Stephanie. I just copied the long Toronto By-law. I couldn't find a way to make the Toronto by-law fit in my 5 minutes, so just usb with my bit of video on it, which I will bring and I am hoping you can make copies of my Statement of Whereas and Therefore...it is up to you if you think the entire Toronto By-law needs to be copied out as well. Brian was just looking for it.

Maggie

-------- Forwarded message --------
From: Maggie Hughes
Date: Mon, Mar 29, 2010 at 1:00 PM
Subject: let me know what else you need
To: "McHattie, Brian" <Brian.McHattie@hamilton.ca>

I am addressing the Green/White by-law presented by Councillor McHattie Aug. 9 2009.
To cover the following

I would like to amend the Green/White by-law to be more precise and include parking lots as well.

Whereas, Green Roofs means the use of vegetation to cool roofs of buildings and allow for more control of water run off and to include green walls, also made of plantation that do not destroy the building by the design, and;

Whereas, White building and design means to paint or otherwise, make black roofs and black parking lots white or Greener by vegetation to allow urban cooling, and;

Whereas, it has been proven by various studies and by actual use that using more Plants on roofs and walls of buildings cools them in the hot months, and helps keep them warmer in the cold months, and;

Therefore, request a by-law that requires all building permits, and renovation permits for any buildings, parking lots, garages, sheds, and other cement and tarmac projects, require the accompaniment or addition of a green wall or roof. The variance will depend upon the size of each structure according to the same building code Toronto uses.

The Toronto Building Code is far too detailed for me to match in this proposal.
Here is a copy of it below. It is up to you if you choose to print it all.

Maggie Hughes

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Chapter 492

GREEN ROOFS

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[HISTORY: Adopted by the Council of the City of Toronto 2009-05-27 by By-law No. 583-2009.1 Amendments noted where applicable.]

GENERAL REFERENCES

1

Editor's Note: This by-law was passed under the authority of section 108 of the City of Toronto Act, 2006, S.O. 2006, c. 11.

Building construction and demolition — See Ch. 363. Development of land — See Ch. 415.

ARTICLE I

General

§ 492-1. Definitions.

As used in this chapter, the following terms shall have the meanings indicated:

APPLICABLE LAW — Shall have the same meaning as defined in sentence 1.4.1.3(1) of
Division A of the Building Code.

APPLICANT — The owner of a building or property who applies for a permit or any person authorized by the owner to apply for a permit on the owner’s behalf.

AVAILABLE ROOF SPACE — The total roof area of the building or building addition excluding:

A. Areas designated for renewable energy devices;

B. Private terraces no greater in area than the floor of the abutting residential unit at the roof level; and

C. In the case of a residential building or a building addition to a residential building, outdoor amenity space up to a maximum of two square metres per dwelling unit contained in the residential building or building addition to the residential building.

AVERAGE GRADE — The average elevation of the ground surface measured at the street property line.

BASEMENT — The portion of a building between the first floor and any floor below the first floor.

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BUILDING CODE, ONTARIO BUILDING CODE or OBC — Means or refers to Ontario Regulation 350/06 as amended, under the Building Code Act, 1992.

CHIEF BUILDING OFFICIAL — The Chief Building Official and Executive Director, Toronto Building.

CHIEF PLANNER — The Chief Planner and Executive Director, City Planning.

COMPLETE BUILDING PERMIT APPLICATION — An application submitted to the Chief Building Official for an above grade building permit which complies with all technical requirements of the Building Code Act, 1992, and includes the payment of all applicable fees.

COMPLETE SITE PLAN APPLICATION — An application submitted to the Chief Planner for site plan approval pursuant to section 114 of the City of Toronto Act, 2006, and section 41 of the Planning Act, and includes the payment of all applicable fees and
the submission of all supporting documentation as may be required by the Chief Planner or his delegate.

FIRST FLOOR — The floor of a building closest to average grade.

FLOOR PLATE AREA — The total area of a floor of a building, measured from the exterior of the main wall of the floor level, including voids at the level of the floor, such as an atrium, mezzanine, stairwell, escalator, elevator, ventilation duct or utility shaft.

GRADE — The finished ground level of the land upon which the building is located.

GREEN ROOF — An extension of an above grade roof, built on top of a human-made structure, that allows vegetation to grow in a growing medium and which is designed, constructed and maintained in accordance with the Toronto Green Roof Construction Standard.

