

Sustainable Communities

Geog 4771 – Fall 2017

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Lakehead University



What is a sustainable community?

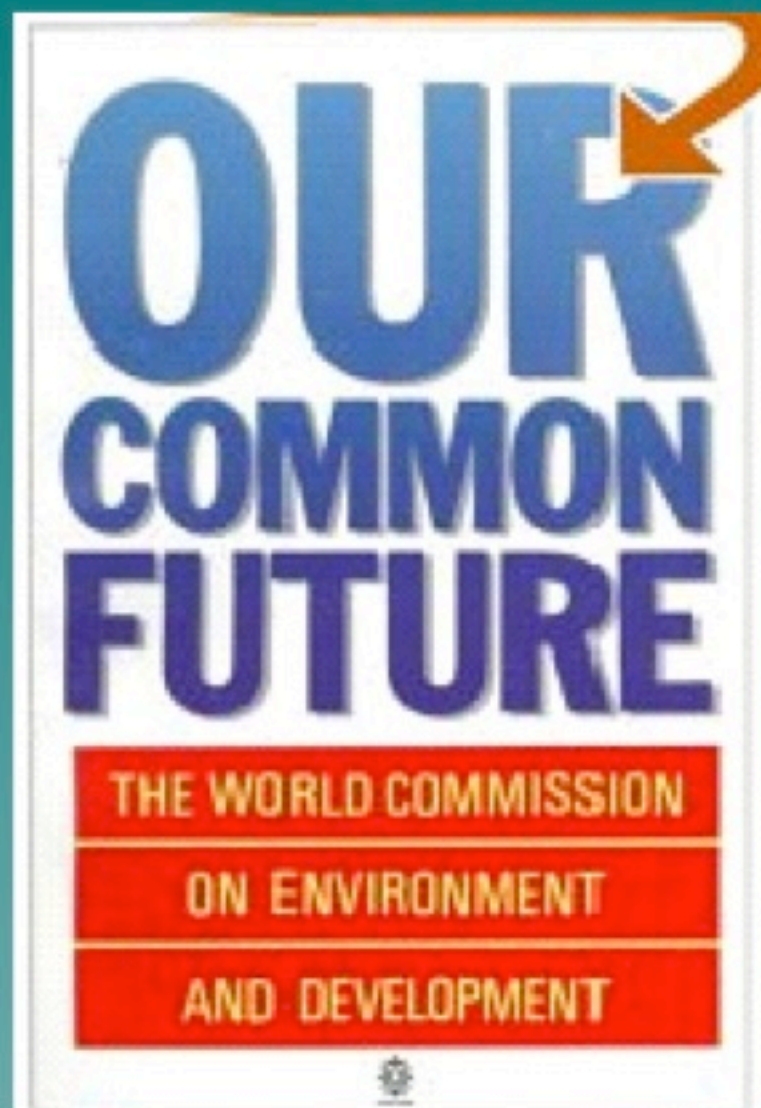
There are many definitions and concepts.

The path to sustainability is different for every community but the common elements are:

- **a healthy environment,**
- **a strong economy**
- **and the well-being of the people living in the community.**

When sustainability areas are addressed in tandem with each other, they have a powerful, positive effect on the quality of life and future of a community.

A Definition of Sustainable Development



“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987, p.8)

Sustainability

- ◆ Sustainability is viewed as a balance between the **Environment**, the **Economy** and **Societal Well-Being**
- ◆ As stewards of the planet, we are responsible to **strike a balance** between our activities and environmental preservation

“Sustain”

from Latin *sustinere*

“hold up, support, endure,”

from sub “up from below”

+ tenere “to hold”

Dictionary.com

Course Description:

A review of practical applications relating to concepts of sustainable community planning, with specific reference to:

- transportation systems
- land-use zoning
- water and energy usage
- severe weather resilience
- agriculture.

Measurement of urban sustainability and the sustainability of human activities at regional and city scales are also considered.

Course Grading:

Seminar 1: (assigned topic)	15
Seminar 2: (student choice)	
Proposal & Paper	25
Presentation	10
Midterm	25
Group Policy Brief & Oral Report	10
Project Final Written Report	10
Class Participation	5
	<hr/>
	100

More about seminars and group project

- ◆ Seminars
- ◆ Group project
 - LCRA?
- ◆ **Lakehead University Climate Change Forum**
- ◆ **September 28th and 29th, 2017** A network of researchers, community workers, academics, and government agencies will converge to discuss climate change adaptation/mitigation strategies.
- ◆ <http://climatechange.infosuperior.com/>
- ◆ Other possibilities?

Course Objectives:

- ◆ provide an appreciation for the principles of Sustainable Community Design
- ◆ explore technical issues of sustainability with regards to: waste management; landscape naturalization; water and wastewater treatment; transportation; energy; green building standards; land use planning and policy; **need and methods for preparation for severe and more frequent severe weather events;**
- ◆ evaluate sustainability in Thunder Bay and region
- ◆ provide opportunities for development and practice of writing and communication skills.

Preparing for Severe Weather



Severe Weather Events

Houston and related flood areas



Photo credit: Pu Ying Huang for The Texas Tribune

The third catastrophic flooding event this region of 6.5 million people has experienced during 2015 to 2017.

Missed preparations

(long term)

- ◆ Preserve and restore as much prairie land as possible
- ◆ Restrict development in floodplains and buy flood-prone homes
- ◆ Educate the public about risk of flood

“The exact same storm that comes along today has more rain associated with it than it would have 50 or 100 years ago... Houston needs to plan for more frequent and intense rainstorms, just like many other cities in the country”

Katharine Hayhoe, climate scientist

Barker Dam and Barker Reservoir in the background in Houston, Texas



Photo credit: ary Coronado / Houston Chronicle

Evacuations

(short term)

◆ **Why not evacuate before Harvey?**

139 deaths that the state linked to Hurricane Rita, 73 occurred before the storm hit Texas. Twenty-three people died in a bus fire. Ten others died from hyperthermia due to heat exposure.

◆ **Florida evacuations**

Climate change

Little or no planning

Local policy makers largely looked to past rainfall totals and weather patterns. Climate change heighten the risks that the region already faces. Gulf of Mexico, where sea levels are rising and waters have been warming as the planet gets warmer. Warm water means more evaporation and more water vapour in the air — when a storm comes along, there is more moisture to pick up and dump on nearby land. This is exactly what's happening with Tropical Storm Harvey.

