

CLIMATE CHANGE PLANNING:

CASE STUDIES FROM CANADIAN COMMUNITIES



Natural Resources Canada / Ressources naturelles Canada

Canada



CANADIAN INSTITUTE OF PLANNERS / INSTITUT CANADIEN DES URBANISTES

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Introduction

During the past six years the Canadian Institute of Planners (CIP) has been very active in mainstreaming climate change adaptation planning among its members and the planning profession as a whole. With financial support from Natural Resources Canada, [then] Indian and Northern Affairs Canada, and assistance from many of its members, CIP has produced a model Standard of Practice for climate change planning; introductory and in depth climate change modules for practitioners and university students; benchmarking studies; eleven community climate change adaptation plans (seven in Nunavut and four in Atlantic Canada); a climate change adaptation planning toolkit for northern Canada and an adaptation planning handbook for small Canadian communities; and a “Policy on Climate Change”. Most of the results of this work are available at www.planningforclimatechange.ca.

In addition to mandating much of the above work, CIP’s “Policy on Climate Change” has a directive for the organization to engage in “developing and disseminating best-practice recommendations for climate change mitigation and adaptation planning”.¹ This compilation of climate change planning case studies helps fulfill this objective and presents 10 projects for the use of planners across Canada and elsewhere. As in CIP’s previous work, the support of Natural Resources Canada in funding this compilation of case studies is much appreciated and gratefully recognized.

This collection of case studies originates from CIP members across Canada. A request was sent to all CIP members seeking climate change planning projects that could be replicated in other jurisdictions or planning practices. The following ten case studies, spanning the country, were selected for presentation.

The case studies have been organized by geography, starting in eastern Canada and finishing in the West. They are:

1. Tantramar Dykelands Infrastructure at Risk - Sackville, New Brunswick
2. Toronto Green Standard - Toronto, Ontario
3. Waterfront Toronto’s Carbon Tool - Toronto, Ontario
4. Hot Weather Response Plan - Sudbury, Ontario
5. Ecological Footprint and Land Use Scenarios - Calgary, Alberta
6. Planning for Climate Change Adaptation and Mitigation - Red Deer, Alberta

7. Climate Change Adaptation Strategy - Prince George, British Columbia
8. Gibsons Harbour Area Plan - Gibsons, British Columbia
9. Interim Flood Construction Levels - Vancouver, British Columbia
10. Flood Management Planning in Delta - Delta, British Columbia

The case studies are arranged to allow for a quick review, so that planning professionals can determine easily how deep they want to dig. The material is presented at four levels and readers can determine at each level whether the case study is applicable to their professional context.

The first level is The Project - a brief description of the case. Just the basics of the case are covered to allow a rapid assessment of its applicability to the readers’ jurisdictions. The next level is The Essentials. Here the key lessons learned and major tools developed and employed are laid out. Still interested? The next level, The Specifics, covers the project’s approach, steps, barriers, results, responsibility, time and costs. The final level, The Contact, allows detailed follow-up with one or more knowledgeable proponents of the project who have agreed to act as resource persons.

We would like to thank all the planners who proposed case studies. To the authors of the selected case studies, we would like to acknowledge the time you spent preparing the material. Your work in this vital and constantly evolving field of planning will be of great assistance to your colleagues across Canada.

1. Section 4.5(d). CIP’s Policy on Climate Change can be found at www.planningforclimatechange.ca

Tantramar Dykelands Infrastructure at Risk Sackville, New Brunswick



THE PROJECT

Tantramar residents have long known that the famous marshland that acts as the link between New Brunswick and Nova Scotia is a natural floodplain, modified in centuries past by Acadians to create highly productive land on which to farm. Detailed topography of the region shows the intricate dykes and ditches that transformed the massive salt marsh into arable land interspersed now with freshwater creeks and wetlands. Much of the region is at (and in some places below) sea level, but the 29.6km dyke system at the head of the Bay of Fundy protects 7280 hectares of land from tidal flooding.

While the system has worked relatively well for the past three centuries, with rising sea levels and predicted increased frequency of severe storms in the future, considering climate adaptation strategies is a major priority for this region. The average dyke height is 8.6m and the present-day expectation (for 1 in 10 year severe weather event) is for sea level to reach 8.9m. At this level it is projected that 90% of the dykes will be overtopped, flooding 20% of the Town of Sackville once a decade.



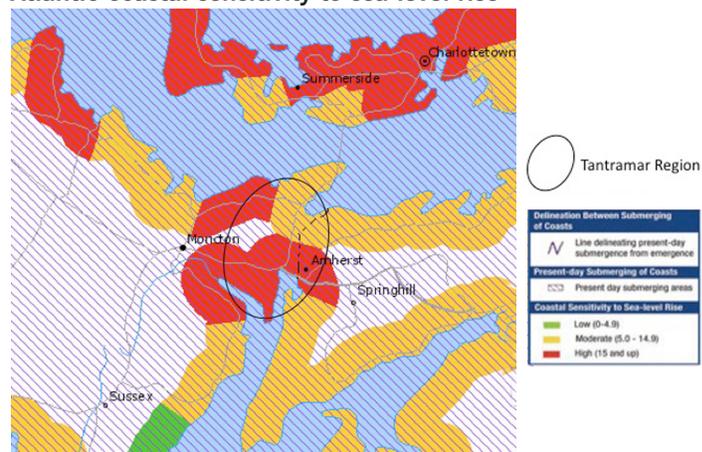
The Tantramar Dykelands Infrastructure at Risk study is one of six New Brunswick projects under the Atlantic Climate Adaptation Solutions Association.¹ This has been a collaborative effort involving scientists, climate meteorologists, GIS technicians, planners, various government agencies, as well as local government. It is a large project that started in 2009, and has included a broad range of data collection², creation of digital

elevation models, and development of storm scenario projections. The component of the project that this case study will specifically focus on is what the working group - which includes the GIS lab at Mount Allison University, the local planning authority (Tantramar Planning District Commission), and local government (Town of Sackville) - has done with this data.

The GIS lab has created a number of key products, the first of which was a refined elevation model of the dyke system. The product is colour graduated to indicate which areas of the dyke are most at risk of being overtopped to those that are relatively secure. The group then analyzed the condition of the dyke system and again, using a graduated colour system, illustrated the areas considered most vulnerable to erosion.

Using the storm scenarios for this particular region created by scientists, the GIS lab then illustrated the flood extent for a 1 in 10 year storm at the year 2000 (i.e., present-day threat) and then again at 2085. The key reason why the 1 in 10 year storm scenario was selected was two-fold: 1) because the Sackville region is characterized by low-lying floodplain surrounded by uplands, we have a “bathtub effect” – this means that when there is a flood, a certain portion of the municipality is always affected, while those parcels on the uplands are not threatened. As the flooding worsens, there is very little increase in the number of parcels affected, although the depth of water does increase; 2) from the perspective of communicating meaningful information to the public, the planners determined that the time scale had to be something that was understandable – a 1 in 100 year storm is unimaginable for most, while a 1 in 10 year storm is something everyone can expect to experience repeatedly throughout their lives.

Atlantic coastal sensitivity to sea level rise



¹ <http://www.atlanticadaptation.ca/>

² Data sources included: LiDAR data imaging, multispectral satellite imagery, property data and topographic maps from Service New Brunswick, high resolution orthometric imagery, and GPS ground survey.

The GIS lab then calculated the number of parcels, hectares and buildings at risk of flooding based on the 1 in 10 year storm scenarios at both times (2000 and 2085). Maps were a primary product, which graphically illustrated the extent of flooding in the community. The maps included elevation, building footprints, and reference points (Town Hall, hospital, churches, schools, rail line, sewage lagoons, etc.)

The planners and GIS lab worked closely to determine the best way to share the information with the public beyond traditional maps. The GIS lab developed several visualization techniques by which to share the information, including a drive-along animation of the area affected and a walking tour of the critical area of the downtown core, which is also severely impacted. This street view perspective is animated to show the depth of water along the buildings as well as how vegetation, cars and people would be impacted by a flood. Preliminary results of focus groups indicate that using a combination of the empirical data, regular 2 dimensional mapping, plus the visualization work are the most effective means of changing the community's opinion about the threat of flooding.

These tools and maps are currently under study and are being actively presented in focus groups. Further, key groups in the community are already using the information for decision-making.

For example, the Emergency Measures Committee is now working on incorporating flood rescue scenarios within its EMO plan based on the results of this work. Specifically, it has put out a call to the public to develop an inventory of flat-bottomed boats that could be accessed in an emergency response situation. Further, the Planning Commission will be closely assessing the municipality's flood plain mapping to ensure that policies and regulations surrounding development in the floodplain help to reduce the risk of the community to flooding. Work is ongoing to determine the economic impact of "doing nothing" as well as several other reactive and proactive scenarios for adaptation.

THE ESSENTIALS

Key Lessons

1. The more data the better. We were very fortunate to be able to participate in this NRCan-sponsored project. Having access to high-resolution images through LiDAR technology was significant in the current project. We acknowledge that this is not an affordable option in all of our communities, and we

have learned to use a range of resources available and work with partners to secure the best data sources possible.

2. If pictures are worth a thousand words, then high resolution maps are worth several 1000-page reports.
3. Unfortunately, there are a lot of skeptics that choose to ignore climate change discourse because they don't "believe in" climate change. Two lessons on this:
 - As planners, we shouldn't pretend to be experts on the scientific issues, but bring in the scientists and experts on climate meteorology, who can answer the questions even from "non-believers"; and
 - Take advantage of adverse weather events; the local community that has just experienced a massive storm surge or weather event is more likely to come out and get engaged, than people who don't see how climate change affects them personally.
4. Avoid scare tactics. Many of the maps paint a pretty grim picture of things to come; we have an obligation to share them with the public, but at the same time, we don't want to create mass panic. We need to acknowledge that the scenarios are just that – projections of what can happen, and be prepared with some ideas to help the community deal with the possibilities (e.g., recommending people move valuables out of their basements, emergency strategies, etc.).
5. Try to avoid the argument about whether climate change is "real" or not and focus on presenting the reality based on empirical evidence (if you can't, see 3) above). Develop key messages to summarize climate change issues to share with the community.
6. Empirical science (boiled down to the basics) makes climate change discussions easier to grasp for local decision-makers. Collect local empirical data points to show that the global trends are reflected locally. Try to have some historical data available to illustrate trends to-date (increasing sea level, increasing temperatures).



Winter storm surge damage - TPDC staff photo



Ongoing coastal erosion - TPDC staff photo

7. Climate scenarios are very complicated. We need to make them as simple as possible, without losing the essence of the material. We went with 1 in 10 year storm scenarios – people can grasp that. Complicating the information with 1-25 year storms or 1-100 year storms (which change as time moves forward to 2085 or 2100) makes the complex data even more difficult to understand.

Major Tools

High resolution mapping – Digital Elevation Models and GIS layers created for flood scenarios are excellent new tools that we have at our disposal to share with the public and use, as we establish long-term land use policy in the flood-prone areas.

One of our most unique tools developed for this project are the animated visualizations of mapped results. For example, seeing a man walking into a flooded area of downtown Sackville and the height of the water on buildings and water covering cars/vegetation, is a very dramatic way of looking at the results of the study.

Finally, an important deliverable from this project will be a web-based “Map Viewer” developed by the GIS lab, so that those interested will be able to access and view the maps and animations from virtually anywhere.

THE SPECIFICS

Approach

The Tantramar Dykelands study followed a collaborative approach. Coordinated by the NB Department of Environment, it involved a wide array of partners including the local planning authority; Mount Allison University scientists; GIS specialists; the municipality; local EMO; NB Departments of Agriculture, Transportation, and Environment; Environment Canada; Parks Canada; CN Rail; and climate meteorologists. This project also included our Nova Scotia partners who are doing a similar project on the Nova Scotia side of the border.