GROSS FLOOR AREA — The total area of each floor level of a building, above and below average grade, measured from the exterior of the main wall of each floor level, including voids at the level of each floor, such as an atrium, mezzanine, stairwell, escalator, elevator, ventilation duct or utility shaft, but excluding areas used for the purpose of parking or loading.

HEIGHT — The vertical distance measured between a horizontal line drawn from the average grade to the highest point on the building, but shall not include the following elements located on a roof of the building:

2

Editor’s Note: See S.O. 1992, c. 23.

3

Editor’s Note: See S.O. 1992, c. 23.

4

Editor’s Note: See S.O. 2006, c. 11.

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A. Equipment used for the functional operation of the building, such as electrical, utility, mechanical and ventilation equipment;

B. Structures or parts of the building that are used for the functional operation of the building, such as enclosed stairwells, roof access, maintenance equipment storage, elevator shafts, chimneys, vents and water supply facilities;

C. Structures that enclose, screen or cover the elements listed in Subsections A and B above;

D. A flagpole;

E. An antenna; and

F. A satellite dish, provided that no part of such element shall exceed a vertical distance of 25 metres measured from average grade, and further provided that in the case of the elements listed in Subsections A, B and C above, the total area of all of those elements together shall not cover more than 30 percent of the area of the roof.

HOTEL — A commercial establishment offering temporary accommodations on a daily or weekly rate to the public, and where all rooms, suites, apartments or similar forms of accommodation are owned by a single owner or entity.

INDUSTRIAL BUILDING — A building or a building addition exclusively used or designed or intended for use for or in connection exclusively with the manufacturing, producing or processing of goods, warehousing or bulk storage of goods, self-storage facility, distribution centre, truck terminal, research and development in connection with manufacturing, producing or processing of goods, and:

A. Includes office uses and the sale of commodities to the general public where such uses are accessory to and subordinate to an industrial use;

B. Does not include:

(1) A building used exclusively for office or administrative purposes unless it is attached to an industrial building as defined above; or

(2) Warehouse clubs and retail warehouses, including commercial
establishments which have as their principal use the sale of goods and
merchandise in a warehouse format.

NURSING HOME — A building or portion of a building licensed as a nursing home
under the Nursing Homes Act.6

OUTDOOR AMENITY SPACE — An area located on the roof of a building and
intended for recreational use by the residents of the building.

6

Editor's Note: See R.S.O. 1990, c. N.7.

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PODIUM — The base of a building consisting of a base and a tower above the base
where the base is two storeys or greater.

PRIVATE TERRACE — Outdoor amenity area on a roof that is available exclusively for
use by the occupants of an abutting residential unit for recreational or social activities.

RENEWABLE ENERGY — Energy obtained from solar energy or wind energy.

RESIDENTIAL BUILDING — A building or building addition where more than 60
percent of the gross floor area of the building or building addition is used, designed or
intended to be used for one or more dwelling units, including accessory uses naturally
and normally incidental in purpose and exclusively devoted to the residential use, but
does not include a nursing home, retirement home or lodge, or hotel.

RETIREMENT HOME OR LODGE — A building or portion of a building which
provides room and board accommodation for senior citizens and is not presently
governed under any Provincial Act.

ROOF — The overhead structural component of a building or a part of a building
supported by walls or columns and which functions primarily to shelter the interior of the
building from the effects of weather and the infiltration of water.
SOLAR ENERGY — Energy from the sun that is converted to produce electrical or thermal energy.

STOREY — The portion of a building, other than a basement, between any floor level and the floor, ceiling or roof immediately above it.

STREET — A public highway.

TORONTO GREEN ROOF CONSTRUCTION STANDARD — The minimum mandatory standards for construction of a green roof as set out in Article IV of this chapter.

TOWER — The portion of a building above the podium of the building, where the tower portion of the building is at least 12 storeys.

VEGETATION — Plants selected in accordance with the plant selection criteria of the Toronto Green Roof Construction Standard.

WIND ENERGY — Energy from the wind that is converted to produce electrical energy.

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§ 492-2 GREEN ROOFS

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ARTICLE II

Requirement for Green Roofs

§ 492-2. Green roofs required.

A. Every building or building addition constructed after January 30, 2010, with a gross floor area of 2,000 square metres or greater shall include a green roof with a coverage of available roof space in accordance with the following chart:

and no person shall construct a green roof or cause a green roof to be constructed unless a permit therefor has been issued by the Chief Building Official.