adapted from Los Angeles Times article



Two-Day Graphical Tropical Weather Outlook

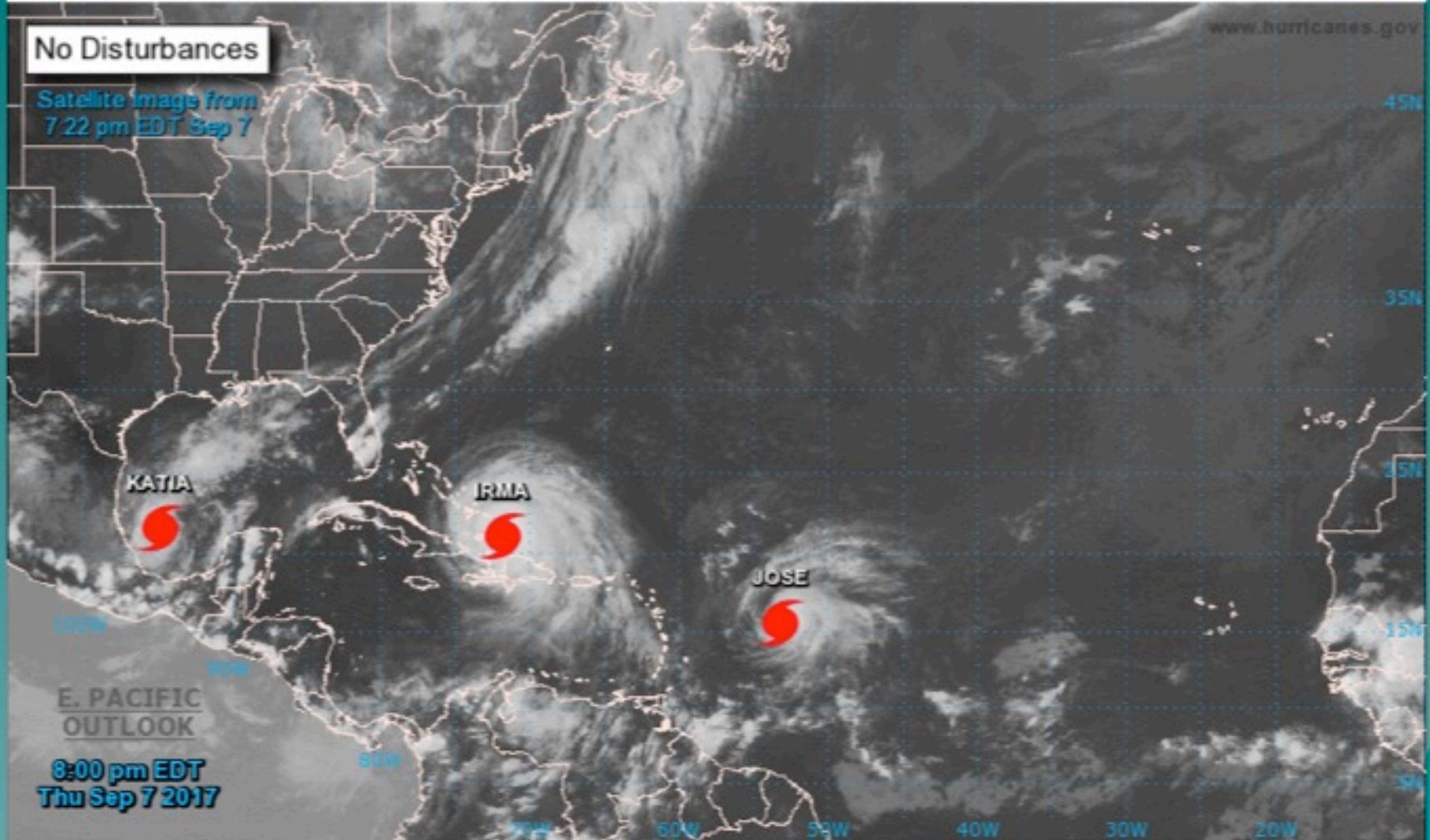
National Hurricane Center Miami, Florida



No Disturbances

Satellite image from
7:22 pm EDT Sep 7

www.hurricanes.gov



E. PACIFIC
OUTLOOK
8:00 pm EDT
Thu Sep 7 2017

Current Disturbances and Two-Day Cyclone Formation Chance: < 40% 40-60% > 60%

Tropical or Sub-Tropical Cyclone: Depression Storm Hurricane

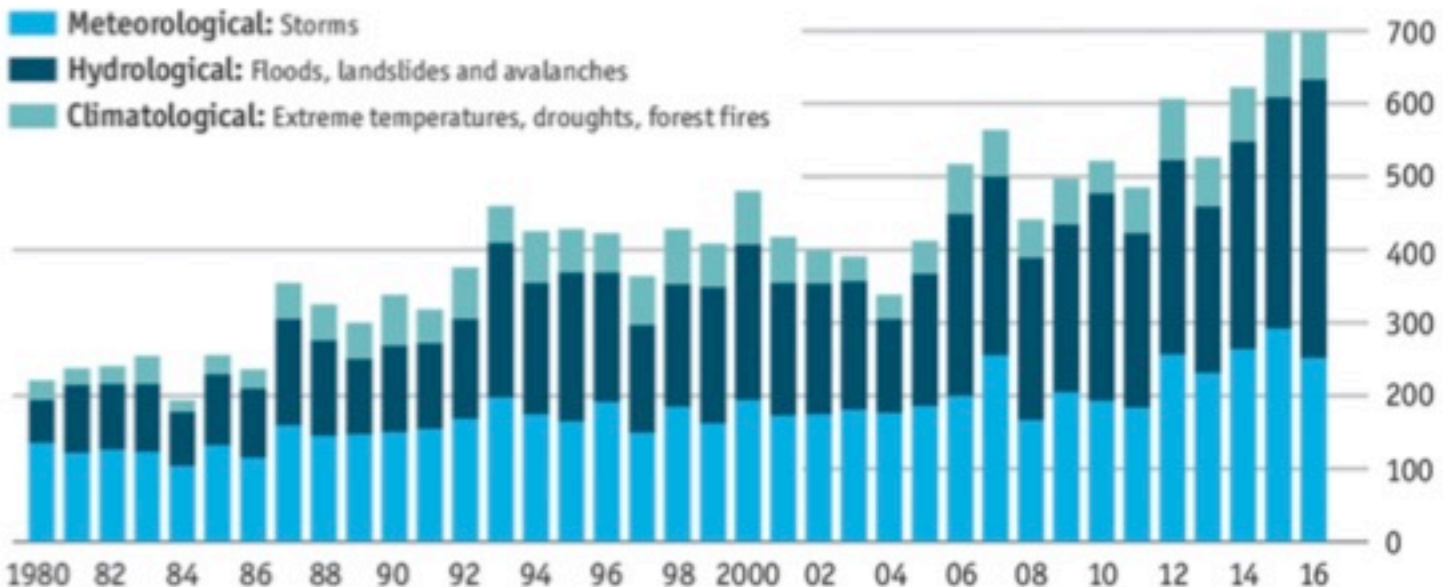
Post-Tropical Cyclone Remnants

Extreme weather: *Le déluge*

The number of natural disasters worldwide has more than quadrupled since 1970 to around 400 a year. There are six times more hydrological events, such as those in Texas or South Asia, now than in 1980. Yet fewer people are dying, thanks to improved building strength, flood-prevention schemes and other measures. To reduce deaths still further, urban planners may have to plan for more such extreme events, [writes our data team](#)

A rising tide

Natural disasters by cause



Source: Munich Re

Irma in Florida

- ◆ What are some long, medium and short term preparations taken in Florida to prepare for hurricanes such as Irma?
- ◆ Do any preparations provide more than one benefit for the community (in tandem)?

DISCUSSION





Agenda for Sept. 13

- ◆ Erma updates and discussion
- ◆ Ignorance about warnings
- ◆ Harvey
- ◆ Not in Canada?
- ◆ Netherlands