Steps

- i) Data Gathering and Analysis (12 months)
 - Raw data gathering of LiDAR and other data and analysis
 - Creation of a digital elevation model (DEM)
 - Tide levels and sea levels estimated based on location-specific measurements
 - Climate scenarios projected based on established sea and tide levels for the locality (as per 2010)
- ii) Map and Tool Creation (8 months)
 - Analysis of dyke elevation and prediction of dyke erosion-rates
 - Overlay of scenarios on maps
 - Digitization of building footprints
 - Identification of reference structures/places within Town
 - Animated sequences developed
- iii) Communication Strategy (8 months and ongoing)
 - Strategic analysis of key information for community engagement
 - Presentation of communication strategy to Municipal Council for approval
 - Public presentation on climate change by 2 climate meteorologists
 - Focus groups to test visualizations among general public and special interest groups (e.g., EMO, Town staff, Environment Canada staff, Mount Allison University staff)
 - Presentations to public groups (Rotary, seniors, community volunteers, high school students, etc.)

Barriers

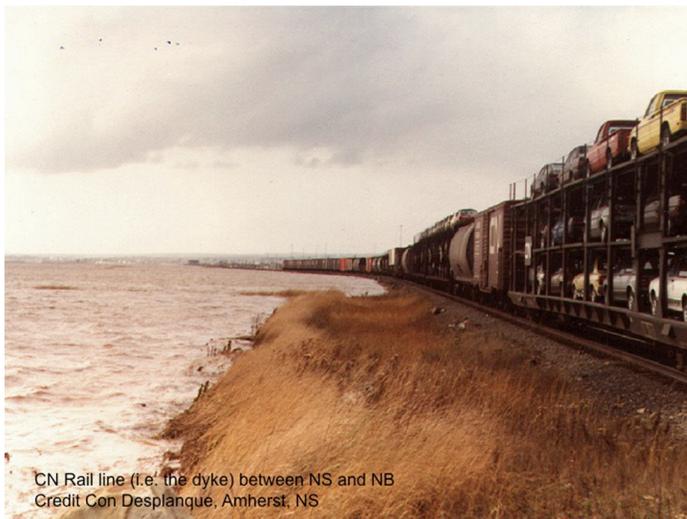
Prior to this project, the real barrier in talking about climate change was the lack of information on how climate change may impact the local community. Now we have a significant amount of data to analyze and present in various ways to the public.

At this point, the real barrier is uncertainty of what the outcomes of sharing this information will be. What can communities and individuals do to protect themselves? Will people lose their homes to floods? How will people be able to sell their homes now that they have been shown in a vulnerable area? Will taxes be reduced to compensate for the change in resale value?

Despite the sound science and information, there remains a certain level of apathy or skepticism that the risks are real. There will need to be a continued effort to share information and educate the public and decision-makers as adaptation efforts are pursued.

Results

The results of this study are really not surprising. Most people in Sackville recognize that we live in a vulnerable area. What is surprising is having confirmed how vulnerable the transportation corridors (specifically between Nova Scotia and New Brunswick) are to floods, due to sea level rise and/or extreme storm events.



CN Rail line (i.e. the dyke) between NS and NB
Credit Con Desplanque, Amherst, NS

One of the key results planners here have come to understand is that people in our community (and likely those in many other places) simply don't believe that climate change issues are a concern to them personally. We have not had an outpouring of participation and interest for participation in focus groups – indeed, we have had to make repeated requests to be part of other sessions, or to have articles put in the local weekly newspaper to get the word out.

However, those who have seen the visualizations and maps have a much better appreciation of both personal and community risk from future events.

From a reactive, emergency standpoint, the Town has remained very involved through the EMO. According to Insurance Bureau of Canada representatives, floods are the new fire, so we need to be aware of the risk and learn how to adapt ourselves and our communities as best we can.

Responsibility

Because this was a collaborative effort, different aspects of this project were led by various people. Consultants and scientific experts were hired to analyze raw data. GIS mapping and analysis were completed at Mount Allison University's GIS lab by Dr. David Lieske and James Bornemann. Interpretation of the findings, planning opinions and facilitation of community sessions were undertaken in house by the Tantramar Planning District Commission staff.

Time & Cost

We were very fortunate to have a significant budget attached to this project to allow for the high resolution data and detailed project analysis over the course of this 3 year project. From a planning perspective, staff of the Tantramar Planning District Commission has been involved from the outset to ensure that planning considerations played a key role in the outcomes and results of the study.

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Toronto Green Standard Toronto, Ontario

1 TIER 1: MINIMUM REQUIRED STANDARD

Green Roofs

Bird-Friendly

Stormwater Retention & Quality

+ 25% Energy Efficiency above MNECB

Tree Planting

Pedestrian Infrastructure

Cool Paving

Cycling Infrastructure

Live green toronto

TORONTO

our cool blue architects
SUSANBLAIRARCHITECTURE | GREEN CONSULTING | IDEAS

THE PROJECT

The largest city in Canada, Toronto is home to nearly 2.6 million people, serves as the economic and cultural engine for the Greater Toronto Area with 5.5 million people, and is one of the most culturally diverse cities around the globe. Changes in the climate of Southern Ontario are expected to affect the city in several ways. Higher summer temperatures may increase the health risks associated with extreme heat and air pollution. Warmer winters may allow the expansion of insect vectors carrying infectious diseases such as the West Nile virus and Lyme disease. Less rainfall during summer as well as more extreme storm events may stress the city's urban canopy and cause damaging flash floods and other infrastructure-damaging effects. Decreased water levels in Lake Ontario may affect port operations, worsen lake water quality and endanger natural habitats.¹

The Toronto Green Standard (TGS) is a set of performance measures adopted by the City for the evaluation of site and building designs. They cover several aspects of a building's functions, including energy and water efficiency, air and water quality, ecological services and solid waste management. The standards are designed to work with the regular development approvals and inspections process and apply to any new development in Toronto that is subject to subdivision or site plan controls or for which a zoning amendment is required.

While climate change adaptation is not explicitly mentioned in the Standard, it addresses some of the most serious impacts of climate change projected for Toronto. For example, the Standard requires the use of light coloured materials, open-grid pavement or shading on at least 50% of the site to be developed. This is intended to reduce urban heat.

Regarding storm water runoff, the Standard requires that new developments retain at least the first 5mm from each rainfall through rainwater reuse, on-site infiltration, and evapo-transpiration from vegetation or alternatively, that the maximum annual runoff from the site be no more than 50% of the total annual rainfall depth. A more stringent set of voluntary standards has also been published. Developments that meet those stricter standards are eligible for a substantial refund on development charges paid to the City to offset costs

of building green, while recognizing the benefits of reduced servicing demand and avoided infrastructure expansion.

The TGS implements Toronto's Official Plan (2002) policies for the natural environment (Chapter 3) including to:

- manage storm water where rain and snow fall;
- protect the natural heritage system;
- reduce energy consumption and reliance on carbon based fuels and,
- support innovative energy producing options, green industry and green building designs and construction.

The City's environmental issues and objectives are outlined in the *Climate Change, Clean Air and Sustainable Energy Action Plan* (2007), *The Power to Live Green: Toronto's Sustainable Energy Strategy* (adopted by Council Nov. 30, 2009) and *Ahead of the Storm: Preparing Toronto for Climate Change* (2008). These documents set out the City's overarching policy objectives to encourage and enable energy conservation and secure, renewable, and district energy supply to achieve the City's greenhouse gas emissions reduction targets of:

- 6% by 2012,
- 30% by 2020 and
- 80% by 2050 below 1990 levels.

The Climate Change Plan includes recommendations towards making the TGS mandatory to account for the effects of proposed construction on Toronto's energy supply, consumption and greenhouse gas emissions and reinforces the importance of sustainable design in new and existing buildings; in Toronto, buildings account for the 63% of our total greenhouse gas (GHG) emissions. *Ahead of the Storm* highlights the major weather changes and impacts expected for Toronto and sets out the stepped approach being implemented currently for risk assessment and strategic actions by City divisions. The TGS plays a major role in improving Toronto's built environment and achieving these objectives by setting minimum performance measures.



1. Richardson, G., and Otero, J. (in progress). 2012. Land use planning tools for adaptation to climate change; Government of Canada, Ottawa, ON

THE ESSENTIALS

Key Lessons

The land use planning process and development controls are integral tools to address climate change. Regulations used to control the location, layout and design of proposed new development are intended to mitigate impacts on the community. The planning process provides an opportunity to review subdivisions, new buildings or alterations to existing buildings on a case-by-case basis, study potential impacts and consider best management practices to counter the impacts of climate change. Since development review occurs early on, the process also dovetails nicely with the integrated design process used to design green and efficient sites and buildings.

The Toronto Green Standard is implemented primarily through site plan control procedures and the use of provisions under the City of Toronto Act (also The Planning Act of Ontario) to secure green design features such as: cool and green roofs, permeable, high-albedo surface materials, energy efficiency, water efficiency and bird friendly building design. In particular, section 41 of the Planning Act of Ontario (also section 114 of COTA) includes provisions to secure matters of exterior sustainable design that assist with addressing climate change.



Green site and building design decreases the demand on water, servicing and energy infrastructure and reduces green house gas emissions contributing to climate change. A cost benefit study conducted by the University of Toronto Faculty of Architecture, Landscape & Design (2008) showed that at least 1.2 billion dollars would be saved over the next 25 years in avoided infrastructure expansion as a result of implementing green buildings in Toronto. GHG emissions would be

reduced as follows: typical condominium 500 tonnes eCO₂; typical office building 300 tonnes eCO₂; and typical single storey retail building 300 tonnes eCO₂. This rationale was the basis for offering a substantial refund on development charges paid to the City, if the higher voluntary standard is verified as having been met.

Major Tools

Under section 41 of the Planning Act of Ontario (1997) a municipality has powers to approve drawings that contain matters of exterior sustainable design and sustainable design elements on any adjoining highway under a municipality's jurisdiction. These powers can only be implemented if both the Official Plan and a Site Plan Control by-law contain provisions related to those matters.

The TGS was the first municipal planning tool of its kind to utilize fully and implement section 41 of the Planning Act by amending the City's Official Plan to incorporate and define matters of exterior sustainable design that could then be secured through site plan control. In addition, the Ontario Municipal Board settlement to OPA 66 further established land use authority to control the design of the exterior building envelope, which affects such matters as energy efficiency. City Council adopted, in January 2009, OPA 66 with additional policies.

A number of products and tools were developed to support TGS implementation:

- TGS checklist: it is required as part of a "complete application" and is completed by the applicant and submitted with zoning, plan of subdivision or site plan proposals to document how and where each performance measure is noted on plans, drawings or in reports.
- TGS site statistics template: the template is stamped onto the site plan drawing and provides quantitative TGS information to assist with development review.
- Internal reference charts of divisional roles and responsibilities in development review of TGS performance measures.
- The Sustainable Development- Toronto Green Standard Training Course for staff.
- The Cost Benefit Study (2008), which looks at costs of building green from a return on investment, life cycle costing and simple payback perspective, provides an in-depth look at trends in green development, opportunities and barriers, and thereby provides valuable information applicable to new construction across Canada.

THE SPECIFICS

Approach

The TGS was initiated in 2005 with a review of over 100 cities' green development requirements and extensive consultation with developers and design professionals and the public. It was adopted by City Council in July 2006 as mandatory for new City-owned facilities and voluntary for private development. A revised TGS was approved by City Council in December 2008 and December 2009, based on the results of the Cost Benefit Study and stakeholder consultation. The revised two-tier TGS emphasizes those elements of green development that will be required by the City in Tier 1, and those features that would receive a proposed development charge refund to raise the bar further in Tier 2. Tier 1 became mandatory on January 31, 2010.

Steps

In 2005 a working group was formed with staff and citizen representatives from the Roundtables for a Beautiful City and the Environment. In April 2006, stakeholder workshops were held with architects, engineers, developers, builders, environmental groups, and large property owners and/or managers to discuss green development options. A survey was distributed to Toronto developers to understand what green initiatives are being built and the barriers to more green development.

The results of all the work were compiled into a published Discussion Paper for consideration at a public meeting of the Roundtable on the Environment. The TGS Cost-Benefit Study relied on the expert advice of a Steering Committee consisting of developers and sustainable building experts. Consultation also involved working closely with private developers and the design community through focus group and individual meetings. The revised TGS was before Council's Planning and Growth Management Committee in December 2008 and October 2009 and stakeholders made deputations before the Committee.