B. Every building or building addition consisting of a tower above a podium, where no storey in the tower above the podium level has a floor with a floor plate area
exceeding 750 m², shall be permitted to provide the required green roof area on available roof space at the podium roof level or levels and the roof area of the tower shall not be considered as part of the available roof space for a green roof.

C. In the case of an industrial building or a building addition to an industrial building, constructed after January 30, 2011, with a gross floor area of 2,000 m² or greater, the provisions in Subsection A above shall not apply, but the building or addition shall include a green roof with a minimum coverage of available roof space that is equal to the lesser of 2,000 m² or 10 percent of the gross floor area of the building or addition.


Every green roof required to be constructed pursuant to this chapter shall be maintained in accordance with the maintenance plan required in the Toronto Green Roof Construction Standard.

Gross Floor Area

(Size of Building)

Coverage of Available Roof Space

(Size of Green Roof)

2,000 — 4,999 m² 20%
5,000 — 9,999 m² 30%
10,000 — 14,999 m² 40%
15,000 — 19,999 m² 50%
20,000 m² or greater 60%

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§ 492-4. Permit required.

A. No person shall construct, or cause to be constructed, a green roof required pursuant to this chapter unless a permit has been obtained from the Chief Building Official in accordance with the requirements of this chapter.
B. No person shall materially alter, or cause to be materially altered, a green roof required pursuant to this chapter unless a permit has been obtained from the Chief Building Official in accordance with the requirements of this chapter.

C. Where a green roof is constructed in conjunction with a building or building addition the Chief Building Official may issue a single permit under section 8 of the Building Code Act, 1992, for the building or building addition and for the green roof.

D. Where a green roof is proposed although not required under this chapter no person shall construct a green roof or cause a green roof to be constructed unless a permit has been obtained from the Chief Building Official in accordance with the Toronto Green Roof Construction Standard.

§ 492-5. Exemption.

A. Section 492-2 does not apply to a building or building addition if:

(1) A complete building permit application in accordance with section 8 of the Building Code Act, 1992, has been submitted for the building or building addition prior to January 31, 2010; or

(2) A complete site plan application has been submitted for the building or building addition prior to January 31, 2010.

B. Section 492-2 does not apply to a residential building or building addition to a residential building with a height less than or equal to the greater of six storeys or 20 metres.

C. Section 492-2 does not apply to an industrial building or building addition to an industrial building constructed prior to January 31, 2011.

Editor’s Note: See S.O. 1992, c. 23.
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ARTICLE III

Application and Fees

§ 492-6. Application for approval.

An application for a permit for construction of a green roof shall be made to the Chief Building Official on forms, including a “Green Roof Declaration Form,” that may be prescribed by the Chief Building Official from time to time. The “Green Roof Declaration Form” may require information including, but not limited to: structural design; intended use of the roof and whether or not it will be accessible to the public; and fire safety provisions.

§ 492-7. Fees and charges.

A. Where an application for a required green roof is made in conjunction with an application for a permit for construction of a building or building addition under section 8 of the Building Code Act, 1992, there shall be no additional fee for the green roof.

B. Where an application for a permit is made for an alteration or renovation to construct a green roof, the fee for the application shall be the same as for the building permit classification “Re-Roofing with structural work, raise roof structure” provided in Chapter 363, Building Construction and Demolition.

ARTICLE IV

Toronto Green Roof Construction Standard


A. The purpose of the Toronto Green Roof Construction Standard is to set out minimum requirements for the construction and maintenance of green roofs. The design and construction of a green roof shall meet the City’s minimum requirements for green roof construction while also meeting the Ontario Building Code (OBC).
requirements. The Toronto Green Roof Construction Standard does not replace or alter any existing OBC requirements, or define a singular code-compliant green roof design.

B. A designer of a green roof shall apply the measures described in this article with reference to the principles governing the OBC requirements related to each measure.

C. This article is considered an acceptable solution for the design and construction of a green roof in addition to the acceptable solutions contained in parts 3 to 12,

Editor's Note: See S.O. 1992, c. 23.

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Division B, of the OBC. Designs shall meet the OBC objectives to demonstrate compliance with the OBC; however a design that complies with the provisions of § 492-9 shall be deemed to comply to such objectives.

D. A green roof designed to the Toronto Green Roof Construction Standard may be constructed on both combustible and non-combustible buildings.


