrence Berkeley Laboratory, 2009

ENERGY SAVINGS INCREASE WITH COMMISSIONING SCOPE

Projects employing a comprehensive approach attained nearly twice the overall median level of savings, and five-times the savings of projects with a constrained approach.



Source: Lawrence Berkeley Laboratory, 2009

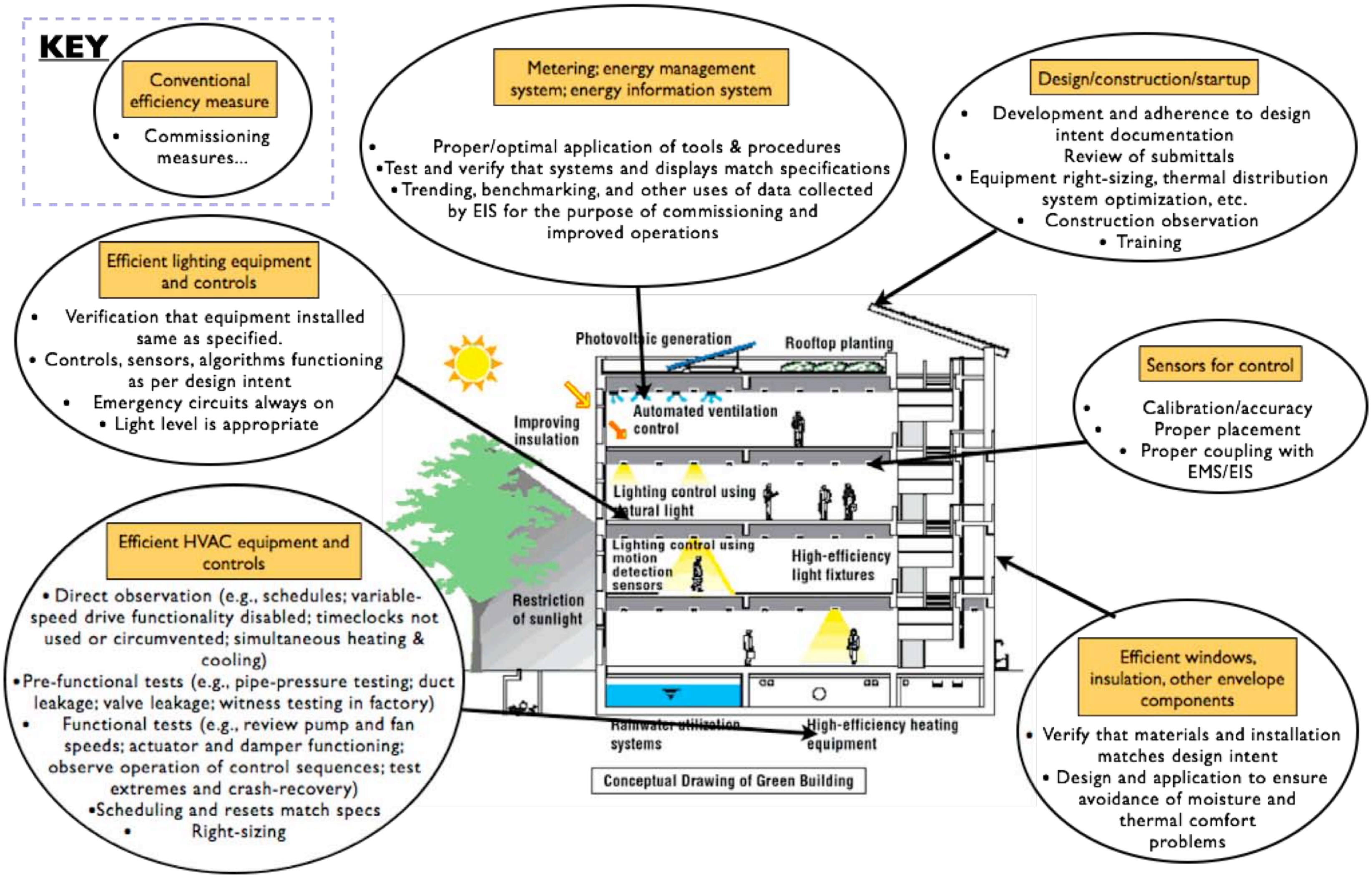
TOP 13 FAULTS CAUSING ENERGY EFFICIENCIES IN COMMERCIAL BUILDINGS

	National Energy Waste (Quads, primary/year)	Electricity equivalent (BkWh/year)	Cost ($billion/year)
Duct leakage	0.3	28.6	2.9
HVAC left on when space unoccupied	0.2	19.0	1.9
Lights left on when space unoccupied	0.18	17.1	1.7
Airflow not balanced	0.07	6.7	0.7
Improper refrigerant charge	0.07	6.7	0.7
Dampers not working properly	0.055	5.2	0.5
Insufficient evaporator airflow	0.035	3.3	0.3
Improper controls setup / commissioning	0.023	2.2	0.2
Control component failure or degradation	0.023	2.2	0.2
Software programming errors	0.012	1.1	0.1
Improper controls hardware installation	0.01	1.0	0.1
Air-cooled condenser fouling	0.008	0.8	0.1
Valve leakage	0.007	0.7	0.1
Total (central estimate)	1.0	94.6	9.6
Total (range)	0.34-1.8	32.4-171.4	3.3-17.3

Adapted from Roth et al. (2005) assuming 10,500 BTU/kWh, and $0.10/kWh

Source: Lawrence Berkeley Laboratory, 2009

Commissioning vs. Conventional Efficiency Measures



SECTION VI: CLOSING REMARKS

Towards the Science of Ecocity Building

The Campus as a Living Laboratory

As little as two or three conventional city blocks can potentially have enough diversity of structures and functions to embody the kind of city the future needs. Schools, housing, offices, labs, social gathering places, places to eat and drink, and useful commerce would all have to be there. Architectural designs respect proper sun angles and are informed by the weather and ecology of the place. A creek running underground provides an opportunity for waterway, fish and riparian restoration coordinated with social open spaces.

Australian architect Paul Downton called this kind of full-features community development an Ecocity Fractal, a fraction of the whole with all essential parts present and well arranged for mutual synergistic benefit. Such fractals could be what Ecocity Builders has variously called an integral neighborhood, and integral downtown, or in the case being considered here, an integral campus.