Barriers

One perceived barrier was internal/external concern that development review time for the TGS would increase processing time for development applications. This was overcome by extensive staff training, both in terms of an understanding of sustainable development and why it is important, and also in terms of the role of each development review subgroup. An internal reference chart was created to understand who is responsible for what. For example, Forestry is responsible for

reviewing the number of shade trees in the boulevard and the required soil volume; Development Engineering is responsible for review of storm water reports; Urban Design is responsible for reviewing high albedo paving materials and bird friendly requirements.

Another perceived barrier were the newly required TGS checklist and the statistics template to be completed by the development applicant. The checklist identifies how the TGS performance measures are met and on what drawing. The statistics template summarizes how performance measures are being addressed, such as % of hardscape shaded, number of trees planted per m² of hardscape, softscape, etc. The newest components of the TGS are the minimum energy efficiency requirement for buildings of 25% above the Model National Energy Code for Buildings (MNECB) and the addition of the City's Energy Efficiency Office (EEO) to the development review and approvals process. In this case, standardized review comments and pre- and post-development approval conditions were established in an MOU with the EEO resulting in lower review times than normal.

Results

The Toronto Green Standard is a two-tiered set of performance measures for all new development in Toronto that is intended to achieve high performance, sustainable design of sites and buildings. There are 3 standards: i) low-rise non-residential; ii) low-rise residential; and iii) mid- to high-rise residential, commercial/ industrial and institutional. The TGS was the first time a municipality in Ontario had required sustainable performance measures, including those addressing climate change adaptation, using the planning approval process. Tier 1 identifies the minimum sustainable performance measures that will be secured during Ontario Planning Act application approval processes (zoning bylaw amendment, official plan amendment and site plan approval) with the use of plans and agreements.

The measures focus on exterior sustainable design, landscaping, site level infrastructure features (such as automobile, cycling and pedestrian infrastructure) and submission of an energy efficiency modeling report indicating a 25% better performance than the Model National Energy Code for Buildings (MNECB) or Energyguide 80 for low-rise development.

Tier 2 identifies enhanced sustainable performance measures that raise the bar and encompass whole building performance such as 35% energy

efficiency above MNECB or Energuide 85 for low-rise development. The enhanced standard includes matters that are outside of what can normally be secured under the Planning Act but will be achieved through a Development Charge Refund program of 20%. As of October 2011, there were approximately 400 applications, where Tier 1 performance measures were required, including 10 developments seeking to achieve Tier 2.



Responsibility

Preparation of the TGS involved municipal staff in the divisions of City Planning, Toronto Water, Facilities and Real Estate (Energy Efficiency Office), Parks, Forestry and Recreation, Technical Services (Development Engineering), Toronto Building and Legal Services.

A variety of consultants were hired for background studies including engineering/planning consultants, building scientists, architects, policy analysts, sustainable building experts and experts in energy management and sustainability indicators. Representatives from the Building Industry and Land Development Association (BILD) and other developers participated on a steering committee.

Time & Cost

Development of the TGS cost the City \$390,375.00. This was paid through 50% funding from the Federation of Canadian Municipalities' Green Municipal Fund (GMF), 25% in grant contribution from Ontario Centres of Excellence and 25% through the municipal operating budget.

The TGS was initiated in 2005 with a review of other municipal green standards. It was adopted by City Council in July 2006 as mandatory for new City-owned facilities and voluntary for private development. A revised TGS was approved by City Council in December 2008 and October 2009. It took approximately 51

months to develop the two-tiered standards and implementation procedures.

There are significant financial savings to be realized through meeting the requirements of the TGS. The Cost Benefit Study indicated that, typically, the cost of complying with the Toronto Green Standard would be a 2% to 7% premium, but payback for most items could be as little as 5 to 7 years with a Return on Investment of 20 to 30% (depending on building type). In terms of the City itself, the Study indicated that over the next 25 years the economic benefit achieved from adopting the TGS is about 1.2 billion dollars. The savings from good development practices, avoided water and wastewater expansion, and avoided air quality related health costs exceed the premium for green development.

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<http://www.toronto.ca/teo/adaptation/index.htm>



Waterfront Toronto's Carbon Tool Toronto, Ontario



THE PROJECT

In November 2001, the Government of Canada, the Province of Ontario and the City of Toronto established Waterfront Toronto as an independent organization to oversee and lead the renewal of Toronto's waterfront. Waterfront Toronto has a 25-year mandate to transform 800 hectares of brownfield lands into sustainable, mixed-use communities and dynamic public spaces. In 2005 the corporation completed a Sustainability Framework, which set policy objectives and presented a road map to guide this transformation.

As part of early collaboration between Waterfront Toronto and the C40-Clinton Climate Initiative's Climate Positive Development Program, a joint effort was undertaken to develop a Carbon Tool. This effort included funding support from the Ontario Power Authority. The Carbon Tool, which is a spreadsheet assessment tool based on Climate Positive objectives, was tested by Waterfront Toronto and then shared with the Climate Positive Development Program more widely. The goal of the Carbon Tool is to help drive sustainability considerations into the urban design and decision-making process for community development and infrastructure design projects.

The Waterfront Toronto Carbon Tool is designed to measure the sustainability performance of urban development projects over a baseline, business-as-usual scenario, and to influence decisions during the design, planning, and development process. It does so by modeling the interactions between focus areas - land use, energy, water, waste, transport, carbon, and materials. Each focus area has a set of strategies and associated target levels that can be adjusted, allowing users to assess a range of possible sustainability outcomes as they work on planning alternatives. This gives users an opportunity to understand the relationship between development decisions and sustainability, thereby exploring ways of improving performance and combatting climate change.

Once baseline performance and development data are inputted into the Tool and strategies and associated target values selected, the Tool performs calculations and produces outputs for the aggregate development project in question. The outputs can be expressed per person, per square meter, or per year for carbon, energy, potable water, wastewater, waste landfilled, and transport. The Carbon Tool's analytical functions are interactive and interrelated in nature. It provides a means to calculate, visualize and understand the

relationships between development decisions and sustainability, and, in the process, explore ways of increasing performance by modifying those decisions or introducing new strategies.

A series of figures, displayed at the end of the case study, graphically overviews certain aspects of the Carbon Tool. Figure 1 is a snapshot of the Scenario Control Panel. The Scenario Control Panel is the control centre for the Tool and provides instant output charts showing the incremental effects of two specific strategies by focus area. Figure 2 is the resource wheel diagram showing the performance of the baseline and two scenarios. The Tool also produces a set of bar and pie charts showing the breakdown by both land use/program element type and focus area for the baseline scenario and the two operational scenarios (see Figure 3 and 4).

THE ESSENTIALS

Key Lessons

Timing is critical when applying the Carbon Tool. It works best at the front end of development activity during the integrated design process, if the intent is to create meaningful change and influence decision-making. Once this critical period passes, the opportunity to modify designs is reduced significantly, as is the possibility to optimize sustainability performance. At that point, the Carbon Tool can only function as a monitoring tool.

Another challenge with the Carbon Tool is developing transportation strategies that are based on modeling assumptions. Developers have little control over peoples' behaviour, which makes these strategies very theoretical in nature and may skew results. It is best to keep this in mind when examining predictions.

Major Tools

The Carbon Tool was developed to:

- Facilitate integrated project planning connecting land-use, landscape design, transportation, and architectural decisions with quantitative measures of resource sustainability performance;
- Facilitate the education of stakeholders on how design and planning decisions impact sustainability; and
- Inform future updates to Waterfront Toronto's Minimum Green Building Requirements (which are mandatory green building standards that all Waterfront Toronto controlled buildings must comply with) and identify future priorities for Waterfront Toronto in the area of sustainability performance.

Although the Carbon Tool has been specifically designed and calibrated for the Waterfront Toronto setting, a generic version of the Tool is being developed for the Climate Positive Development Program. Once tested and refined, Climate Positive will strive to extend the tool publicly in order to help shift the market to sustainable urban development and drive supportive municipal policies.

THE SPECIFICS

Approach

The Carbon Tool was developed by a team led by Arup as part of Waterfront Toronto, in collaboration with the C40-Clinton Climate Initiative's Climate Positive Development Program and the Cities Centre at the University of Toronto with funding support from the Ontario Power Authority. Halsall, EC3 and Loop Initiatives led a multidisciplinary workshop to identify sustainability performance measures for use in the Tool's development. The University of Toronto developed the transportation-planning component of the Tool and reviewed the assumptions used in other focus areas.

Steps

The Tool development process included the following stages:

1. Identify Focus Areas;
2. Plan Tool architecture;
3. Conduct multidisciplinary workshop to agree on Focus Areas and identify Performance Measures;
4. Develop Performance Measures and their Baseline assumptions;
5. Develop an initial list of Strategies and indicative performance Targets associated with those Strategies;
6. Develop Tool using West Don Lands Phase 1 and 2 master-plan as a test case;
7. Present initial Tool to core team for feedback and comment;
8. Review Tool; and
9. Present Tool to the team.

Barriers

The Carbon Tool does not take into account whether the sustainability strategies will actually be feasible or applicable to a specific development plan, so technical expertise by the user is assumed. In addition, the Carbon Tool does not attempt to quantify or predict the specific cost or economic impacts of scenarios or strategies.

The Carbon Tool currently is not integrated with GIS and CAD, although such capabilities are possible. At present, data must be inputted manually, however, opportunities for integration are being explored.

Results

The Tool development by the project team included testing the model against a development scenario in order to evaluate the performance of the model and formulate competing scenarios. The Tool has been applied to Waterfront Toronto's West Don Lands precinct. The model was populated with data derived from approved plans for the precinct, which were developed by Waterfront Toronto and approved by the City of Toronto.

Inputs included details on building types, density, and occupancy rates for the precinct plan, as well as parkland and public realm planned for the area. Scenario 1 strategies included best practices beyond the baseline and Waterfront Toronto's sustainable development features such as the Minimum Green Building Requirements, which contain a mandatory energy performance requirement and LEED® Gold certification for all buildings. Scenario 2 strategies included more aggressive stretch objectives to reach a climate positive outcome.

The baseline inputs reflect the current conditions in Waterfront Toronto precincts such as energy supply mix on the grid, planned transit services, and building standards based on the Ontario Building Code and Toronto Green Standard Tier 1.

The application of the Tool has been useful in the sustainable planning and development of the West Don Lands precinct. The Carbon Tool outputs for the West Don Lands, comparing Scenario 1 to the baseline, predict the following: 39% energy savings; 42% potable water use savings; 36% savings in waste landfilled; and 36% savings of carbon related to materials. This amounts to a total carbon (primary and secondary) savings of 32%.

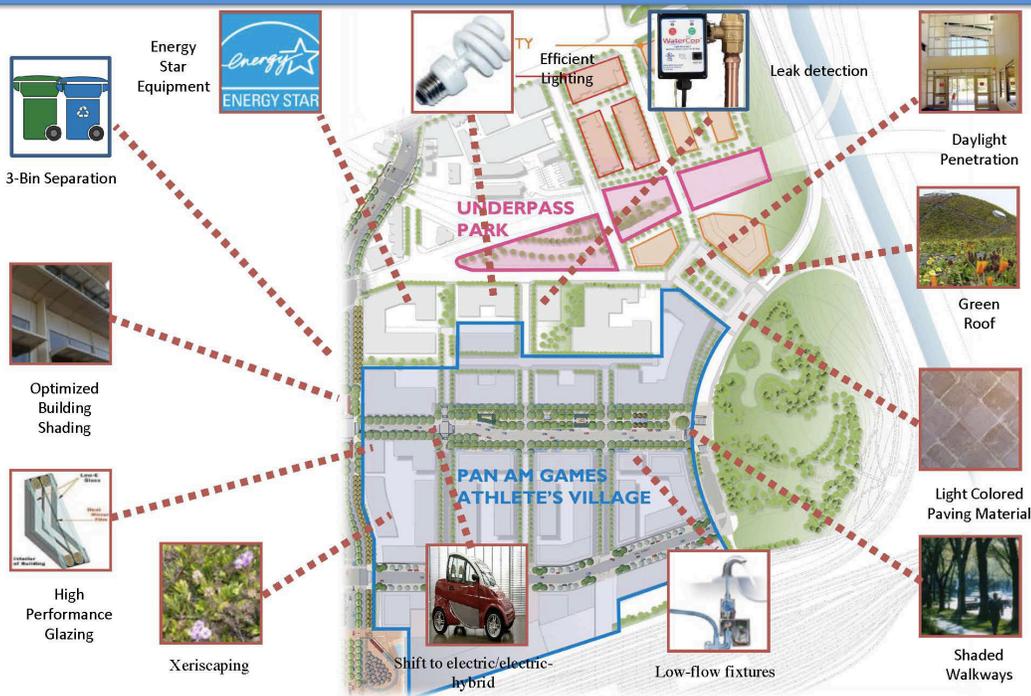
This comparison between Scenario 1 and the baseline also gave Waterfront Toronto useful information on the benefits that may be attributable to the Minimum Green Building Requirements.