Two-Day Graphical Tropical Weather Outlook

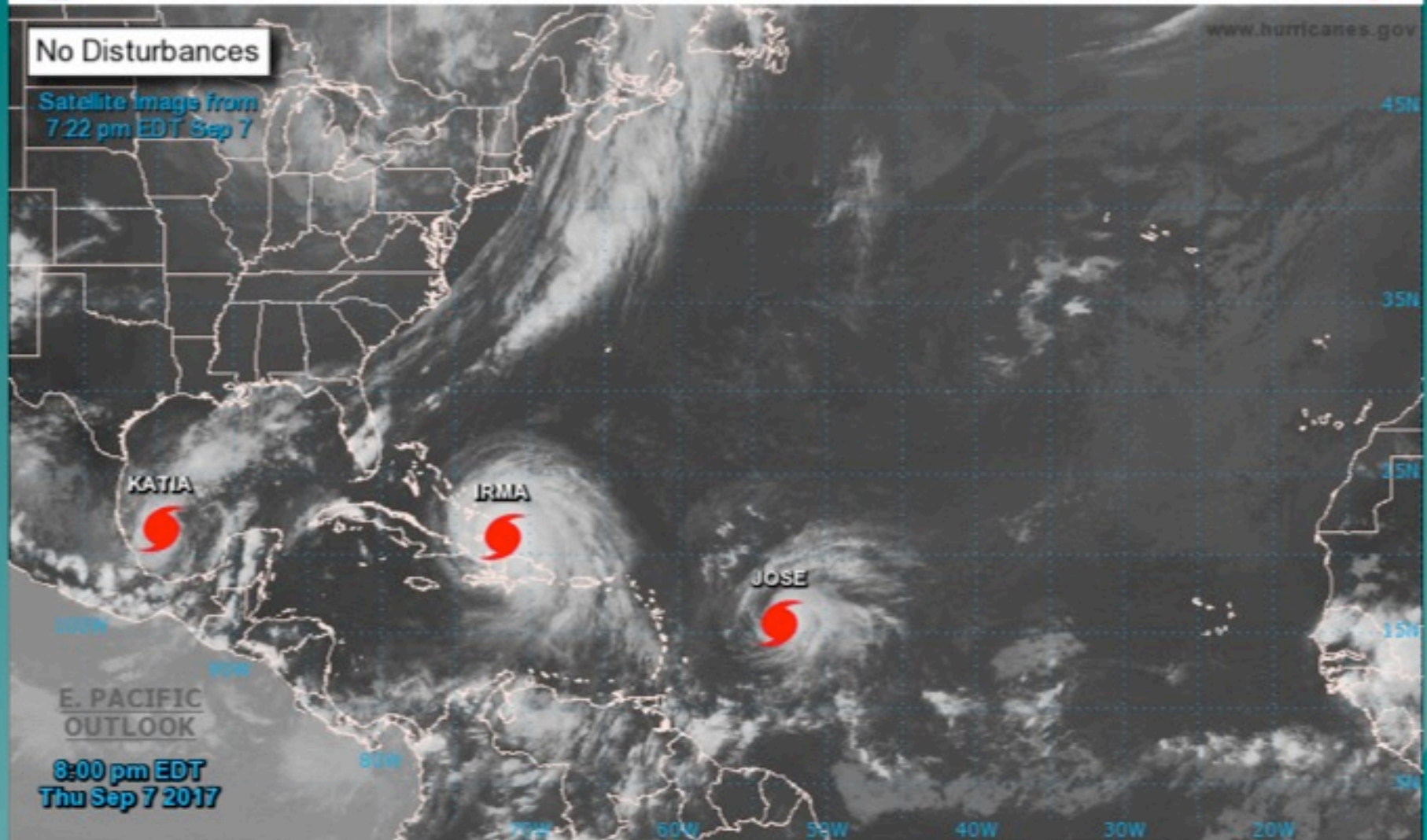
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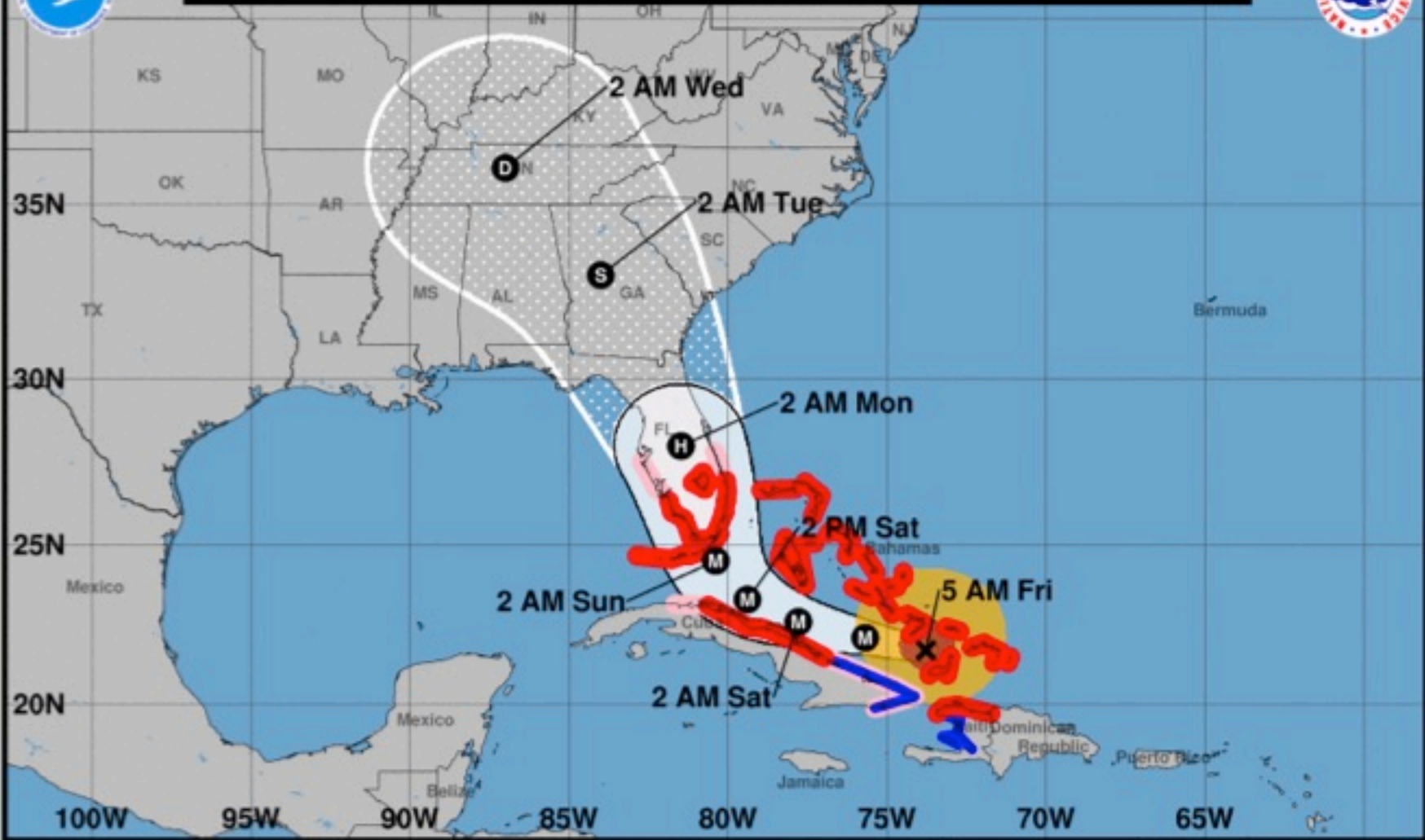
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Tropical or Sub-Tropical Cyclone: Depression Storm Hurricane

Post-Tropical Cyclone Remnants



Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



Hurricane Irma
 Friday September 08, 2017
 5 AM EDT Advisory 37
 NWS National Hurricane Center

Current information: x
 Center location 21.7 N 73.8 W
 Maximum sustained wind 155 mph
 Movement WNW at 16 mph

Forecast positions:
 ● Tropical Cyclone ○ Post/Potential TC
 Sustained winds: D < 39 mph
 S 39-73 mph H 74-110 mph M > 110 mph

Potential track area:

Day 1-3 Day 4-5

Watches:

Hurricane Trop Stm

Warnings:

Hurricane Trop Stm

Current wind extent:

Hurricane Trop Stm

Extreme weather: *Le déluge*

The number of natural disasters worldwide has more than quadrupled since 1970 to around 400 a year. There are six times more hydrological events, such as those in Texas or South Asia, now than in 1980. Yet fewer people are dying, thanks to improved building strength, flood-prevention schemes and other measures. To reduce deaths still further, urban planners may have to plan for more such extreme events, [writes our data team](#)