The following standards shall be met in the design and construction of a green roof:

A. Green roof assembly.

A green roof assembly shall, as a minimum, consist of a root repellent system, a drainage system, a filtering layer, a growing medium and plants, and shall be installed on a waterproof membrane of an applicable roof.

B. Gravity loads.

1) The applicant shall calculate green roof gravity loads following the protocol provided by the ASTM standard: “ASTM E2397.05 — Standard Practice for Determination of Dead Loads and Live Loads Associated with Green Roof Systems.”

2) The density of the growing media shall be determined:
(a) In accordance with “ASTM E2399.05 — Standard Test Method for Maximum Media Density for Dead Load Analysis of Green Roof Systems”; or alternatively
(b) The designer may use an un-factored, saturated density of the growing media of 2,000 kg/m³.
(3) The applicant shall include design loads definition as part of the “Green Roof Declaration” form which shall be required as part of an application for building permit.
C. Slope stability.
All roofs with slopes in excess of 10° (17%) that support green roof assemblies shall incorporate anti-shear measures.
D. Parapet height and/or overflow scupper locations.
(1) Parapets and scuppers shall be specified in the design, as required, to limit retained rain water loads to within structural limits in the event of obstructed internal drains.
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(2) Analysis shall be done in conformance with OBC Division B 4.1.6.4.(4).(3)
The referenced point for the overflow scuppers height must be clearly indicated to avoid the possibility of confusing the overflow scupper height as being measured above the finished green surface or other layer above the waterproofing resulting in higher water load than accounted for by the design as indicated in the sketch below.
E. Wind uplift.
The applicant shall provide a report, stamped by an engineer, providing wind uplift pressures being designed for (including a description of how the pressures were determined), and describing how the design addresses these pressures.
F. Fire safety.
Where roof penetrations, intersecting walls, parapets, upturns or mechanical
equipment are clad with combustible materials the design shall include a
vegetation-free border zone abutting such features and the vegetation-free border
shall be equal to the vegetation height at maturity but in no case be less than 0.5 m.

G. Occupancy and safety.

The applicant shall state, in a green roof declaration form and the green roof
application, the use of the roof and whether or not it will be accessible to the public.

H. Waterproofing.

(1) The design and construction shall include the installation of a root barrier in
all vegetated roofing systems.

(2) Immediately prior to installation of the green roof, the applicant shall cause to
be conducted one of the following leakage testing protocols:

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(a) Flood test;

(b) Electric field vector mapping;

(c) Impedance test;

(d) Infrared (IR) thermal imaging;

(e) Low voltage testing;

(f) High voltage testing;

(g) Moisture sensors;

and a report documenting a successful test, signed by an architect or engineer,
shall be provided to the Chief Building Official.

I. Drainage.

(1) The design hydraulic load shall be evaluated assuming that the green roof
system is fully saturated prior to the maximum fifteen-minute rainfall.

(2) Positive slope to drain shall be provided at the level of the waterproofing
membrane.

(3) The system shall permit effective drainage beneath the growth media.

(4) Vegetation-free zones shall be provided around all drains.

/\/\/\/\}
J. Water retention.

(1) Water retention mats or equivalent materials shall be employed as required to promote vegetation growth.

(2) The drainage layer shall be appropriate for storm water retention and must be selected following “ASTM E2398-05 Standard Test Method for Water Capture and Media Retention of Geo-composite Drain Layers for Green Roof Systems.”

K. Vegetation performance.

In order to support plant survivability:

(1) When structurally possible, the growing media shall be at a minimum 100 mm; or

(2) The applicant shall provide a report confirming that the engineered system as designed provides plant survivability comparable to that of an un-irrigated system with growing media at minimum 100 mm.

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L. Plant selection.

(1) Vegetation on a green roof shall not include any noxious weeds as defined in Ontario Regulation 1096 under the Weed Control Act, as may be amended from time to time.

(2) The plant selection and design shall be such that within three years of the planting date the selected plants shall cover no less than 80% of the vegetated roof.

(3) Compliance with the plant coverage required in the preceding sentence can be satisfied by a design that will provide one or more of the following:

(a) That seeds for groundcover plantings shall be sown at a rate not less than 325/m²;

(b) That cuttings shall be distributed not less than 12kg/100m²; and

(c) Either that pre-grown plugs shall be installed not less than 11/m² or a
report from the designer that describes how the design fulfills this
coverage requirement shall be provided with the application.