In addition, the results showed that 62% of carbon is attributed to energy, while 30% is transport-related. Further, 75% of the carbon emissions are associated with residential land-use, followed by commercial and retail development. The results of this breakdown provide the project team with the resource type and land-use type that have the greatest impact on carbon emissions, and can help the project team decide where to direct further sustainable strategies to combat climate change.

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Applying the Carbon Tool to Development



Responsibility

The Carbon Tool was developed by a multidisciplinary team involving several partners. Members of the partnership are noted in the subsection dealing with the Approach.

Time & Cost

The development of the Carbon Tool began in July 2010 and was completed by April 2011. The Tool cost approximately \$150,000 to develop in collaboration with the C40-Clinton Climate Initiative.

Figure 1: Snapshot of Scenario Control Panel



Figure 2:

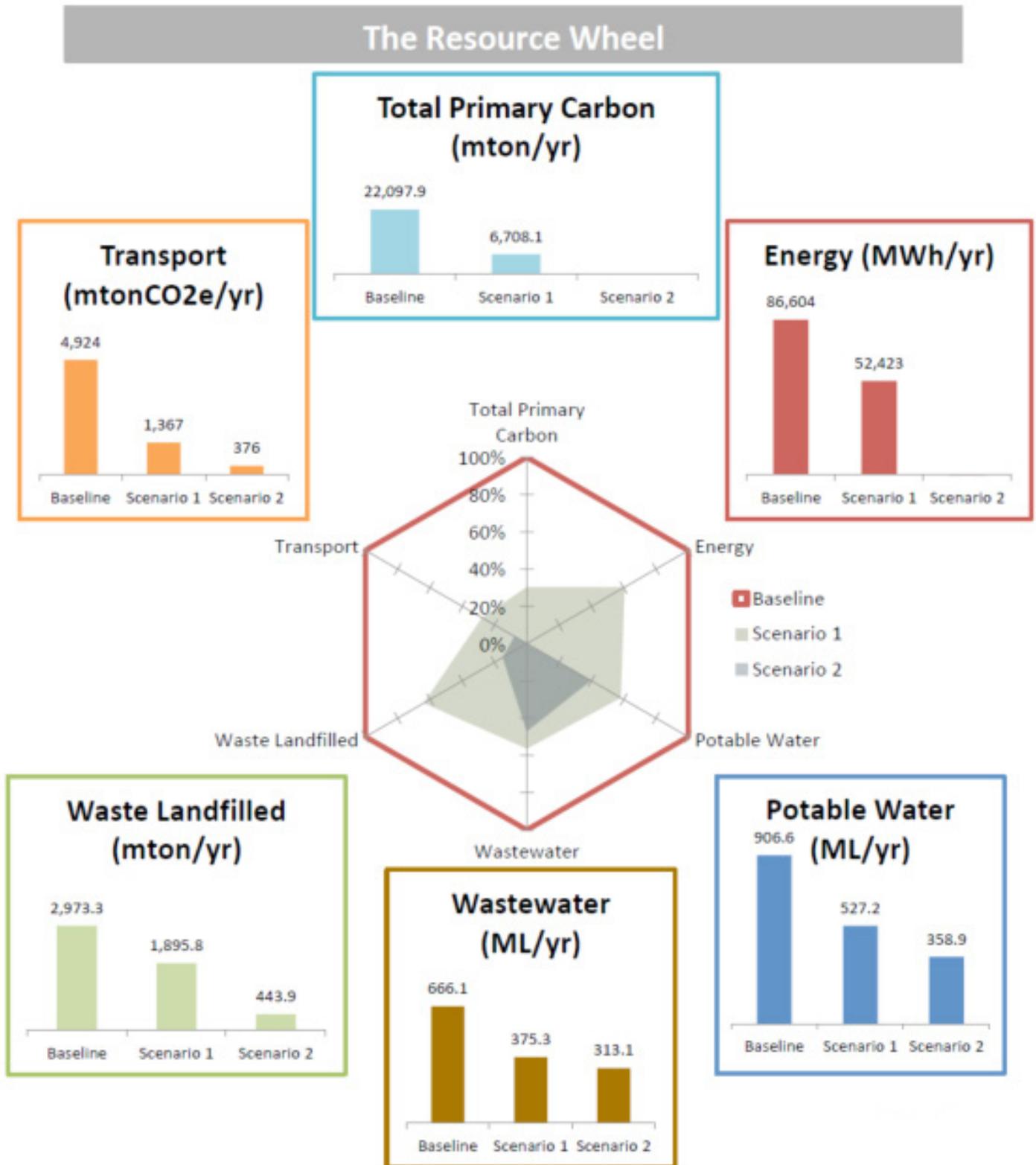


Figure 3: Sample Outputs

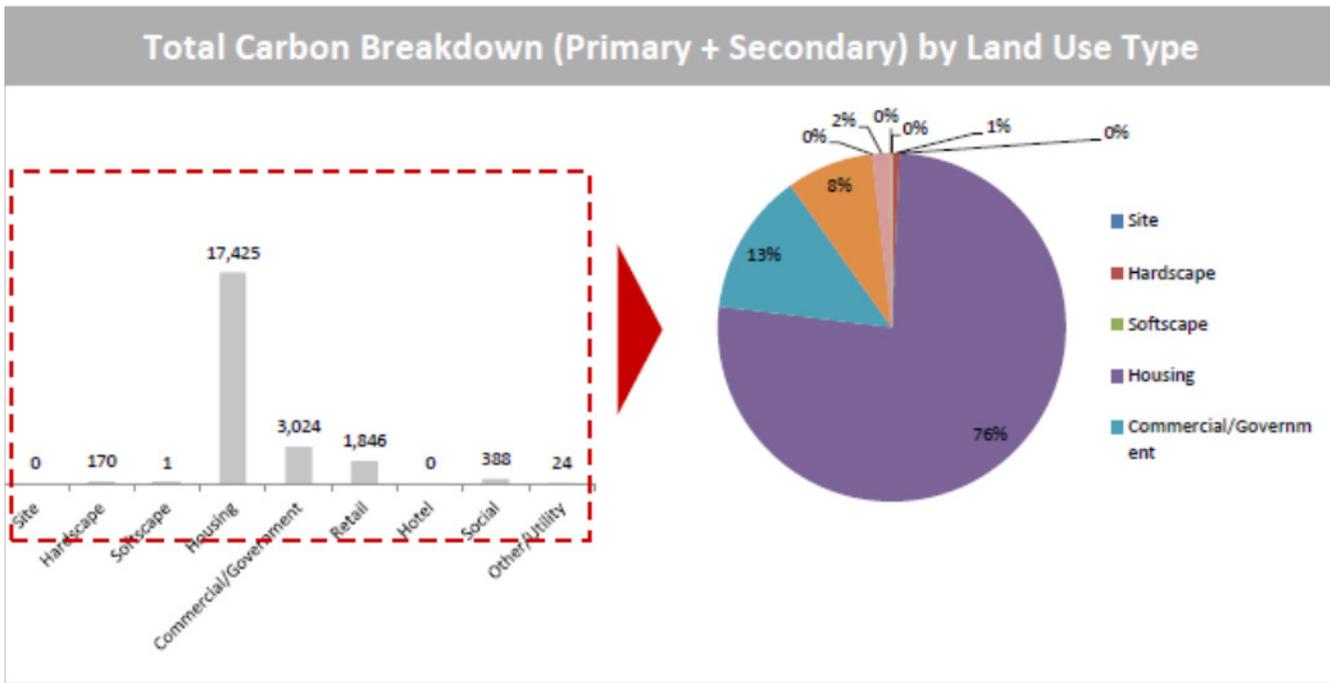
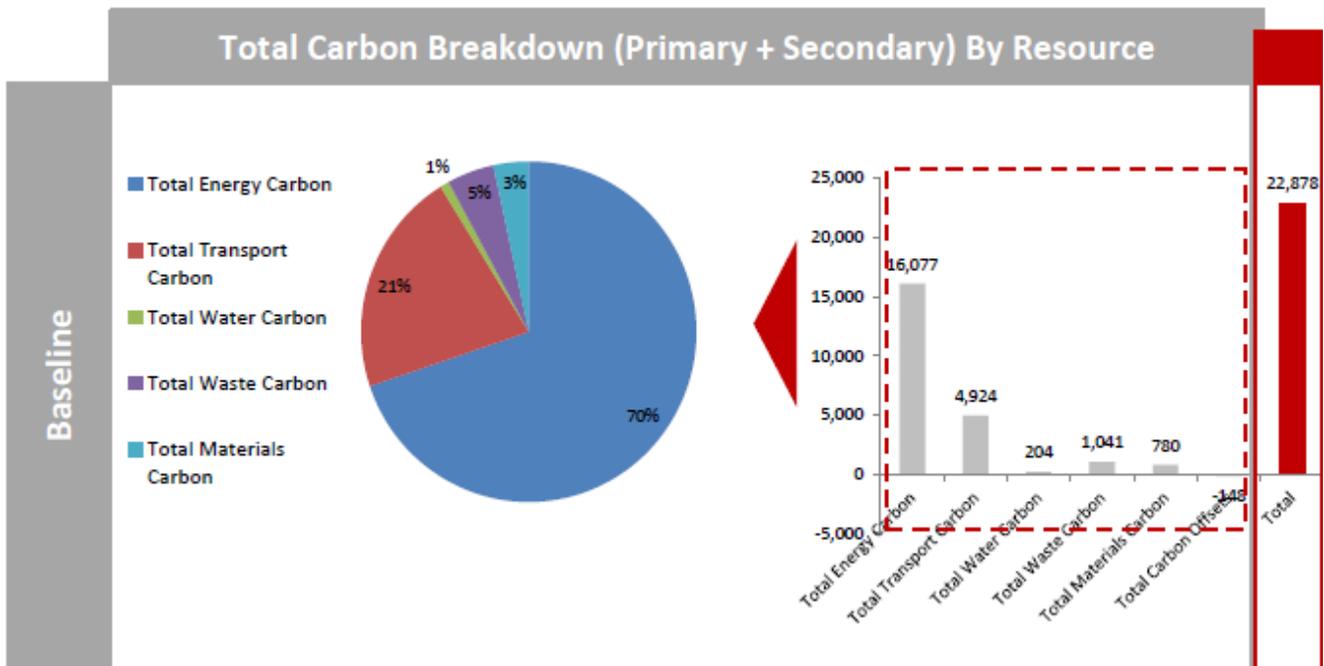


Figure 4: Sample Outputs



Hot Weather Response Plan Sudbury, Ontario



THE PROJECT

The City of Greater Sudbury (CGS) and the Sudbury & District Health Unit (SDHU) collaborated to develop a reasonable and workable tool to address a specific health threat - extreme heat. The result was the Hot Weather Response Plan (HWRP). The HWRP is intended to alert those most at risk of heat-related illness that hot weather conditions are either imminent or currently exist and to take appropriate precautions.

All parties involved with the project recognized that climate change is occurring. Although Greater Sudbury does not currently have many extreme heat events, climate change projections and recent studies in the region have demonstrated that these events will increase in frequency and intensity. The proactive approach to this project creates a basis for future adaptation and revision.

THE ESSENTIALS

Key Lessons

1. The triggers or thresholds at which the HWRP must be activated should be clearly defined and should include a variety of factors such as temperature, humidity, presence of smog, and duration of event.
2. Each municipality will have a unique list of neighbourhoods or buildings with a high concentration of the most vulnerable people. The most vulnerable people include infants, seniors, socially isolated individuals, people with pre-existing morbidity or who are unable to care for themselves, and people who have low incomes or are homeless.
3. The feasibility of all options to adapt to extreme heat must be examined thoroughly to determine a balance among volunteers, time and financial cost.
4. Available facilities must be determined and may include municipally owned and operated buildings.
5. Public awareness of personal responsibility during extreme hot weather is tremendously important, and communication must include both oral and written media outreach.