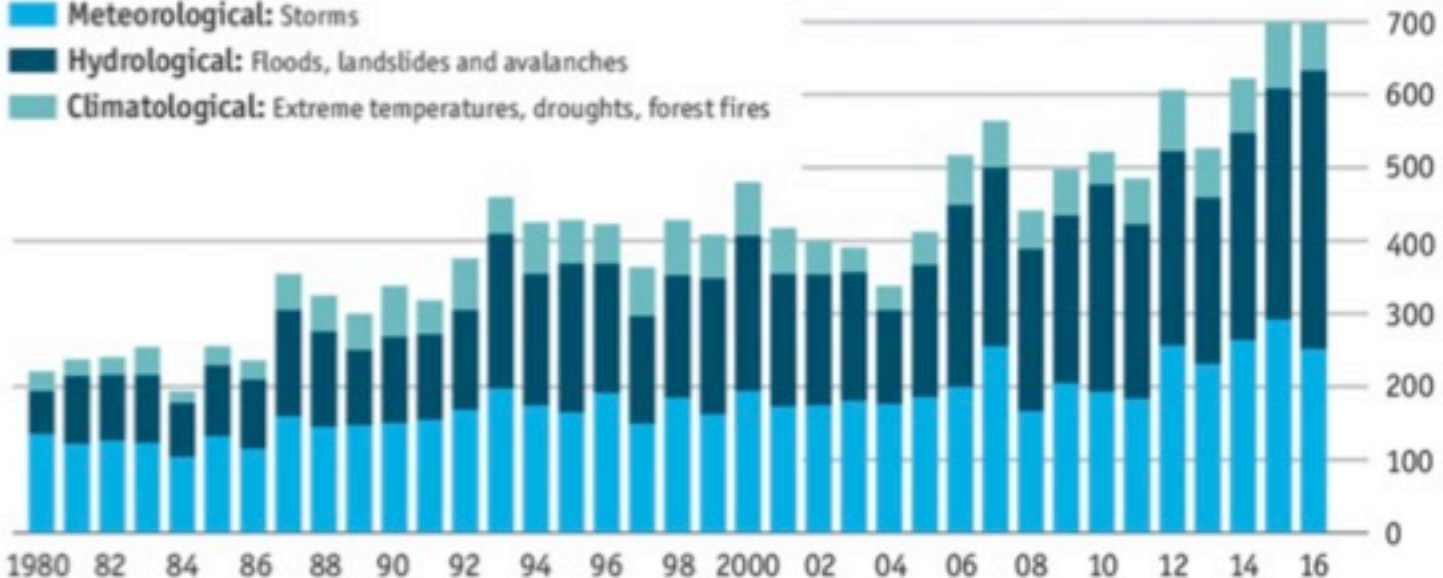
A rising tide

Natural disasters by cause

Meteorological: Storms

Hydrological: Floods, landslides and avalanches

Climatological: Extreme temperatures, droughts, forest fires



Source: Munich Re

Irma in Florida

- ◆ What are some long, medium and short term preparations taken in Florida to prepare for hurricanes such as Irma?
- ◆ Do any preparations provide more than one benefit for the community (in tandem)?

Hurricane Katrina

- ◆ Katrina made landfall August 29, 2005 early in the morning just east of New Orleans.
- ◆ Katrina had wobbling over the Gulf of Mexico for days.
- ◆ It was classified as a strong Category 3 storm with winds to 200 kmh.
- ◆ Protective levees failed during the storm surge. At least 650 people were killed on day one.
- ◆ Total fatalities 1833 and \$108US billion
- ◆ Hurricane Mitch in 1998 caused 11to 20 thousand deaths and about \$5 billion in damage

Lessons learned?

- ◆ President George W. Bush and Vice-President, Dick Cheney had withdrawn the United States from a global climate agreement and dismissed the findings of the government's own climate scientists.
- ◆ Obama: 2008 – 2016
- ◆ Ten days before Harvey hit Texas, President Trump rescinded an Obama executive order requiring public-infrastructure projects in flood-prone areas to be designed with sea-level rise in mind. As rainfall totals in Houston were topping one metre, Secretary of State Rex Tillerson told Congress that he was planning to eliminate his department's special envoy for climate change.

Lessons learned?

- ◆ Last week, against the backdrop of significant weather disasters worldwide the Intergovernmental Governmental Panel on Climate Change (IPCC) met in Montreal for their 46th session since its creation in 1988.
- ◆ The "**Toronto target**" of 1988.
- ◆ Year 2005

Lessons learned?

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Sustainability Concept

- ◆ Reduced consumption of ENERGY, RAW MATERIALS and LAND
- ◆ Achieved via:
 - Use of Renewable Forms of Energy (e.g., wind, solar)
 - Use of Recycled (rather than Virgin) Materials
 - Re-Use of Urban Land (Development of **Brownfields** and Greyfields rather than Continued Expansion onto **Greenfields**)
- ◆ Sustainable Community Design ...

Scales for Sustainable Community Design



- ◆ Orientation of buildings
- ◆ Construction materials
- ◆ “Green Building”

- ◆ Alignment and Style of Streets
- ◆ Traffic Calming
- ◆ Stormwater Treatment

- ◆ Transit and Land Use Planning

- ◆ Conurbation: an aggregation or continuous network of urban communities

END



<https://www.theguardian.com/public-leaders-network/2016/oct/03/china-government-solve-urban-planning-flooding-sponge-cities>

Introduction to Sustainability

Sustainability Preamble (2)

- ◆ Like an ecosystem, the planet has a finite **CARRYING CAPACITY**
- ◆ **Ecological Footprinting**
- ◆ As stewards of the planet, we are responsible to **strike a balance** between our activities and environmental preservation
- ◆ Sustainability is viewed as this balance between the **Environment**, the **Economy** and **Societal Well-Being**

Remainder of Presentation

- ◆ Overview of Green Building
 - ◆ Green Roofs
 - ◆ Toronto's Healthy House
 - ◆ LEED Standards
 - ◆ Brownfield Development
- 

Green Building (definition)

- ◆ The practice of **increasing the efficiency** with which buildings and their sites use energy, water, and materials, and **reducing building impacts** on human health and the environment (from Wikipedia 2007)
- ◆ **Principles applied throughout the complete building life cycle** (i.e., siting, design, construction, operation, maintenance and removal)

Green Building as defined by Alex Wilson (2006) Your Green Home

- ◆ Used to describe buildings with some or all of the following characteristics:
 - Buildings with **minimal adverse impacts** of local, regional and even global ecosystems;
 - Buildings that **reduce reliance on automobiles**;
 - Buildings that are **energy-efficient** in their operation;
 - Buildings and grounds that **conserve water**;
 - Buildings that built in an environmentally responsible manner from **low-environmental impact materials**;
 - Buildings that are **durable** and can be maintained with minimal environmental impact;
 - Buildings that **help their occupants practice environmentalism**;
 - Buildings that are **comfortable, safe, and healthy** for their occupants.

ECOFRIENDLY CONSTRUCTION

With 32 "green" buildings, Seattle has become a leader in environmentally sensitive building and design. Green construction aims to reduce pollution and reduce dependence on power plants and logging.

▶ GREEN ROOFS:

A thin layer of plants and soil on rooftops provides insulation, reduces stormwater runoff, absorbs carbon dioxide and creates oxygen.