An ecocity school, college or university would have to be part of a new ecocity or a conventional existing city, resolutely determined to become an ecocity in its near-term and long-term future growth. An existing school campus could be reshaped and "re-missioned" to create such an ecocity school and provide a context of a whole campus. The concept of a Living Laboratory, that of a full-bodied community in its own right that sets in motion changes in the ecocity direction, can be manifest in both its physical facilities and in related curriculum.

An ecocity campus should adopt a comprehensive architectural approach, not just a few "green buildings." Interrelated structures that express the best of our thinking on ecocities to date -- essential parts and associated functions integrated as best we can imagine, linked by foot, bicycle, elevator, and bridges between buildings -- are essential in providing thorough pedestrian access and pleasure. They include covered walkways in rainy or snowy locations complimented by easy transit access and service. At this late date in solving global problems, an ecocity campus would have to be a complete living organism, structurally whole and healthy. The world needs that kind of model. Richard Register's "anatomy analogy" describes a full spectrum ecocity or ecocity fractal.

The Ecocity University would amount to education embodied in the structure itself. The school would teach, by its own physical example, as well as through its curricula. The ecocity school and its facilities could perhaps start out as a growing branch of and administrated by the School of Construction and the Environment committed to such a sustainability plan. With institutional blessing, such a Sustainability Precinct could work with remodel and integrate buildings into the larger ecocity fractal context, and inspire the rest of the campus and surrounding metropolitan area.

Ecocity University: Curriculum Ideas

The triple crisis of climate change, approaching end of cheap energy and species diversity collapse world-wide requires this to happen as soon as we can possibly organize it. The schools or departments involved and disciplines covered would demonstrate a commitment to innovation around the basic principles of reshaping cities to help solve the world's environmental problems. An initial founding team could discuss the following core areas in some detail, leading to early stages in organizing:

> Construction
> Engineering
> Architecture
> Development
> Layout and City Design
> Transportation
> Energy
> Restoration of Natural and Agricultural Lands
> Public Policy
> Economics and Political Strategies

Basic subjects or courses that would be taught:

> Ecocities: Basic Concepts and Principles
> History of Ecocity Design: Past and Present Patterns
> Ecological Architecture
> Public Transportation: From In-city to International
> Private Transportation and Urban Design: By Foot, Bike and Elevator
> Engineering for Enduring Ecocities: Amortization and Conservation
> Renewable Energy Technologies: Basic Macro Chemistry and Physics
> Materials Resources Inventories and Projections
> Permaculture: Low-Energy Organic, Locally-Focused, and Skills-Intensive
> Indigenous People's Traditional Built Community: Learning from Early Cities
> Land Use and Development Law
> Ecological Economics and Economic Development
> Green Business Development: Building and Maintaining Ecocities
> Political Strategy and Tools for Ecocities
> Restoration of Natural Systems and Related biodiversity and Evolution
> Bioregional Geography
> Sociology and Psychology related to Ecocities

Taken together, the above subjects or courses inform society on "what to build." The current ideas for solving today's environmental problems revolve, rather randomly, around bailouts of already existing and failing systems, with the "shovel ready" approach funding precisely what got us into the problems in the first place. We need to not rebuild the problem but rather the solution. You can only learn how to do that if there is a concerted effort at the level of advanced education to directly confront the problem of building "the right thing." The internal principles, such as those evident studying the "anatomy analogy" and the physics and chemistry of designing for "access by proximity" need to be at the core.

At the same time, each potential ecocity or ecocity fractal must relate sensitively to, as said earlier, the local conditions of sun angles, weather, geography, natural support for food sources in soil and waters, and local cultural traditions. The mix is a wonderfully rich panorama for any school to explore, and indispensable if we are to leave our grandchildren but a lonely planet in chaos.

Opportunity in Innovation

An objective in launching an ecocity college or university initiative could be to gain "priority" as the scientists say in questing first discovery, or as the application of laws or technologies in establishing the world's firsts. If such an initiative were successful, BCIT would enjoy a very influential position among educational institutions around the world. We need to do it right, as fast as possible, as society is likely to break down quickly if we do not learn and teach ourselves how to build radically low-energy, land-conserving, bioculturally regenerative cities. A university can be a very powerful economic, creative and important intellectual key element in a city's economy. It can help an early ecocity thrive and influence other similar city-building.

BCIT CHARRETTE TEAM

Richard Register
President and Founder, Ecocity Builders

Richard Register is one of the world's great theorists and authors in ecological city design and planning. He is also a practitioner with three decades of experience activating local projects, pushing establishment buttons and working with environmentalists and developers to get a better city built and running. He convened the first of the Ecocity International Conference Series in Berkeley, California.

Register illustrates his own writing, and his books are considered as pleasurable for his imaginative drawings as profound in their ecological urban philosophies and visions. Register is the author of Ecocities: Building cities in balance with nature (2002), Ecocity Berkeley: Building cities for a healthy future (1987), and Another Beginning (1978). He is editor of Village Wisdom/Future Cities (1997).

Register is a frequent guest of organizations and conferences large and small in his home town, the San Francisco Bay Area, and around the world. He has traveled the equivalent of 22 times around the world (as of Summer 2003) advocating for the potential for the pedestrian city to save the world -- by reducing automobile dependence, global warming, massive sprawl, ecological habitat fragmentation, air and water pollution and other harms. Cities are the largest systems that humans build, and we can build them to contribute to humanity's creative and compassionate evolution on a healthy planet, in exciting and rewarding built communities from the village to the city scale.

Register has spoken at the alternative events at all the major United Nations environmental conferences, in Stockholm, Rio de Janeiro and Johannesburg, and Habitat II, "The City Summit" in Istanbul. Universities, architectural firms, transportation experts, futurist conferences, colleges' associated student body events, business councils, small local creek restoration groups, and city mayors and government agencies have all hosted his talks or classes.

Register was recently appointed to the international Scientific Advisory Committee on Active Ecological Urban Development to the Scientific Committee on Problems in the Environment (SCOPE), an international association of several nation states and two dozen major scientific associations. The project is led by Rusong Wang, host and co-convener of the 5th Ecocity International Conference in Shenzhen, China.