Major Tools

The key to this plan is the development of the triggers or thresholds at which the Hot Weather Response Plan must be activated. The CGS and SDHU have established thresholds for three status levels; heat advisory, heat alert and extreme heat alert.

The decision to activate the HWRP lies with the Medical Officer of Health and is based on weather forecasts

from Environment Canada. The City's Emergency Management staff has set up a special Emergency Advisory email notification system that allows SDHU staff to send one email for widespread distribution. The email group is reviewed annually and updated as required.

THE SPECIFICS

Approach

The CGS and SDHU recognized that extreme hot weather is an important health risk. Community partners and stakeholders were contacted and invited to contribute to the HWRP. Contributions in some cases involved providing contact information to build the email distribution list. In other cases services and/or actions were committed to. Some of the partners are; the Red Cross, School Boards, hospital, nursing homes, etc.



The basic approach for the HWRP was to determine the risks of extreme hot weather and develop an action plan to prevent or mitigate the negative effects of extreme heat on the residents of our community. We don't keep a list of vulnerable people or places as part of the plan. What the plan is intended to do is to raise awareness of the dangers of extreme heat and encourage agencies and organizations to take steps to mitigate the effects of extreme heat on their client groups.

Steps

The CGS and SDHU began their work on the HWRP by contacting potential stakeholders. These included Emergency Management, Sudbury Red Cross, City Social Services and Community Development. They concluded that the consequences of remaining idle on the subject were too great and action had to be taken.

They examined emergency response plans from other municipalities (primarily from Canada) to determine which approaches may be effective in Greater Sudbury and how they may be modified and simplified for our unique city (with a very large territory to cover).

An important step was to determine the thresholds for action. Three levels of action were established with triggers based on temperature and humidity (the humidex), smog, and duration of event. Every day between May 15 and October 15, the SDHU monitor weather data from Environment Canada, including temperature, humidex and smog forecasts for the City of Greater Sudbury. Following confirmation by the Medical Officer of Health (MOH), the advisory status is declared, and the activation procedures set forth in the response plan are followed.

All partners determine how they can participate in the event of extreme hot weather for each threshold level. Although extreme heat is recognized as a risk, there is no legislation for action and, therefore, all participation by partners is voluntary.

A pilot project was launched for the summer of 2006 to examine the implementation of the HWRP. The CGS and SDHU determined that the original plan included too much background information that could easily be found on the internet. They revised the plan and scaled it back to eight pages of pertinent information with reference to important websites.

Actions vary and depend on the level of the advisory alert. Examples of such actions (as described in the plan): community notification, opening of cooling centres, extending hours of supervision at public beaches, distribution of bottled water, postponing utility service cancellation, free shuttle service, distribution of fans, and evacuation.



To coordinate a community response when temperatures reach extreme levels, public education and awareness are essential. Various campaigns helped promote the prevention of heat-related illness. Media coverage included televised alerts, news releases through websites and radio announcements. Future alerts will utilize social media such as Facebook and Twitter.

To ensure that high-risk populations were cared for when temperatures reach extreme levels, the partners determined who would be considered most vulnerable. They concluded that the target groups would include infants, the elderly, socially isolated individuals, persons with pre-existing morbidity or who are unable to care for themselves and people living in poverty.

To ensure that all agencies working with vulnerable groups are provided with information on what precautions to take when temperatures reach extreme levels, an extensive email database was developed. It includes health-care professionals, daycares, School Boards and seniors' facilities. When the HWRP is enacted, a special email announcement from a unique email address is distributed to people in this database. The database is updated annually in late spring.

Cooling centres were chosen strategically but limited to municipally owned and operated buildings. Greater Sudbury is the largest city in terms of its geographic area of 3600 km² and all outlying communities were included in the planning of the document. The CGS and SDHU included the community centres and libraries of all the small communities and in the city core.

Cooling centres are staffed and supervised by city employees. Health and Safety legislation, Employment Standards Act and union collective bargaining agreements are strictly followed.

The SDHU annually reviews and revises a number of educational materials that outline general precautions to take during hot weather. These bilingual materials are widely distributed to the public and to community organizations including clinics, daycares, long-term care facilities, seniors' residences, health care professionals, religious institutions, sports and recreational facilities, food banks, playground associations, School Boards and Aboriginal groups. Moreover, this information is also available electronically on the CGS and SDHU websites.

The CGS and SDHU also review the effectiveness of the Hot Weather Response Plan and make any necessary revisions annually. Information is collected regarding

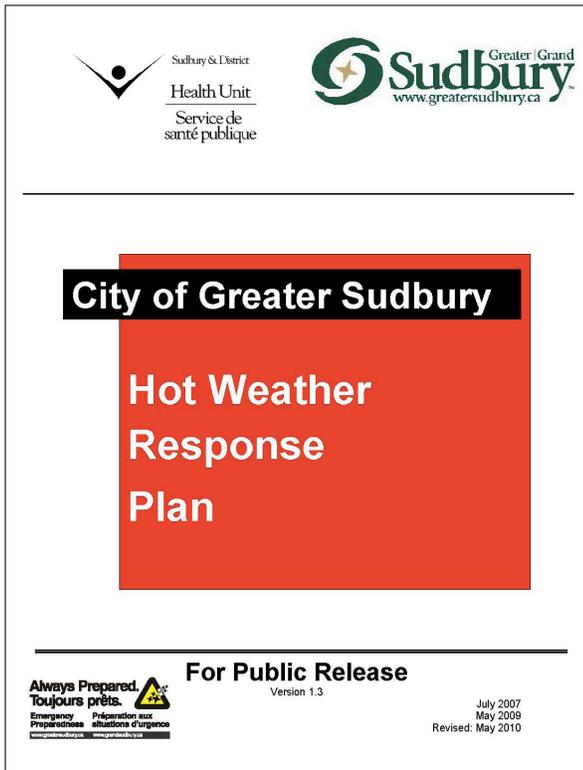
the implementation of the Hot Weather Response Plan including the number of advisories issued, the number of days under advisory conditions, actions taken, and estimated associated costs.

Time & Cost

There was no specific budget for this project. Two staff members (from CGS and SDHU) added this project to their regular workload.

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Barriers

Financial restraints and available staff were a major barrier for the HWRP. Numerous actions that are still desired are not feasible at this time.

Recruitment and deployment of volunteers is an important component of the plan. It is difficult to find volunteers for the implementation of the plan. Existing volunteer organizations are reluctant to share their volunteer lists and/ or have another organization take charge of them. Volunteers may perform various tasks during the activation of the plan, including distributing water or visiting vulnerable neighbours.

Results

The collaboration between the SDHU and numerous departments of the CGS was a very positive result. The community networking was also very important through public consultation and the email database development.

Responsibility

This project was developed by the City of Greater Sudbury and the Sudbury District Health Unit with consultation and participation from numerous community organizations.

Ecological Footprint and Land Use Scenarios Calgary, Alberta



THE PROJECT

Over the past three years, through a major research and development effort, the measurement of the Ecological Footprint (EF) at urban block and census village geographies in a GIS environment has been completed. The EF measure can be contextualized as one component of policy planners' Triple Bottom Line – environmental sustainability. The intent is to supply decision support material in the realm of sustainability. Policy planning carried out today needs to be adapted to the projected impacts of climate change. Initial research shows that the Ecological Footprint is a comprehensive quantitative measure that can be estimated accurately for sub-city geographies. This sustainability measurement tool includes total EF as well as Housing, Mobility and Energy (Carbon footprint) components and has been made available to the City of Calgary Land Use and Policy urban planners.

The EF measurement is a reflection of lifestyle that can be estimated based on several sources of information. Two units of measure of the Total EF are global hectares per capita (gha), and earths (planets required, if the entire global population replicated this lifestyle). Both fit well with the “think global, act local” mindset. The Energy component can also be converted to and expressed in tons of CO₂e. The EF database is able to inform planning scenarios, with numerically comparable results, which vary in housing type, density and mix of uses, location of development (within or around a municipality), as well as such issues as net zero energy housing and urban transit oriented development (TOD) sites.

The current status of the project is:

1. A major test analysis has been carried out using 2010 data on the South Shaganappi Regional Context Study, including net zero energy housing scenarios.
2. The 2011 database, with upgrades to the 2010 database, has been used for an analysis of the Keystone Hills Area Structure Plan, including a proposed TOD site.
3. The procedure has now been reviewed by the Global Footprint Network (GFN), the originator of EF theory and global EF datasets. The GFN final report concludes that the method is “robust, innovative and useful”.

Three papers have now been published in association with this project. References can be found at the end of the case study. Application of the EF would be of

value for planners addressing climate change adaptation across Canada. The methodology described here, or one based on similar data sources, should be replicable by many, if not all, Canadian municipalities who are interested.

THE ESSENTIALS

Key Lessons

- A quick and easily created version of the Ecological Footprint can be calculated from Statistics Canada dissemination area (census village) geography and associated lifestyle data for initial consideration and for regional estimates (see Figure 1).
- The Ecological Footprint is expressed in easily understood units - global hectares or earths. Both function well with raising public awareness and during public engagement processes. The public as well as policy planning professionals understand these units intuitively from a “think global, act local” perspective.
- Energy land, which is a component of the EF and equates to Carbon footprint but is measured in global hectares (also convertible to tons of CO₂e), is a gauge of carbon emissions directly associated with climate change (see Figure 2).
- Housing and Mobility are EF components that fall under the direct influence of policy planners and the policy plans created.
- The EF spatial area units of hectares show well on maps, a commonly used planning tool for public engagement, communication and direct use in policy plans.
- For the more detailed scale of postal code groups or urban blocks, data should be available from internal sources for any municipality: residential building type and size (floor area) from local Tax/Assessment departments; residents per household and mode of transportation to work from civic census; and externally from local utilities companies, Polk (a private marketing firm) and Statistics Canada.