▶ WATER EFFICIENCY

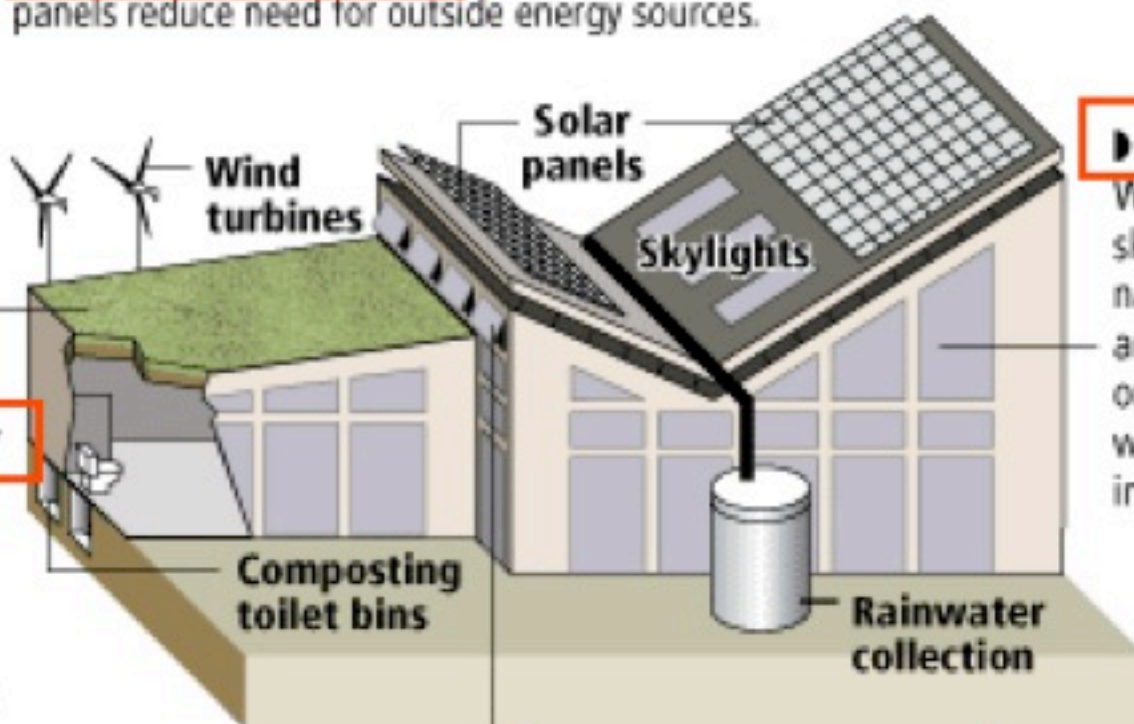
Cisterns collect rainwater to use for landscaping irrigation. Low-flow, waterless or composting toilets help reduce water use.

▶ VENTILATION

Vents and operable windows assist in heating and cooling by circulating air better.

▶ ALTERNATIVE ENERGY:

Roof-mounted wind turbines and solar panels reduce need for outside energy sources.



▶ WINDOWS

Windows and skylights provide natural lighting and heat. Glazed or double-paned windows provide insulation.

▶ BUILDING MATERIALS:

Recycled building materials reduce waste. Building with certified lumber helps protect forests and using non-toxic paints and carpets creates a healthier interior space.

Source: P-I reporting

SEATTLE POST-INTELLIGENCER

Benefits of Green Building

- ◆ **Reduced Operating Costs** by increasing productivity and using less energy and water,
- ◆ **Improved Public and Occupant Health** due to improved indoor air quality, and
- ◆ **Reduced Environmental Impacts**
 - (e.g., lessening stormwater runoff and the heat island effect).

Green Building Materials (1)

◆ Natural Materials

- Less off-gassing of solvents, etc leading to improved indoor air quality



Example: Straw-bale construction

Straw Bale Houses

- ◆ Walls of compressed straw bales (laid like bricks) that are approximately 18 inches (45 cm) thick.
- ◆ Straw bales provide **better insulation than conventional** fibreglass or cellulose fibres.
- ◆ **Energy efficient** (25 - 40% less heating and cooling energy required).
- ◆ **Inexpensive to build** (up to 50% savings from conventional wall structures).

<http://www.kellybradford.com/7thportfolio2.html>

<http://www.strawbalebuilding.ca/strawbales.shtml>

<http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/02-115e.pdf>



Location: Kanata, ON
of Bedrooms: 4
Square Footage: 1890
Built: 2002



<http://www.strawbalebuilding.ca/houses/37.shtml>

<http://www.strawbalebuilding.ca/houses/44.shtml>



Location: Bancroft, ON
of Bedrooms: 2
Square Footage: 1400
Built: 2004



Built Examples

Green Building Materials (2)

◆ **Certified Sustainable**

- E.g., "Certified Wood" from sustainable forests rather than old growth destruction



Green Building Materials (3)

◆ Local Materials

- i.e., short haul distances

◆ Recycled Materials

- Consider the example of Construction and Demolition Debris



Construction & Demolition Debris (C&DD)

- ◆ C&DD consists of {concrete, asphalt, wood, gypsum wallboard, asphalt roofing materials, metal, bricks, glass, plastics, building components, trees, soil, rocks}
- ◆ C&DD in the USA in 2003: **≈ 164 million tonnes**
 - 9% construction waste
 - 38% renovation waste
 - 53% demolition waste
- ◆ Reuse strategies can include on-site reuse, donations to other projects, or off-site recycling

Existing and Emerging Green Technologies

◆ **Energy Generation**

- E.g., solar panels (on- and off-grid systems)

◆ **Greywater Recycling**

- Filtering and reuse of bathing and washing water for non-potable household uses

◆ **Passive Solar Design**

- E.g.s., solar orientation of streets, window placement, building massing

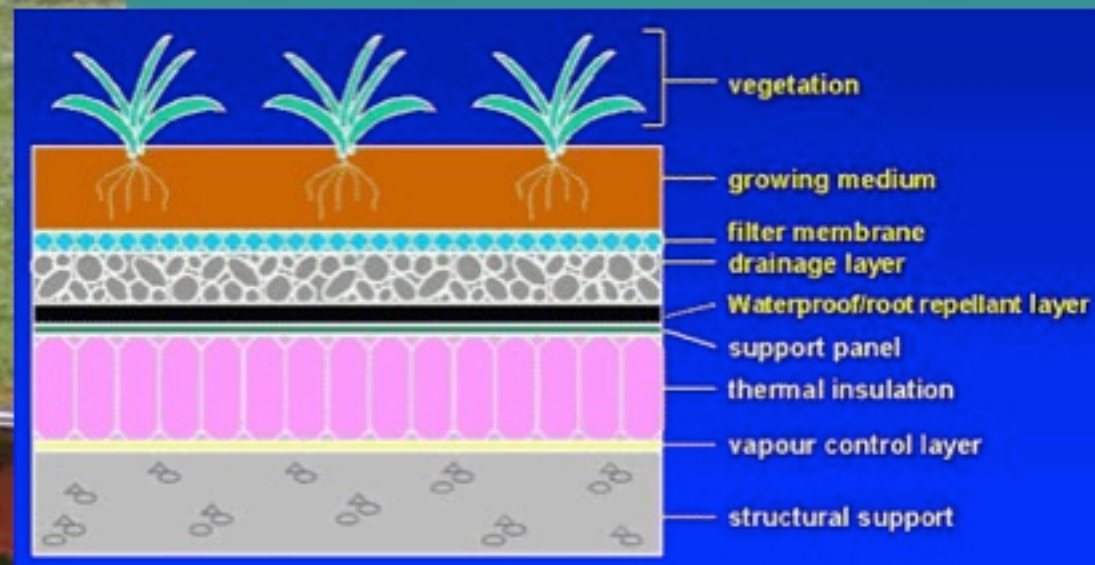
◆ ...