M. Irrigation.

Adequate measures shall be provided to permit irrigation necessary to initiate and
sustain the vegetation during the service life of the green roof.

N. Maintenance plan.

(1) The applicant shall develop a maintenance plan for the green roof as per
CSA-S478-95 “Guideline on Durability in Buildings” which shall define
programs of routine maintenance and inspection sufficient to ensure that the
green roof components perform their required functions for the duration of
their design service lives.

(2) The maintenance plan shall address the requirements of the specified growth
media and vegetation for vegetation survival.

(3) The maintenance plan shall address re-planting, in the event that re-planting
should become necessary, and assure that complete coverage at canopy level
is achieved within three growing seasons and maintained for the service life of
the green roof.

(4) The maintenance plan shall be submitted with the application for a permit for
a green roof.

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Editor’s Note: See R.S.O. 1990, c. W.5.

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ARTICLE V

Approval of Application

§ 492-10. Approval by Chief Building Official.

The Chief Building Official shall approve an application for construction of a green roof
that conforms to this chapter by issuing a permit in accordance with section 8 of the
Building Code Act, 1992,11 in conjunction with an application for construction of a
building or structure that includes a green roof.

§ 492-11. Variation of coverage requirement for a green roof by the Chief Planner and exemption by City Council.

A. If an applicant is unable to provide the green roof coverage as required in this chapter, application may be made to the Chief Planner to provide a smaller green roof area than would otherwise be required provided that a cash-in-lieu payment is made in accordance with this chapter, and the Chief Planner shall notify the local Councillor(s) of the decision.

B. Where an applicant seeks a complete exemption from the green roof requirement of this chapter, the applicant may apply to City Council to be exempted from the requirement.

C. Where an application for a reduced green roof requirement is made to the Chief Planner pursuant to Subsection A, no alteration or variance to the technical standards for construction of green roofs as provided in the Toronto Green Roofs Construction Standard shall be permitted.

D. Where an application for a complete exemption from a required green roof is made to City Council, the Chief Planner shall report to the appropriate Community Council and that Community Council shall consider the application and shall recommend to City Council whether to refuse or approve the application.

E. City Council may refuse the application or approve the application for exemption, and where City Council allows an exemption, the Chief Building Official may issue a permit for the related building or building addition as though the applicant was in compliance with this chapter.

§ 492-12. Cash in lieu of construction of a green roof.

A. Where less than the required green roof coverage than otherwise would be required by this chapter is provided, either because of a variance approved by the Chief Planner, or an exemption approved by City Council, the applicant shall make a payment of cash in lieu of construction of a green roof for the reduced area based

Editor's Note: See S.O. 1992, c. 23.
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on the average actual cost of construction of a green roof which at the time of
passing of this chapter shall be deemed to be $200.00/m2.

B. The Chief Planner shall from time to time, and at least bi-annually, report to City
Council on the cost of construction for a green roof and shall recommend changes
to the base sum in Subsection A to ensure that it reflects the prevailing average
actual cost of construction of a green roof.

C. All of the funds collected as cash in lieu of construction of a green roof shall be
segregated and directed to the Eco-Roof Incentive Program of the City for the
provision of green roofs on existing buildings.

ARTICLE VI

Green Roof Technical Advisory Group


A. The Chief Building Official shall appoint a chair and 10 members of the Green
Roof Technical Advisory Group.

B. The Chair and members of the Green Roof Technical Advisory Group shall be
appointed for a term of three years, and may be re-appointed for an additional term
of three years.

C. The Office of the Chief Building Official shall provide staff support, including
secretariat duties, for the Green Roof Technical Advisory Group.

§ 492-14. Qualifications for Chair and members of the Green Roof Technical
Advisory Group.

A. Persons appointed as the Chair or as a member of the Green Roof Technical
Advisory Group shall possess expert knowledge and professional qualification
concerning green roof technology and have a working familiarity with the building
code.

B. Membership in the Green Roof Technical Advisory Group shall be representative of
various sectors including the following:
(1) Enforcement of regulations and administration of the building code sector including but not limited to members from staff of Toronto Building and the Building and Development Branch of the Ministry of Municipal Affairs;

(2) Design sector;

(3) Material and component manufacturers and suppliers sector;

(4) Construction sector;

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(5) Research sector including but not limited to persons involved in green roof research and testing in a professional academic institution, school of engineering or architecture; and

(6) Green roof industry sector being individuals working in the green roof industry.