Figure 1

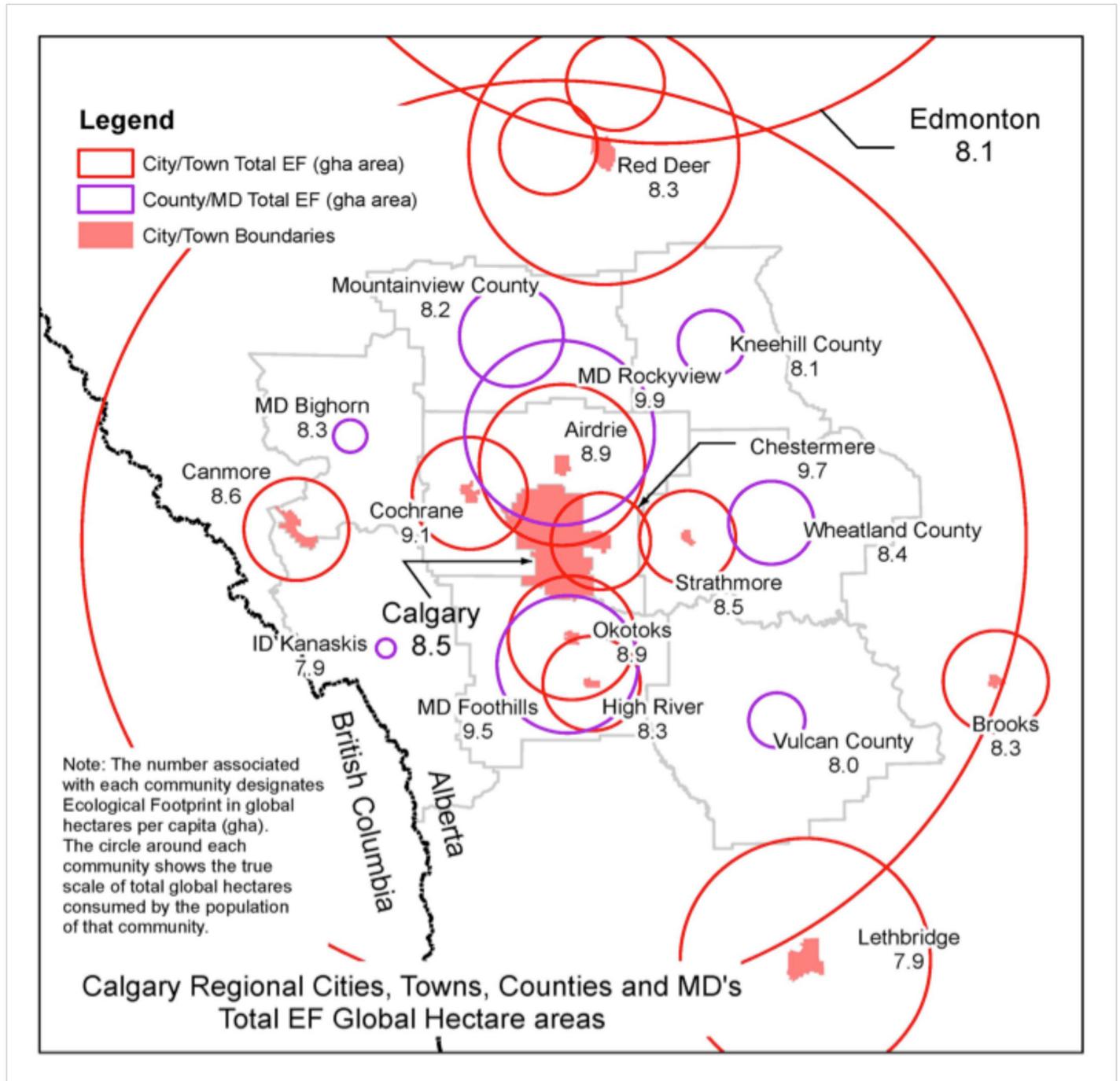
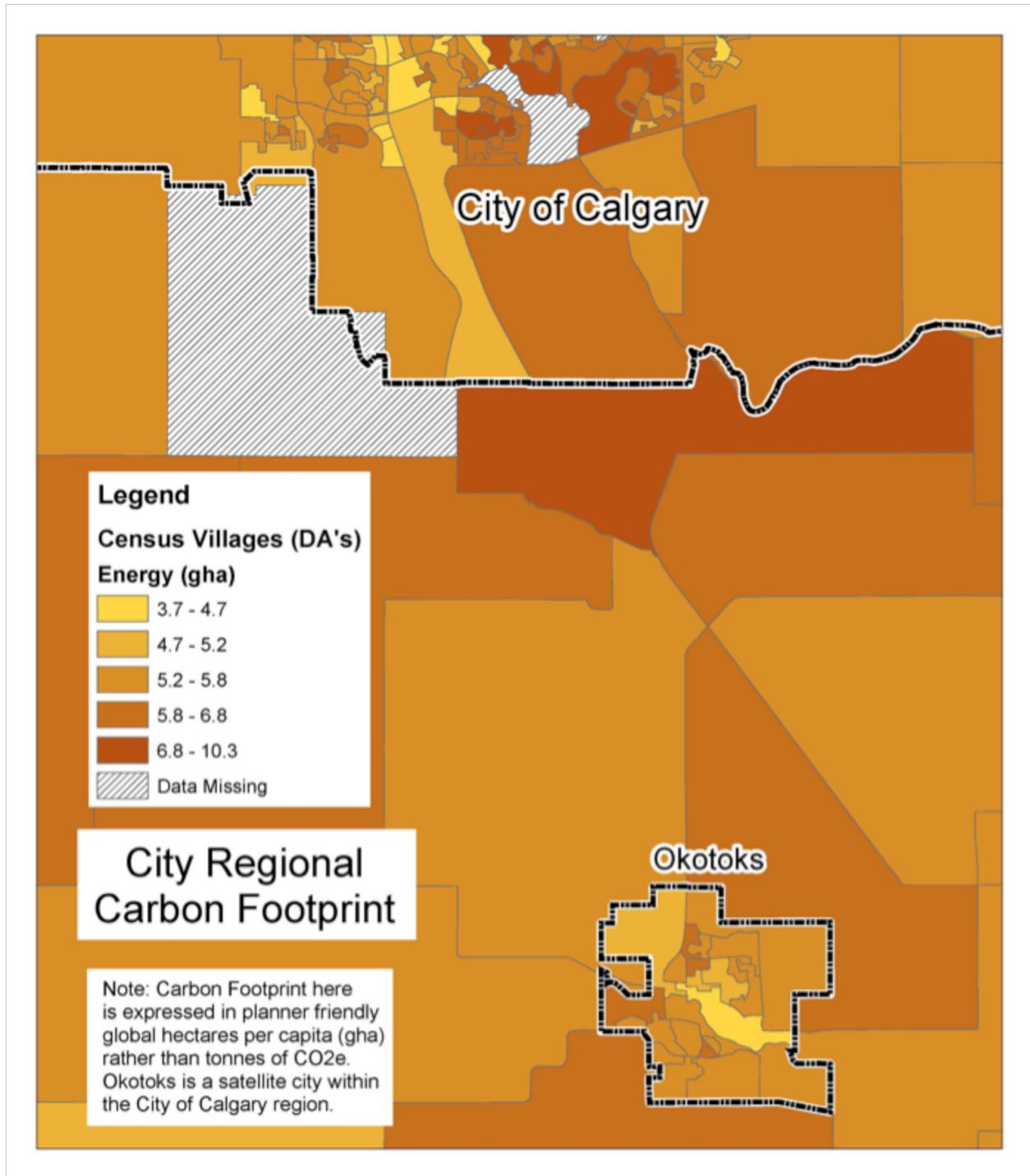


Figure 2

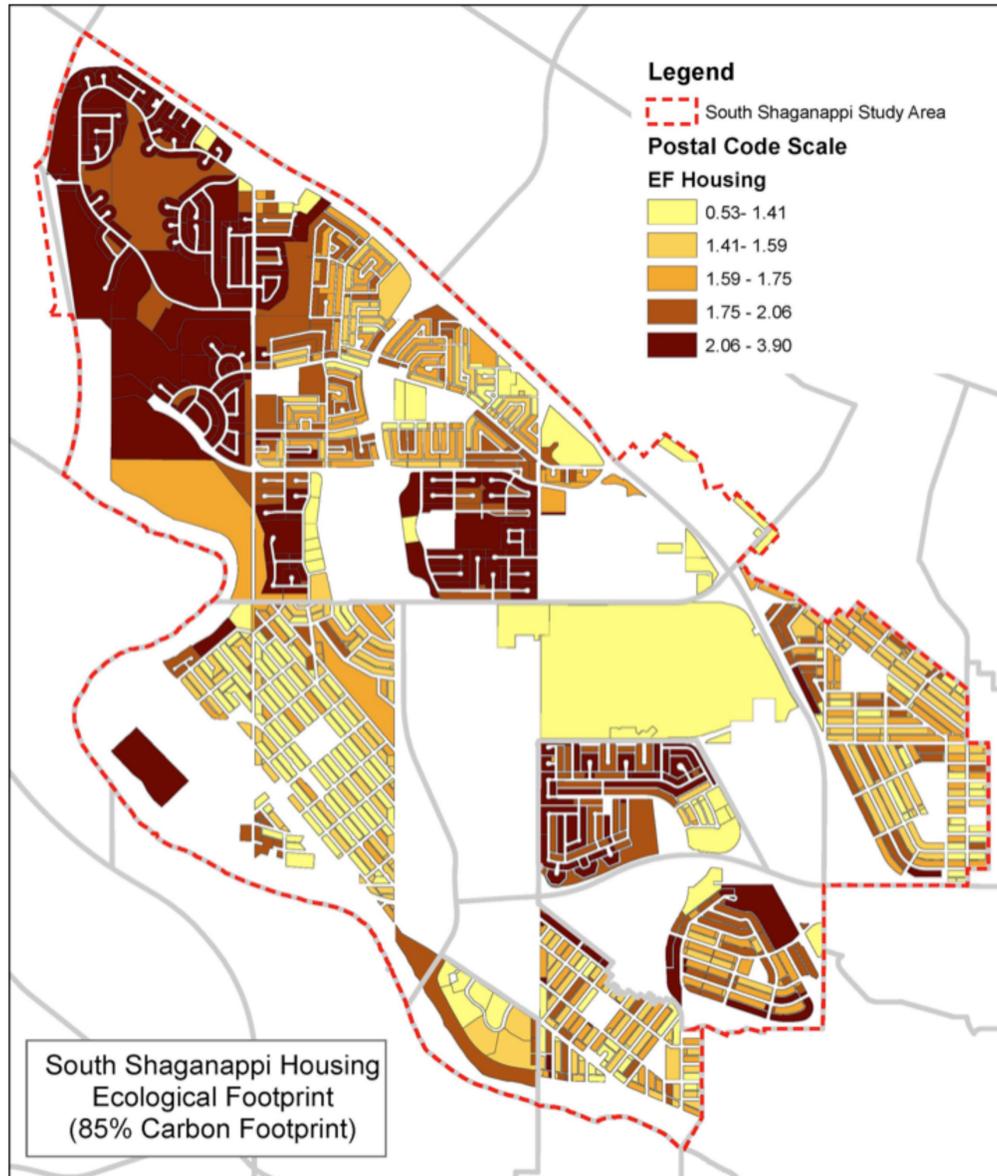


Major Tools

The primary emphasis of this project has been the creation of a new GIS analytical tool – a quantitative measure of sustainability, which can be applied to climate change adaptation. Extrapolating from the very coarse geography of the entire City of Calgary (population just over 1 million), the new tool moves into the finer geographies of census villages and postal code groups (PCG) which approximate city blocks (see Figure 3 below,

which shows existing distribution of the Housing EF for the South Shaganappi study area). Analysis can be carried out at the household level in some cases and density, mix of uses and building type can be isolated for comparison and contrast in their environmental impact on climate change.

Figure 3



THE SPECIFICS

Approach

In a municipal context agreement is first reached with management to begin the research. A project manager with a high level of motivation carries out the research and initiates presentations to planners and management, as well as written publications. Ongoing updates on project development are carried out to keep the project on track towards achieving its objectives.

Steps

1. Initial research to decide on the most appropriate quantitative GIS measurement – decision made to go with Ecological Footprint.
2. Another City department had already contracted the Global Footprint Network to calculate the EF for the entire city, including the important components of Housing, Mobility and Energy. These numbers are shown in a Consumption Land Use Matrix (CLUM) (see Table 1). This calculation is updated on a biannual basis.

- Mobility uses 4 factors: mode of travel to work at postal code scale (data obtained from civic census, also available from Statistics Canada by DA); distance to work at census village level (data purchased from Statistics Canada); distance to other locations such as schools, supermarkets, etc. (calculated in GIS); and vehicles per household at census village level (data obtained from Polk).
5. Assembly of data and development of conversion processes to translate lifestyle data into global hectares.
 6. Making data available to planning analysts.
 7. Carrying out test analyses on urban policy plans and planner questions.
 8. Presenting the method to management and policy planners.
 9. Encouraging the use of EF analyses.
 10. Presentation of EF analyses results to Calgary Planning Commission.
 11. Presentation of EF analyses results to City Council.

Table 1

Calgary 2008 Consumption Land Use Matrix								
Gha/Cap	Cropland	Pasture	Fishing	Forest	Built Area	Energy	TOTAL	
Food	1.37	0.46	0.19	0.1	0.01	0.5	2.63	
Housing	0.06	0.01	0	0.18	0.02	1.47	1.73	85%
Mobility	0.03	0	0	0.04	0.01	0.95	1.03	92%
Goods	0.24	0.02	0.01	0.22	0.01	0.83	1.34	
Services	0.29	0.07	0.03	0.17	0.02	0.68	1.27	
Government and Other	0.18	0.02	0.01	0.26	0.03	0.86	1.18	
TOTAL	2.17	0.59	0.24	0.98	0.1	5.29	9.36	57%

3. Decisions made on which geography is best to pursue – the best are the dissemination area (DA) or census village and the postal code group (PCG) or urban block.
4. Research on available lifestyle data– there are eight numerically defined factors that make up the basis of the EF at a PCG scale:
 - Housing uses 5 factors which are: size (floor area sourced from city assessment); housing type (sourced from city assessment); electricity use (data purchased from local utility company); gas use (data purchased from local utility company); and occupants per household (important for conversion between per household and per capita - data obtained from civic census)

Barriers

- One primary barrier to development of this tool is the time and effort required to obtain data from outside sources. An ongoing challenge exists with obtaining vehicle data from the Province of Alberta at a postal code group scale. So far, data has been obtained through Polk at a census village scale.
- For a new municipality interested in this measure, if based on the research done here, another large investment may be the time and energy required to assemble data into appropriate geographies in GIS.
- Convincing policy planners to make use of the tool is another challenge, along with finding planners who are most likely to show an interest. It takes time to promote a new tool, educate planners about it and get it incorporated into standard professional practice.