Kirstin Miller
Executive Director, Ecocity Builders

Kirstin is an environmental activist, community organizer, and a writer and editor. She has been with Ecocity Builders since 1997 and currently serves as Executive Director. Kirstin has presented for the organization locally, nationally and internationally. Her articles and essays on ecocities, urban ecology and the environment have appeared in a number of publications, including Orion Afield, Ecotecture and Wilderness and Human Communities, The Spirit of the 21st Century.

Kirstin works closely with Ecocity Builders' President Richard Register in the development of the organization's "toolbox" of strategies, such as car free by contract housing, environmental restoration transfer of development rights, centers oriented development, ecological demonstration projects and ecological zoning overlay mapping. She also helps coordinate an alliance of local environmental organizations working to promote and advance ecologically healthy urban policies and projects, including the development of an ecological demonstration project in the heart of Berkeley, CA.

Jane Wardani
Project Associate, Ecocity Builders

Jane Wardani brings 10 years of international experience in urban planning and sustainability, focusing on stakeholder engagement, capacity building, and environmental justice. She has worked in multicultural settings across a range of development topics, from tourism development in Thailand, to neighborhood planning in low-income communities of color in the San Francisco Bay Area. She has lived in Indonesia, France, and Singapore and is a language enthusiast. In 2008, she graduated from the concurrent Master of City Planning, Master of Landscape Architecture program in environmental planning at University of California, Berkeley, completing her thesis on creek and watershed restoration, stewardship and justice. Jane is active in the Northern California Chapter of the American Planning Association, as well as in grassroots nonprofit organizations working locally in the San Francisco Bay Area.

Geoffrey Holton
Licensed Architect, CGBP, LEED AP

Geoffrey has practiced and taught architecture in the San Francisco Bay area since the late 1980s, including work as a studio instructor at UC Berkeley and CCA. He formed his own firm, GHA, in Oakland in 1996. Geoff's long held convictions about green design have recently borne fruit. In addition to several local awards for green architecture projects, the firm has placed highly in recent international sustainable design competitions. In parallel with residential design work integrating renewable energy, living roofs and water conservation, Geoff is currently pursuing community projects emphasizing durable urban futures and local economic development. When not working on his never quite finished house, Geoff enjoys biking in the city and hiking as far away from the city as he and his family can get.

Penelope Grzebik
Project Coordinator

Penelope is a seasoned environmental marketing professional who handles project coordination for Ecocity Builders. Prior to joining Ecocity, she was marketing manager for WeatherTRAK, a smart water management company located in Petaluma. With more than 15 years of marketing experience, her successes include database marketing, website creation, e-marketing, and multi-media collateral development. She is currently earning certifications in green building and environmental planning from both Sonoma State University, and the University of California at Davis. Penelope is a member of the Congress of New Urbanism, Urban Land Institute and U.S. Green Building Council.

Dmitry Ozeryansky, C.E.
Structural Engineer

Dmitry Ozeryansky has over 12 years of structural analysis, design, and project management experience in the San Francisco Bay Area. He has worked on new construction, retrofits, and renovations of large and small buildings. Dmitry has particular experience with projects that often require using a variety of materials ranging from concrete and steel to timber and light framing. He is a Build-It-Green Certified Green Building Professional and is active on the Sustainable Design Committee of the Structural Engineers Association of Northern California as well as other professional organizations listed below. Early in his career, he gained valuable experience while at Rutherford & Chekene working on large projects with advanced systems such as the new medical laboratories at UCSF campus at Mission Bay in San Francisco. More recently, he worked in a small business setting with Yu Strandberg Engineering and brought his experience to the design issues of smaller buildings, especially single and multi-family homes.

About Ecocity Builders

Ecocity Builders is a non-profit organization dedicated to reshaping cities, towns and villages for long term health of human and natural systems. We promote ecocity design principles through planning, policy advocacy, and education.

We work to build thriving neighborhood centers while reversing sprawl development, to build whole cities based on human needs and "access by proximity" rather than cities built in the current pattern of automobile driven excess, wasteful consumption and the destruction of the biosphere. Our goals also include returning healthy biodiversity to the heart of our cities, agriculture to gardens and the streets, and convenience and pleasure to walking, bicycling and transit. We visualize a future in which waterways in neighborhood environments and prosperous downtown centers are opened for curious children and adults and for wildlife.

ECOCITY BUILDERS

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