A. The Green Roof Technical Advisory Group shall make recommendations for consideration by the Chief Building Official with respect to:

(1) Technical issues relating to the creation, implementation and development of the City of Toronto Green Roof Construction Standard;

(2) Possible amendments to the Toronto Green Roof Construction Standard; and

(3) Take part in periodic review of the Toronto Green Roof Construction Standard.


A. The Green Roof Technical Advisory Group shall consider and comment upon the following matters in making recommendations for consideration by the Chief Building Official:

(1) Policy directions from City Council related to requiring and constructing green roofs;

(2) The City’s green roof strategy as expressed in the document “Making Green Roofs Happen”;

AIC 2010
(3) Consultations with stakeholders from government, industry, and the community at large;

(4) Technical viability of existing or proposed standards for green roofs;

(5) Consistency of the green roof standards with objectives of the building code;

(6) Impacts of the green roof standard on the interests of stakeholders and the economic feasibility of the recommendation; and

(7) The enforceability of the recommendation if implemented as part of the green roof standard.

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A. The Green Roof Technical Advisory Group shall meet at the call of the Chief Building Official and the meeting shall consider the matters set out in a meeting agenda prepared by Toronto Building staff.

ARTICLE VII

Changes to the Technical Standards

§ 492-18. Changes to technical standards.

A. The Chief Building Official shall periodically review the Toronto Green Roof Construction Standard and, after consultation with the Green Roof Technical Advisory Group, recommend amendments to City Council to reflect the City’s experience with green roofs and new construction techniques and materials.

ARTICLE VIII

Chief Building Official to Publish Guideline


A. The Chief Building Official shall, after consulting with the Green Roof Technical Advisory Group, periodically develop and publish green roof construction guidelines and best practices to assist designers and others to design and construct green roofs in accordance with the Toronto Green Roof Construction Standard.

ARTICLE IX
§ 492-20. Offences.

A. Every person who contravenes a provision of this chapter is guilty of an offence.

B. Every director or officer of a corporation who knowingly concurs in a contravention of this chapter by the corporation is guilty of an offence.

C. Every person who fails to comply with a term or condition of a green roof permit under this chapter is guilty of an offence.

D. Every person who contravenes an order under subsection 384(1) or 385(1) of the City of Toronto Act, 2006, is guilty of an offence.

Editor's Note: See S.O. 2006, c. 11.

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Every person convicted of an offence under this chapter is liable to a maximum fine of not more than $100,000.
FLL Research Project

Climate Issue: Urban Heat Islands

An Urban Heat Island is the name given to describe the characteristic warmth of both the atmosphere and surfaces in cities (urban areas) compared to their (non-urbanized) surroundings. The heat island is an example of unintentional climate modification when urbanization changes the characteristics of the Earth's surface and atmosphere. I got this definition from: http://www.actionbioscience.org/environment/voogt.html

Picture Showing Urban Heat Island Effect

This picture came from http://www.technovelgy.com/graphics/content06/heat-island.jpg

Heat Island Facts

- Urban heat islands can make it hotter in the city.
- Both the air and city surfaces can be hotter.
- Solar heat adds to surface temperatures.
- The warmest air is found downtown because most of the buildings and parking lots are downtown, and it is usually the center of the city.
- Dry, dark surfaces absorb more sunlight. Dark surfaces such as asphalt roads and parking lots absorb more sunlight and become much warmer than light-colored surfaces.
- Certain structures and city geometry favor heat islands. These are thick-walled buildings that are slow to warm and cool and so they store and release heat.
- Storm Water rains off instead of being infiltrated through the ground. Ominous dark ground with water on it absorbs and makes it deeper and keeps the rain from cooling it down. Also, the storm water does not trickle through the ground and it carries pollutants directly into streams and waterways.
- Storm Water runoff can cause flooding.

How This Hurts People

- **Higher daytime temperatures & slower nighttime cooling** Can affect human health by making people miserable, causing respiratory difficulties, heat cramps and exhaustion, non-fatal heat stroke, and heat-related deaths.
- **Heat islands can make heat waves last longer** Children, older adults and those with existing health problems suffer most.

Solutions for Heat Islands That Already Exist
• **Green roofs** Another alternative to traditional roofing materials is a rooftop garden, or "green roof". On hot summer days, the surface temperature of a vegetated rooftop can be up to 90 degrees Fahrenheit (50 degrees Celsius) cooler.