Results

Key policy planning questions have been raised based on EF analyses. A planning analyst, a senior planner and a coordinator of Land Use and Policy Planners (LUPP), along with a sustainability consultant from the City of Calgary's Office of Sustainability, have submitted a proposal for the 2012 Banff CIP conference focused on the use of the Ecological Footprint.

The Council approved (2009) Municipal Development Plan (MDP) and Calgary Transportation Plan (CTP), provide long-term policies for more compact, sustainable development. These policies align with the 2020 Sustainability Direction (2011), and the 10-year strategy to implement imagineCALGARY. Sustainability is now embedded in City work and the MDP and CTP are now linked to the Community Green House Gas (GHG) Plan and Ecological Footprint (EF) targets.

However, day-to-day planning decisions require effective implementation tools to achieve these visions. The EF and Carbon footprint, measured in global hectares (gha) or earths calculate environmental sustainability. Units reflecting global environmental impact epitomize the "think global, act local" idiom. A Geographic Information System (GIS) methodology, analyzing urban block EF data to support planners' decision-making towards GHG and EF targets, has been piloted for two planning projects:

South Shaganappi Communities Area Plan (SSCAP) - provides a level of strategic planning between the MDP and subsequent Local Area Plans including indicators and targets that contribute to 30-year strategic objectives. An EF analysis, completed as part of the Sustainability Appraisal (SA), informs project decision-making through the question: How does the project under consideration contribute to achieving the City's 2020 Sustainability Direction?



Keystone Hills Area Structure Plan (ASP) - this first New Community Local Area Plan under the 2009 MDP represents a higher-than-usual greenfield density with anticipated full build-out of 60,000 residents and 18,000 employees. An EF analysis, part of the Sustainability Appraisal, informed project decision-making regarding the question: Can greenfield development, even at high intensities, help achieve the goals of the City's 2020 Sustainability Direction?



Responsibility

This project was developed mostly "in house", with some contracted input from the Global Footprint Network for an initial calculation of the Ecological Footprint for the entire city and for a review of the finer scale sub-city procedures.

Time & Cost

This project involved three years of research including: an initial search for and evaluation of the various measures potentially available; the decision to focus on the use of the Ecological Footprint; further contacts being made on available data; trials carried out on various data sources; tests carried out on sample planner questions and analyses of existing policy plans; and a final evaluation of the process by the Global Footprint Network (GFN).

The research cost was approximately 70% of 3 people years, no external cost to the Planning Department; but the GFN Community Land Use Matrix calculation for the City of Calgary had a \$11,000 USD cost; approximately \$1100 was spent on Statistics Canada data; \$12,000 for a contract with GFN to review the procedure; several hundred dollars to purchase energy data from local utilities companies, no cost for the Polk data; no external cost to the Planning Department but approximately \$30,000 to have the mode of travel to work data collected for a 100% survey with the 2011 Civic Census.

For another municipality to take on this project, much research and procedure evaluation cost would be unnecessary, if the methods described here were to be entirely or partially followed.

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Planning for Climate Change Mitigation and Adaptation Red Deer, Alberta



THE PROJECT

The City of Red Deer is working on our first climate change adaptation and mitigation plan in order to understand and prepare our organization and corporate operations for upcoming climate change impacts. This work involves a project charter, steering committee, resource experts, and a partnership with ICLEI Canada. It is a two-year project and we are part way through. Excerpts from our Climate Change Adaptation Plan Project Charter can be found at the end of the case study.

The plan stems from the Environmental Master Plan that was adopted by Red Deer a year ago. This plan, recognized with the 2011 Innovators award from the Alberta Urban Municipalities Association (AUMA), sets benchmarks, metrics, and targets around specific actions we will take as a municipality and as a community. All actions are aimed at sustainability and ultimately contribute to mitigation and resiliency around climate change. We established some unique public input opportunities in developing the plan such as a \$5 coffee reward card for public input and a carnival like eco-fair.



To implement this plan we also developed a unique partnership with our public library system to have home energy audit kits available for loan in their circulation collection, just like a book that library cardholders can check out, use, and return. The kits have been so popular that there is a continual waiting list that just keeps growing, as word of mouth spreads and as people understand that they can save money, be more efficient, and address climate change in their own homes.

The Climate Change Mitigation and Adaptation Plan was initiated with an emphasis on corporate action and preparedness around the impacts of climate change. As a secondary element of this work, there will be a component of citizen engagement and education around the broader effects on the community and the future of city services. Taking on this plan indicates a commitment by the City to show leadership and model the principles of environmental sustainability expressed in the 2009-2011 Strategic Plan. It also partly implements the recommendations in the Environmental Master Plan that identifies the need to undertake climate change mitigation and adaptation planning for our community. In addition, the Climate Change Mitigation and Adaptation Plan addresses the environmental stewardship and responsive decision making components of the City's Sustainability Vision. It is a key part of striving to protect and improve our community for current and future generations.

THE ESSENTIALS

Key Lessons

- Very multi-faceted – more departments and impacts than initially expected, so you need to narrow the scope.
- Partnerships are needed – but selective – what is it you want from those partners? What mutual benefits can you offer?
- The scope - climate change is huge as a topic; to make progress narrow in specifically on what things you are focusing on (e.g. corporate actions, built environment, reduction of GHG emissions). The more specific the less likely you will get bogged down and the more likely you will be able to set parameters, establish targets, and define actions.

Major Tools

- The chief tools we are using in developing our climate change adaptation plan are: the use of a steering committee and a group of resource experts; spreadsheet tracking and forecasting; and public opinion surveys. These are by no means new techniques, but we have used them in a new application for environmental planning. They also highlight that we are trying to utilize the resources available to us (such as surveys or expertise and staff time) in a very focused way.
- Steering Committee and Resource Experts Team: The Environmental Initiatives Section of the City’s Environmental Services Department assumed the role as project lead. The Director of Development Services agreed to champion the project within the corporation/senior management team. A staff steering committee (also called an adaptation team) with staff representatives/expertise from various departments was put in place to support developing this plan for the City.

In addition, a team of cross- departmental resource persons, selected from departments that have a role or some specific expertise but not necessarily broad involvement, is available on an as-needed basis. This ensures that the project is well integrated into the ongoing work of the City and that it is robust in its approach and scope of impacts, risk, and assessment.

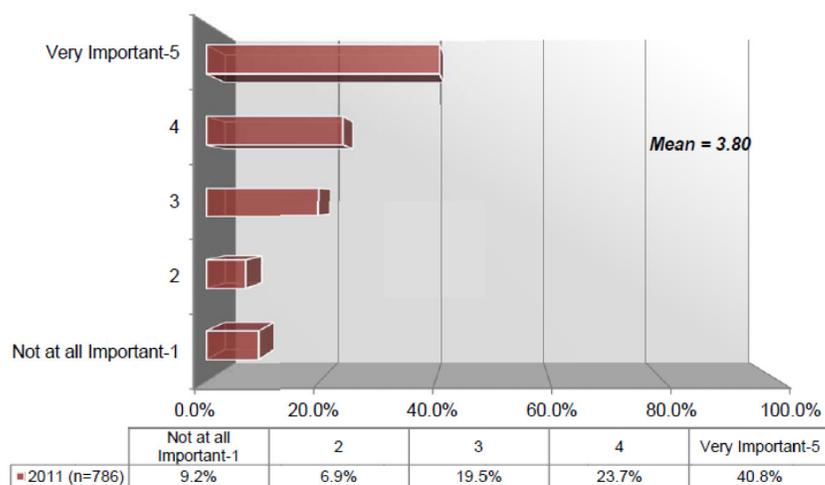
- Spreadsheet Tracking: In addition we have the benefit of using excel based spreadsheets provided by our partner, ICLEI, to track possible climate change impacts and associated risks. The charts allow us to track and update our information and possible impacts as we progress.
- Public Opinion Survey: We were able to piggy-back on a public opinion telephone survey the City was conducting on general environmental services to provide us with statistically valid benchmark data. We asked: “How would you rate your level of concern overall regarding the types of effects or impacts being predicted as a result of climate change?”

- We also asked: “How important is it that the City has a plan and policies in place to address the impacts of climate change?”
- Our results tell us that 48.4% of residents are concerned or very concerned about the predicted impacts in general and that 64.5% believe it is important or very important that the City have a plan and/or policies in place to address the impacts of climate change (see graph below).
- This is excellent benchmark information, since we did not previously have local data about where Red Deerians stand on the issue or the prioritization of adaptation to climate change.
- We can build on this data moving forward in future years to determine how our work is being accepted or how it is affecting community behaviour and results.

City of Red Deer
2011 Environmental Services Customer Satisfaction Survey **Final Report**

Almost two-thirds of respondents (64.5%) rated it important (4 or 5 out of 5) that the City has a plan and policies in place to address the impacts of climate change, while 19.5% were neutral and 16.1% felt it was not important. See Figure 27, below.

Figure 27: Importance of the City Having a Plan and Policies to Address Impacts of Climate Change



THE SPECIFICS

Approach

There are several deliverables expected from this project. The most fundamental is a specialized adaptation plan identifying specific information and actions for our city. In addition to this, we hope to arrive at strategies to raise awareness about climate change and the necessary adaptation measures throughout our organization and with our stakeholders and partners. Our stakeholders and partners include our residents, local industry and business, community groups and other municipalities in our region. As the largest community in Central Alberta we believe that our environmental decisions impact surrounding communities just as their decisions and actions influence our environment.

Lastly, we need means of further aligning our climate change plan with other planning and policy work already underway in our community including the City's new Environmental Master Plan, our Municipal Development Plan, Strategic Plan and any future Red Deer Regional Plans to be completed under the Province of Alberta's Land-use Framework. Integration with these processes and plans is essential to ensure that implementation moves forward throughout all parts of the organization. In working through this process it is important that we retain our high environmental quality that our residents benefit from at present. The river, park system, livable residential neighbourhoods, and surrounding agricultural lands, are integral to our sense of place in Red Deer and help to shape our identity.



Steps

The project steps were set in agreement with our partner ICLEI. In exchange for the program membership fee ICLEI provides support over the two-year planning period and includes approximately 12 webinars/webshops, two or three in person meetings, linkage with the other participating communities, hands on training/study, online newsletters, research reports, document review/feedback and professional support. The project steps or “milestones” are:

- Milestone One: Initiate Project – develop a shared understanding of project goals, establish a staff steering committee, project charter, communications approach and commit resources. This stage is complete.
- Milestone Two: Research Phase – collect scientific data on climate change in the Prairie Region and in the Red Deer Region specifically. Complete vulnerability and risk assessments for Red Deer. This stage is complete.
- Milestone Three: Draft Plan – draft the plan for Red Deer based on research, data, and assessments. This stage is in progress and will run through 2012.
- Milestone Four: Develop an Implementation Strategy for the Plan – based on the previous steps including risk assessments and plan recommendations, develop an implementation strategy which may cover timelines, costs, responsibilities, and priorities. This stage will begin later in 2012.
- Milestone Five: Monitor and Review - establish approaches for regular monitoring of plan implementation and review of plan recommendations and data. This stage will begin later in 2012 and run into and beyond 2013.

Barriers

- Because this is a new initiative, while interested, staff has little time to devote to it.
- With the current workload the completion of the implementation may be difficult to accommodate. Skills and expertise (i.e. project management, etc.) are available in the organization but not necessarily the capacity.