Green Roofs



Green Roofs (1)

- ◆ (def'n) part or all of the roof area is covered with vegetation, planted in a layer of soil that sits on a membrane directly on the roof surface;



Source: NRC 2004

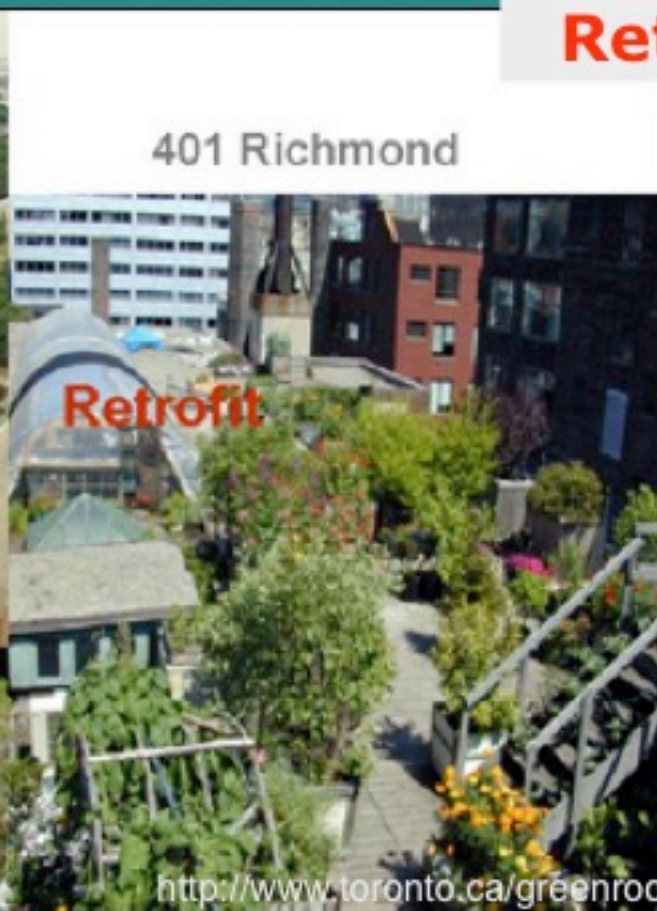
Green Roofs (2) – examples from Toronto

- ◆ “concept ...to replace the vegetated footprint lost when the building was constructed” (Schneider 2006)



New

York University
Computer Science Building



401 Richmond

Retrofit

Retrofit

New

Benefits of Green Roofs

- ◆ Stormwater retention
- ◆ Insulation
- ◆ Cooling
- ◆ Air quality improvements
- ◆ Energy conservation
- ◆ Sound absorption
- ◆ Food production
- ◆ Bird/insect habitat



Herb garden on top of the Fairmont Hotel in Vancouver.

Toronto's Healthy House

The image features a solid teal background. In the bottom right corner, there is a stylized, dark teal silhouette of a mountain range with jagged peaks.

Canada Mortgage and Housing Corporation (CMHC)

Healthy House Competition (1996)



Healthy House in Toronto's
Riverdale Neighbourhood

Photo Credits: Breathe Architects
(2007)

Key Facts

- **1700 ft²**, semi-detached, 3 bedroom home operated by CMHC
- **100% "OFF GRID"** with an annual operating cost below \$300.
- All **concrete is 78% recycled natural materials**
- **Greywater recycling system** typically recycles water 5 times in a system that duplicates soil filtration
- **Solar heating and electricity generation** through photo voltaic panels and south facing windows.
- Healthy House **uses one-tenth the amount of energy** as a conventional home.