• **Cool Pavements** Cool paving does not get as hot. There are two types of cool paving materials: lighter-colored materials and porous materials (porous means the water goes through). Lighter-colored materials reflect the sun's energy and stay cooler. Lighter-colored materials come in shades of white, beige, light gray and light brown.

• **Plant trees and plants** Increasing the cover of trees and vegetation in a city is a simple and effective way to reduce the urban heat island effect. Trees provide a wide range of other benefits, from increasing property value to reducing storm water runoff.

• **Use less energy** This reduces stress.

• **Light Colored Roofs** Light colored roofs reflect the sunlight back up and do not absorb as much heat.

• **Some things we can't change:** Some of these factors, like prevailing weather patterns, geography, and pollution transported from upwind regions, are largely beyond the immediate influence of local policy. However, we can affect all of them listed above.

### Brainstorming a Solution

Our team gathered and we came with these solutions: Simon came up with solar powered wind mills (if we put them to the West of town they would blow the hot air away like ocean breezes do for towns on the coast). Max kept saying we should all plant trees. Other ideas were to go with: porous pavement, cool pavement, green roofs (or walls), or planting trees and plants.

So we decided to ask an expert.

### Dr. James Voogt

Dr. Voogt is an Associate Professor in the Department of Geography at the University of Western Ontario in Canada. He says "My academic training is in physical geography and boundary layer climatology and meteorology. My current research combines surface and boundary layer meteorology and climatology with remote sensing and GIS. It focuses on the importance of the surface." We got a lot of our information from his web sites. He agreed to email back and forth with us and help us with our questions.

His school web page is: http://geography.uwo.ca/faculty/voogt/

### The Email to Dr. Voogt

For the email to Dr. Voogt we all wrote down our questions and then Kaisa and Deja sent him the email. Our questions were: 1) The solutions seem to be porous pavement, cool pavement, green roofs, planting trees and plants, and using less energy. 2) If we could only do one which would make the biggest difference? 3) Would solar powered windmills work to blow heat away from the city like ocean breeze heat from the coast? 4) If everyone planted a tree which kind of tree would be best for the urban area? 5) Are there any cities where something has been done and it worked? 6) What are those cities and how did they know it worked?
He answered all our questions (see attached document). He said planting trees made the most difference, and our windmills idea was interesting, but not efficient. He told us we needed to research trees for our area, and that there were cities where they thought it had made a difference, but there was not a lot of research yet.

**The Best Choice is Planting Trees**

The reason that he made this choice is that for many cities plants provide multiple benefits, not just reduction of air temperature. Trees and plants typically reduce daytime air temperature because some of the energy they receive is used to transpire water, rather than heating the air. They also create shade which can be important for cooling surfaces or building in a city. Other advantages of trees and plants are to filter the air of some pollution particles, and providing habitat for other animals, or acting as source of food (for some plants). Trees and plants can also provide important benefits in cities where there is a cold winter and warm summer. Trees that lose their leaves can allow buildings to receive sunlight in the winter when they need it to offset heating costs. Evergreen trees can be used as windbreaks to help reduce the heat lose from cold northerly winds.

**Cincinnati has a Climate Protection Action Plan**

Cincinnati has a "Climate Protection Action Plan" called the "Green Cincinnati Plan". So far they are wanting to offer grants and loans to people and businesses that want to install green roofs. They also plan to plant more trees in the city. This plan is a proposal. They recommend a lot of other things that are environmentally friendly. The news articles we found said that Cincinnati would like to become a leader in green roofs. You can find the plan on their web site if you really look for it. You can see the actual plan at: [http://www.cincinnati-oh.gov/cmgr/downloads/cmgr_pdf18280.pdf](http://www.cincinnati-oh.gov/cmgr/downloads/cmgr_pdf18280.pdf)

**How Chicago Reduces Urban Heat Island Effect**

Chicago has an official plan in place to reduce the Urban Heat Island Effect. The information below is from their web site.

**Reducing the Urban Heat Island Effect**

There are two main ways to reduce the Urban Heat Island effect: replace dark-colored surfaces (such as black tar roofs and asphalt parking lots) with light-colored surfaces, and increase vegetation. Light-colored roofs and paving materials reflect light and heat, making the surrounding area cooler than when dark-colored roofs and paving are used. Adding vegetation to an urban area helps clean and cool the air, and trees can be located to shade asphalt roads and parking lots.