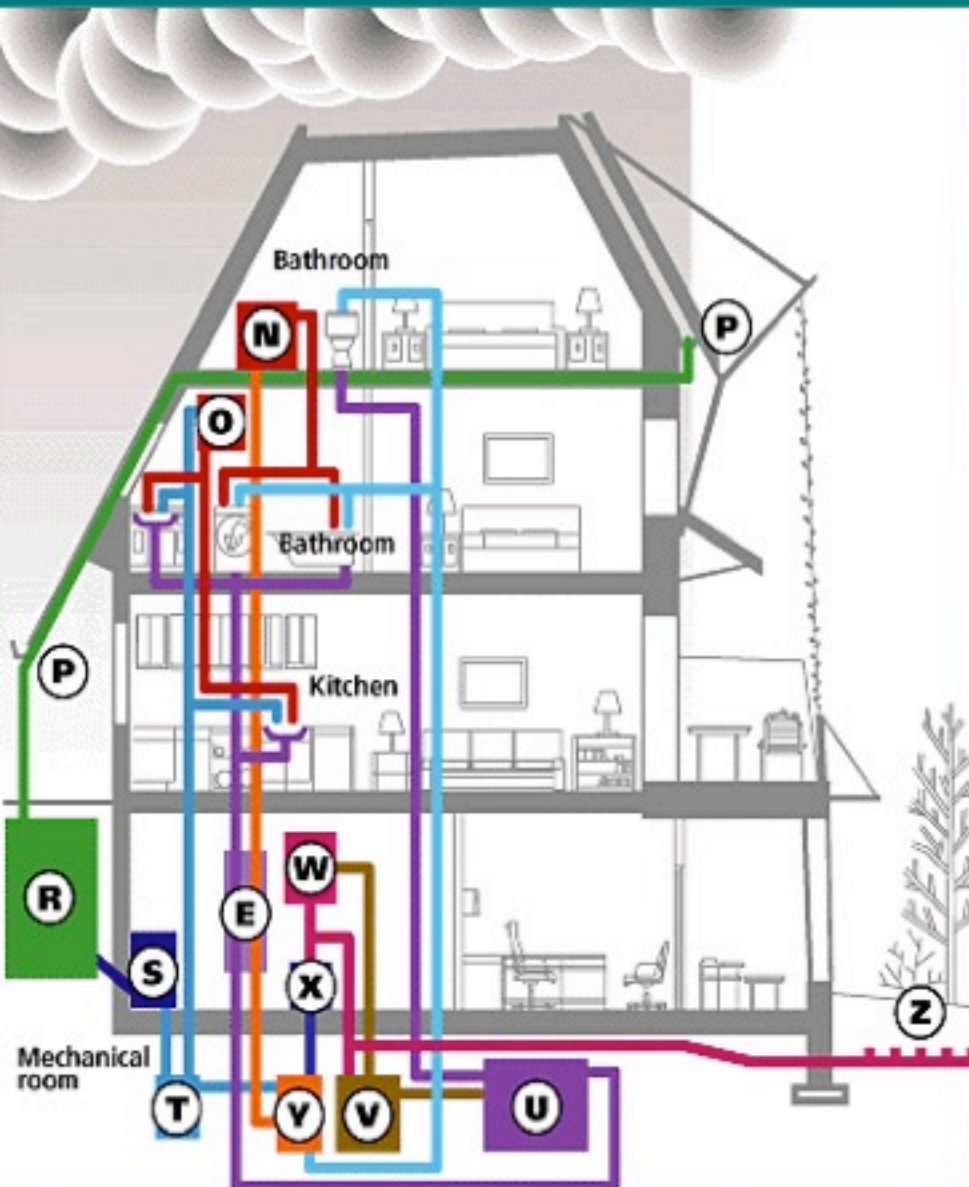
Toronto Healthy House



<http://www.cmhc-schl.gc.ca/popup/hhtoronto/frame.html>

<http://healthyhousesystem.com/toronto.html>

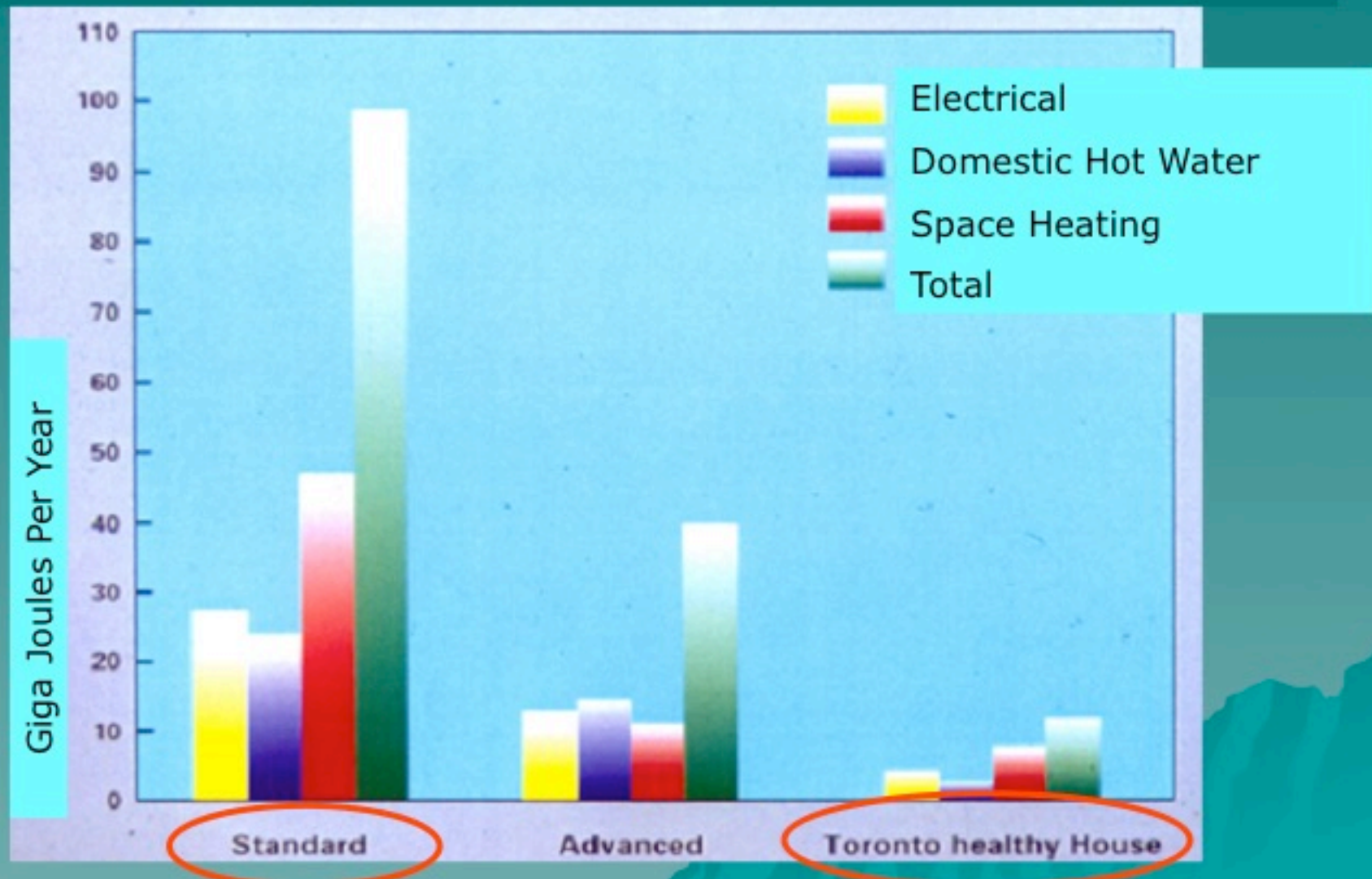
Waste(grey-)water Recycling System



- ◆ **P** - EAVESTROUGHES
- ◆ **R** - RAINWATER CISTERN
- ◆ **S** - COMBINATION FILTER
- ◆ **T** - DRINKABLE-COLD-WATER TANK
- ◆ **O** - DRINKABLE-HOT-WATER TANK
- ◆ **E** - GREY WATER HEAT EXCHANGER
- ◆ **N** - RECLAIMED-HOT-WATER TANK
- ◆ **U** - SEPTIC TANK
- ◆ **V** - RECIRCULATION TANK
- ◆ **W** - WATERLOO BIOFILTERTM
- ◆ **X** - TWIN COMBINATION FILTERS
- ◆ **Y** - RECLAIMED-COLD-WATER TANK
- ◆ **Z** - GARDEN IRRIGATION

Annual Energy Consumption

(source: Breathe Architects)



Benefits of the Toronto Healthy House

- ◆ Annual Thermal Energy Cost:
 - \$80 versus \$800 (1996 dollars)

- ◆ Annual Water Use:
 - 120 L versus 1050 L

- ◆ Total Operating Cost:
 - Under \$300 annually

- TR's House (Thunder Bay)

- ◆ Heat via natural gas (\$1500)

- ◆ City Water (\$500)

- ◆ Electricity (\$1000)

**At least \$3000
annually**

LEED Standards

A green buildings and certification system
championed by:

USGBC: United States Green Buildings Council

CaGBC: Canada Green Buildings Council

LEED (1)

- ◆ **LEED:** Leadership in Energy and Environmental Design
- ◆ As of 2004, a “voluntary standard that defines high performance green buildings – which are **healthier, more environmentally responsible, and more profitable** structures” (www.usgbc.org)
- ◆ Certifies both **new construction and major renovation** projects to promote Green Building practices



YMCA Environmental Learning Centre, St. Clements, Ontario

Photo by Terri Meyer Boake

Pictured: Photovoltaic (PV) panels used storage system to supply energy for a building off the power grid

Photo Credits: www.cagbc.org

LEED created to:

- (1) define "green building"
- (2) promote integrated, whole-building (holistic) design practices
- (3) recognise environmental leadership in the building industry
- (4) stimulate green competition
- (5) raise consumer awareness of green building benefits
- (6) transform the building market

LEED ratings for various building sectors

◆ **LEED-NC (new construction)**

- Since 2001 (US); since 2004 (Canada)
- Office & Government Building, Schools, Health Care Facilities;

◆ **LEED-EB (existing buildings)**

- Addressing operations and maintenance phases of a building's lifecycle
- Since June 2006

◆ **LEED-H (homes)**

- promotes the design and construction of high performance "green" homes
- Pilot version released Feb 2007

LEED Mechanics (1)

- ◆ Certification is based on points awarded to a project for achievements in 6 categories:

Sustainable Sites	14 pts
Water Efficiency	5 pts
Energy and Atmosphere	17 pts
Material and Resources	14 pts
Indoor Air Quality	15 pts
Innovation and Design Process	5 pts

TOTALS 70 pts

LEED Mechanics (2)