The City of Chicago has used these strategies in a variety of ways to reduce the Urban Heat Island effect. Projects include the rooftop garden on City Hall, a permeable and reflective alley on the North Side, miles of median planters and many campus parks that transform asphalt.
parking lots around public schools into parks. The City of Chicago also uses green building technologies and practices in all of its public building projects. Additionally, Chicago has enacted legislation to require landscaping around parking lots and require more energy-efficient building practices.

**What You Can Do to Reduce the Urban Heat Island Effect**

Consider using light-colored, reflective materials when repairing or replacing the roof on your building. If you are building or repairing a driveway, consider using concrete or other reflective materials. Plant trees on your property to increase the shading of buildings and parking lots, and increase the amount of vegetation overall, if possible. Use rain gardens and other storm water management techniques to capture rainwater on your property, so that it is absorbed into the ground instead of diverted into the sewer system; doing so will increase the amount of moisture in the air, providing cooling.

This information came from: http://egov.cityofchicago.org/

**Our Solution - Porous Parking Lots and Trees**

We wanted to choose the one thing that would make the most difference. We chose to:

Replace asphalt parking lots with porous parking lots, and to plant trees in the parking lots using sivla cells to keep the ground from becoming compacted

We got this picture from: http://www.landscapeonline.com/products/listing.php?id=4306

To see a movie explaining porous pavement and sivla cells click HERE

**The Benefits**

- Grass covered parking lots do not absorb as much heat
- Trees provide shade for buildings and cars
- Water now filters through ground and roots, reducing storm water run off
- Each mature tree reduces atmospheric carbon by 903 pounds per year

Every Mature Tree* Will Provide the Following
- Reduce atmosphere carbon by 903 pounds
- Eliminate 10,996 gallons of storm water runoff
- Conserve 289 Kilowatt hours of electricity for cooling and reduce consumption of oil or natural gas by 8.765
- Absorbing pollutants like ozone, nitrogen dioxide and sulfur dioxide through their leaves
- Intercept particulate matter like dust, ash and smoke
- Release oxygen through photosynthesis
- Lower air temperature which reduces the production of ozone
- Reduce energy use and subsequent pollutant emission from power plants

For our example we used a mature sugar maple, 30 inches in diameter. We chose a sugar maple based on the a pamphlet called "Recommended Street Trees" that we got from the Clermont County Soil and Water District. Data came from the “Tree Benefits Calculator” at iTreetools.com.

Sharing

To share our information we gave our presentation to our teachers and put up a poster presentation for the whole school.

We also wrote Cincinnati Mayor Mallory explaining our research and how trees reduce the Urban Heat Island Effect. We thought he would be interested because Cincinnati wants to see green roofs on building tops and plans to offer financial incentives to property owners to replace tar and shingles with vegetation. It might be cheaper to give money to people to buy trees.

We also emailed the team Cyberthunder in Chattanooga, TN and told them our solution. For their solution they came up with the idea of a water powered lawnmower. It would use the water to make hydrogen and the engine would run on hydrogen and would reduce pollution.

Sources

These are just some of the places we got our information from.

- Urban Heat Islands: Hotter Cities By Dr. James Voogt. We got a lot of our information from here.
- The Heat Island Group This web site had a lot of good information and pictures. Very kid-friendly
- James A. Voogt Ph. D. Is a teacher at Western Ontario University who published the web site we got a lot of information from. He emailed back and forth with us.
- Cincinnati Wants to Lead Green Roof Movement Article about giving people money to replace shingle roofs with green roofs
- Reducing the Urban Heat Island Effect This is what Chicago wants to do to reduce the Urban Heat Island effect.
- **Integrated Tree & Storm water System** How to plant trees in a porous parking lot.
- **Urban Heat Island Make Cities Greener** Why cities retain heat. It also has satellite pictures.
- **Tree Benefits Calculator** A website that tells you how much a tree and type of a certain size will benefit the environment each year.
- **Grand Traverse Conservation District** Gave us the information we needed on Sugar Maples.
- **The Green Cincinnati Plan** Cincinnati's Climate Protection Plan - The Green Cincinnati Plan. This is from June 19, 2008. It's all the things Cincinnati would like to do to make Cincinnati more environmentally friendly. It is just a proposal right now.
- **Salt Lake City shows hot and cold spots** Satellite pictures showing the Urban Heat Island Effect in Salt Lake City.
- **Recommended Street Trees** This was a pamphlet provided to us from the Clermont County Soil and Water district on picking good trees for the city.