- ◆ 4 levels of LEED certification

LEED Certified 26 to 32 pts

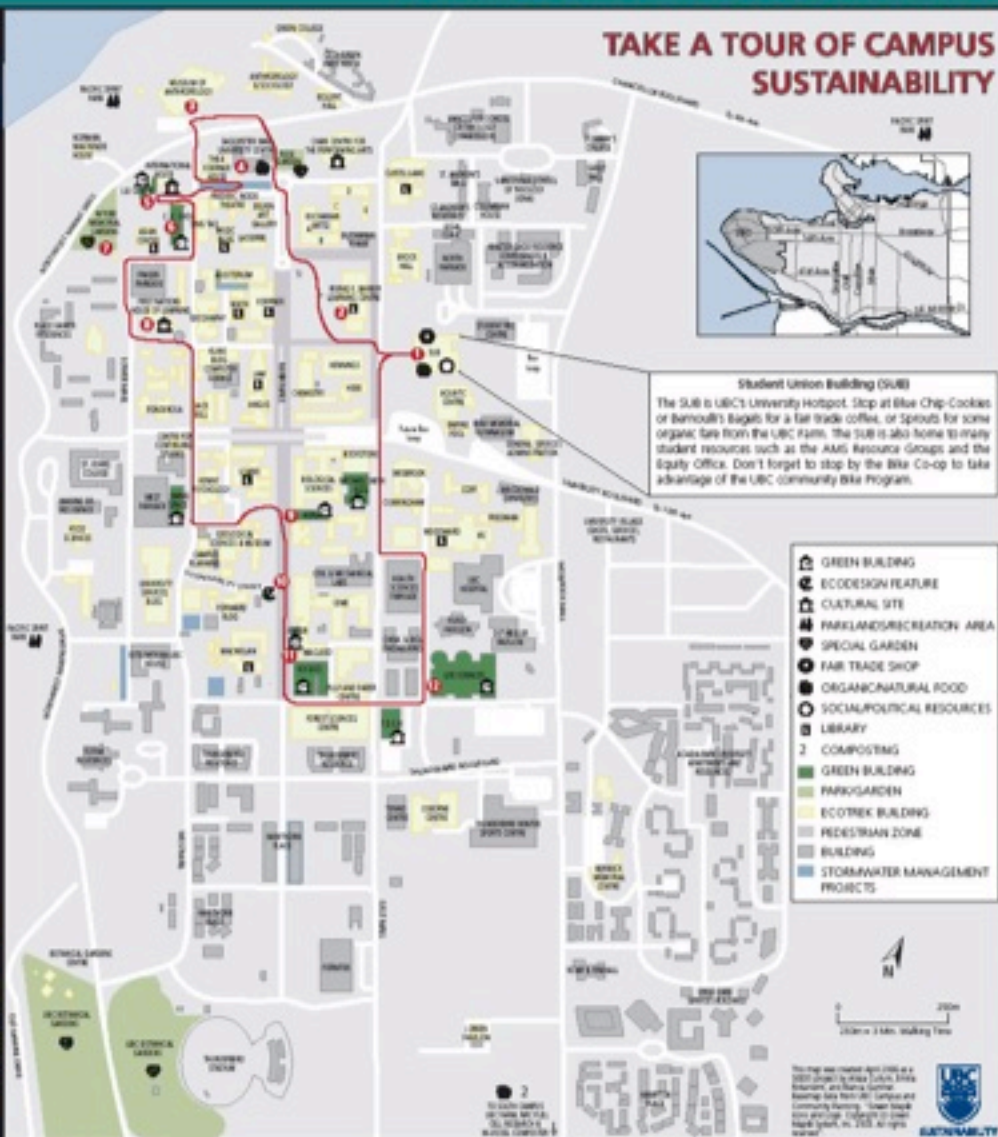
LEED Silver 33 to 38 pts

LEED Gold 39 to 51 pts

LEED Platinum 52 to 70 pts

LEED Rating Categories	Examples of ways to achieve LEED points
Energy & Atmosphere	Passive or active solar heating and cooling
	Solar energy, windpower, hydropower, or other renewable energy
Sustainable Sites	Erosion, sediment, and stormwater runoff control
	Public transportation access
Water Efficiency	Water-efficient landscaping
	Water-efficient (low-flow) fixtures
Materials and Resources	Recycled-content building materials
	Reduced construction waste
Indoor Environmental Quality	Daylighting
	Low-emitting paints, carpets, wood, and other materials
Innovation & Design Process	Involvement of a LEED-accredited professional
	Other design innovations

UBC: A leader in application of LEED and other sustainability principles



- ◆ **Map of Campus Sustainability** (April 2006)
- ◆ **3 LEED-certified buildings** + 6 other green buildings
- ◆ Awareness through demonstration and teaching (**over 300 courses** related to sustainability at UBC)
- ◆ Several **sustainability research institutes**

UBC's CK Choi Building housing the Institute of Asian Research



Source: UBC 2006

- ◆ Campus's 1st green structure in 1996
- ◆ Set many of the early benchmarks for green building
- ◆ One of top ten Earth Day 2000 green buildings (by Amer. Inst of Architects)
- ◆ Features:
 - reused and recycled materials
 - natural ventilation
 - composting toilets

UBC's 3rd LEED Building: **GOLD** for the Life Sciences (LSC) Building



- ◆ Features:
 - Emits 1,000 tonnes fewer **greenhouse gases**;
 - Consumes **28% less energy** and **50% less water**;
 - Electrical and mechanical efficiencies **save \$200,000 per year in energy costs**;
 - 80% of construction waste was salvaged;
 - **Materials** selected for construction based on their **high recycled content**; **low VOC emissions**; and **local availability**;

- ◆ Largest building in Canada to achieve LEED Gold; only 11 other Gold-rated buildings in Canada as of Jan.2006;

Brownfield Development



Bethlehem Steel Warehouse

Photo Credit: Sean M.L. Galbraith Photography

Brownfield Development (1)

- ◆ Recycling of old, abandoned land and/or buildings
- ◆ Refurbishing as both commercial and residential properties



Example: Granville Is. Public Market, Vancouver

Source: <http://www.seegravilleisland.com/views/views.htm>

Brownfield Development (2)

Example: Loft Conversions, Former Tip Top Tailor Factory, Toronto Waterfront



Issues with Brownfields

- ◆ Soil Contamination
- ◆ High Costs
- ◆ Asbestos Contamination
- ◆ Land Acquisition
- ◆ Public Distrust



Lister Block, Hamilton, Ontario

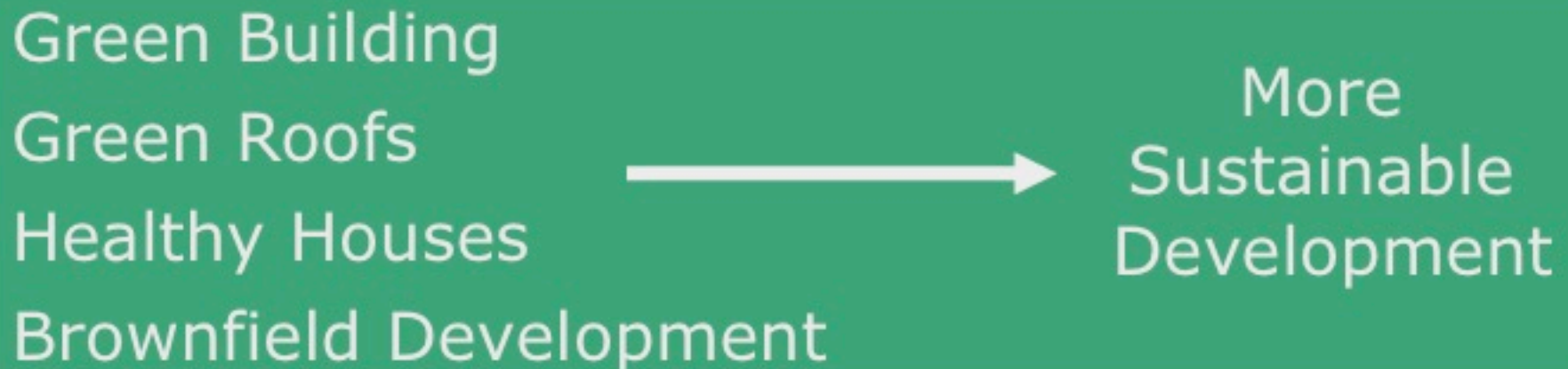
Photo Credit:

Sean M.L. Galbraith Photography

Conclusions



Summary Remarks



- ◆ All provide opportunities to **re-evaluate the use of existing land and buildings** and to consider alternatives that could result in less environmental impact while still allowing for economic and societal well-being.
- ◆ **More sustainable development** uses less material, resources, land and energy than conventional development approaches

Selected References**

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http://www.nrcan.gc.ca/media/newsreleases/2004/200423_e.htm

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WILSON, A. 2006. Your Green Home: A Guide to Planning a Healthy, Environmentally Friendly New Home. Gabriola Island, BC: New Society Publishers.

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** In addition, photo and content credits to websites are indicated on the appropriate slides.