- Not everyone feels it is a priority. There are some departments, stakeholders and decision-makers who focus on the immediate and short-term future. Therefore, thinking about impacts, and taking action on preventing those impacts 25 years out, is not their normal method of operating.
- Climate change is a difficult and controversial subject matter around which to build awareness and support.
- The connection to such a wide range of departments slows down the process of developing the plan.
- You need to show people that things are being done elsewhere particularly in communities that resonate with them. This can be a barrier that CIP and/or ICLEI can help municipalities overcome by showcasing examples, assisting with networking or creating Canadian information databases.
- Building an understanding that climate change adaptation planning is an investment in Red Deer's future rather than "another" cost is challenging but important. Success has been found in other communities by identifying the past cost of dealing with clean up or repairs afterwards rather than ahead of climate change impacts (e.g. clean up of severe weather impacts is normally more costly than preventative measures).
- Specialized climate science resources and expertise may be required to complete the research phases of the project.

Results

- Our most significant results to date are starting to bring climate change onto the radar as an issue that demands attention and establishing an adaptation team and baseline public opinion data.
- Also, we have realized how many projects we have already undertaken in the name of efficiency, cost savings, risk management or sustainability, that go a long way in helping us with climate change adaptation. Examples are our GHG study, water conservation, waste diversion, idle-free fleet program, and residential density review.

Responsibility

- Our project stems from a unique partnership with ICLEI Canada.
- The project is being done in house by staff, but with some support and tools provided by ICLEI (these tools and supports include research, spreadsheet templates, and educational resources such as webinars and a study tour).

Time & Cost

- The project cost is approximately \$30,000 not including staff time.

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Excerpts of our Climate Change Adaptation Plan Project Charter:

STRATEGY OUTCOMES (Corporate, Department):

What is the purpose or intent of this strategy from a corporate and department perspective? What are the benefits to the corporation and/or the community?

- Build an understanding of what climate change may mean for our community and how it could affect us
- Develop a plan for mitigating and adapting to climate change and its impacts in our community
- Incorporate climate change awareness and preparedness into future City planning and policy
- Maintain safety, well-being , and quality of life as the City grows over the next 30 – 50 years
- Implement priority actions of the Environmental Master Plan
- Demonstrate leadership as a sustainable community both within the city and in the region
- Engage staff and citizens in environmental planning and actions to adapt to climate change

DRIVING FACTORS

What is the reason this strategy is seen to be needed? (e.g. Council direction, implementation of specific plan, needs to be addressed before certain strategies can be implemented, need to streamline/improve processes) Why is this strategy so important – why do we need to do this. What is the driver(s)?

- Environmental Master Plan implementation: “Air Priority Actions: Community: Develop a Climate Change Adaptation and Mitigation Plan.”
- Meeting the objectives of the Municipal Development Plan for sustainable development and environmental responsibility
- Continue the vision of the City’s Strategic Plan and Environmental Pillars to be a sustainable community, enhance the City’s environmental reputation, and practice continuous improvement in our delivery of services and programs.
- Position The City to respond to emerging issues and opportunities around climate change

Climate Change Adaptation Strategy Prince George, British Columbia



THE PROJECT

Prince George is a City of 76,000 people near the geographical centre of British Columbia. Like most northern areas, the Prince George region has experienced changes in its climate that are more rapid than the global average. Also, as a resource-dependent community, Prince George is particularly vulnerable to the effects of climate change. Local staff and stakeholders have been noticing the impacts of climate change in the region for some time. The mountain pine beetle infestation is particularly prevalent in this area, and the great number of dying trees has had huge impacts on the local economy, local parks and forest fire risks. Warmer winter temperatures related to climate change have been a major contributor to the pine beetle infestation. Other changes have also been noted in Prince George including rising winter road maintenance costs and increases in the frequency and severity of flooding.

In late 2007, a University of Northern British Columbia (UNBC) graduate student approached the City of Prince George with a proposal to collaborate on local climate change adaptation. The manager of long range planning and the chief engineer, who were well aware of the effects of climate change in the community, were keen to partner on the project. The intended purpose of the project was to create a detailed adaptation strategy for Prince George, and to ultimately implement proactive measures to help the community prepare for the negative and positive impacts of climate change.

The key activities and partnerships that have led to an adaptation strategy for Prince George are listed below in Table 1. Each of these is discussed in more detail afterward.

Table 1: Overview of steps towards an adaptation strategy for Prince George

Step #	Step Name	Description
I	Climate information	Analysis of past climate trends and downscaled future projections, created in partnership with the Pacific Climate Impacts Consortium (PCIC), informed future actions.
II	City adaptation workshop	The adaptation researchers ran a workshop with assistance from the Fraser Basin Council to gather feedback on adaptation priorities from local practitioners and key stakeholders.
III	Community input	An existing survey provided community feedback about climate impacts. Adaptation researchers also participated in a Smart Growth on the Ground (Smart Growth) event and solicited further feedback about impacts.
IV	Creating the strategy	Adaptation priorities were determined by triangulating the sources of information. These priorities were described and implementation actions recommended in an adaptation strategy.
V	Ongoing implementation	Ongoing actions include incorporating adaptation into the Integrated Community Sustainability Plan and the Official Community Plan (OCP), and exploring key impacts in more detail.

THE ESSENTIALS

Key Lessons

- Partner, partner, partner: an incredible number of agencies and organizations have offered their expertise and assistance when requested. It doesn't hurt to ask!
- Encourage staff and stakeholders to participate in adaptation planning and let them know that they are experts who hold important local knowledge. This process builds local knowledge and awareness, empowers action and can lead to people becoming champions of adaptation in their respective roles. (In the Prince George OCP draft, many of the references to adaptation were suggested by others, not by the adaptation researchers.)
- Senior staff and stakeholders are eager to provide assistance but they are extremely busy. Therefore, their time must be used very wisely.
- Normalize adaptation into mainstream plans. Adaptation strategies are important, but a large body of research shows that they are unlikely to be implemented as separate plans. Incorporating adaptation into main planning documents – such as OCPs – lowers the probability of the topic being ignored.
- It is easier to join an initiative, than to start a new one. Incorporating adaptation into existing plans, processes and initiatives is much less work and takes less time than creating a new initiative.
- Climate change adaptation is a new field and uncertain, but it is important and needs to be done. Do not let a perceived lack of expertise keep you from beginning. You may not know exactly what you are doing, but neither does anyone else!
- Downscaled climate information is not necessary, but it is helpful. Free tools are becoming available that can provide basic information (such as: www.Plan2Adapt.ca).

Major Tools

The following workshop overview was published in the Journal of Environmental Science and Policy as a framework for a one-day community adaptation workshop:

Table 2: Adaptation workshop framework (from Picketts et al., 2012)

Step	Purpose	Information presented	Time allocation
1. Introduction	clarify workshop focus; overview activities; inform participants of their key role in outlining strategy	definition and differentiation between adaptation and mitigation; explanation of participants' role as experts with local knowledge	15 min to 1 hr ¹
2. Understanding changes in the climate	provide overview of past changes and future temperature and precipitation projections in the region	past climate trends and future scenarios (preferably downscaled and presented by climate information specialist)	1 to 2 hrs ²
3. Identifying local impacts	link climate projections with actual impacts in community (can be done in focus groups or as one larger group)	none, but requires careful facilitation by persons familiar with adaptation and the community	~1 hr (depends on group size)
4. List of local impacts	combine outcomes of step 3 into a single list (if necessary)	outcomes combined by organizers and presented to plenary for discussion and finalization	~45 min ²
5. Visioning an adaptation strategy	prioritize impacts and recommend implementation actions	framework for determining risks; potential sectors to address impacts; documents where implementation may be outlined	~90 min
6. Final discussion, next steps	encourage continued engagement in adaptation planning and solicit feedback on event	feedback should guide further local adaptation	~ 30 min ³

¹ for neophyte communities a separate capacity building event may be preferable

² ample time for discussion should be allocated

³ can encourage discussion to continue after formal workshop end

The following matrix was published as a workshop tool that participants can fill out to evaluate risk, sectors most affected by impacts, and potential implementation plans (Picketts et al., 2012):

Table 3: Matrix for evaluating impacts in a workshop (from Picketts et al., 2012)

Prince George Climate Change Workshop Matrix																
Impact:	RISK		SECTORS MOST SERIOUSLY EFFECTED (please check off only 5 sectors)												IMPLEMENTATION	
	RISK: likelihood and timing (scale of 1 - 5: see chart 1)	RISK: consequence of inaction (scale of 1-5: see chart 2)	Administrative Services	Corporate Services	Development services	Operations	Community Services	Outside Agencies, Organizations, Groups	ICSP	OCP	Annual Provisional Financial Plan	Standards Bylaw	Asset Mgmt-Performance Measures	Other (please specify)	Where should this issue be addressed? - please indicate top priority	
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																

 CITY OF PRINCE GEORGE		Name: _____
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Chart 1: Risk Scale - likelihood and timing	
Score	Explanation
5	likelihood occurring now
4	already happening
3	likely to happen in next 10 yrs
2	may happen in next 20 yrs
1	unlikely or may not happen

Chart 2: Risk scale: consequence	
Score	Explanation
5	catastrophic
4	major consequences to human life
3	risk to health and life v. expensive (>\$10mil)
2	risk to health, expensive (\$2-10mil)
1	low risk to health, mid expense (\$1-2 mil)

THE SPECIFICS

Approach & Steps

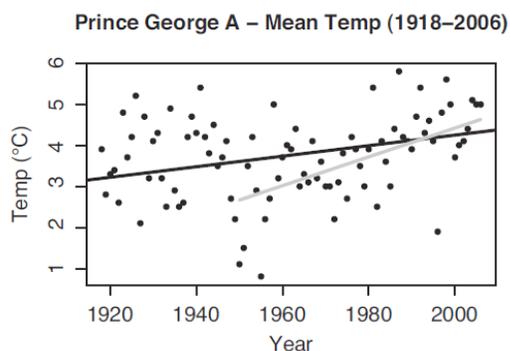
STEP I - Climate Information

When the City of Prince George and UNBC began working together, it quickly became apparent that regional climate analysis and future projections were valuable tools that could help to inform local plans. Therefore, they partnered with the Pacific Climate Impacts Consortium (PCIC) to obtain climate information. The UNBC researcher and PCIC climatologists worked together to create the report entitled, "Climate Change in Prince George: summary of past trends and future projections" (available at: <http://www.pacificclimate.org/sites/default/files/publications/Werner.ClimateChangePrinceGeorge.Aug2009.pdf>).

Highlights from this report are as follows:

- Air temperatures in Prince George warmed at a rate of 1.3°C per century between 1918 and 2006. Rates of warming increased throughout the century, and mean warming trends of 4.6°C per century were observed between 1971 and 2006 (Figure 1).
- Total precipitation, snowfall and rainfall each increased between 1918 and 2006. Since 1931, trends have been negative for snowfall but positive for rainfall, suggesting that more precipitation has been falling as rain.
- Through an analysis of 140 climate projections from many global climate models (GCM) under multiple emissions scenarios, annual temperatures in the region are projected to increase by 1.6 to 2.5 °C by the 2050s (based on the 25th to 75th percentiles of the projections).
- Through an examination of the same 140 GCM projections, precipitation is projected to increase by 3% to 10% annually in the 2050s. Large increases are expected for winter, and precipitation may actually decrease in summer.

Figure 1: Trends for mean precipitation in Prince George from the airport (A) station (grey line shows trend from 1951-2006) (from Picketts et al. 2012)



STEP II - City adaptation workshop

A directed workshop with senior City staff and key stakeholders was planned to gather feedback on adaptation priorities from local experts. Response was excellent, but the workshop had to be completed within a short time frame to accommodate busy schedules. Using the PCIC information as a guide, adaptation researchers organized a single day event to gather feedback from the group of 38 stakeholders. The main steps of the workshop were as follows:

1. Organizers defined the scope of the workshop to focus on adaptation and informed participants of their key role in defining an adaptation strategy (as they are the experts with local knowledge and experience).
2. A PCIC climatologist presented an overview of past climate trends and future projections for the region.
3. The plenary was divided into four facilitated focus groups, each with representatives from major City sectors. Participants used the climate information to identify the top impacts that will affect the City.
4. Organizers combined the focus group outcomes into a master list and presented it back to the plenary for discussion and finalization.
5. Participants individually ranked each adaptation priority from the master list in terms of risk. They ranked the variables, 'likelihood and timing' and 'consequences of inaction' on a scale from one to five. These scores were multiplied to create a score out of 25. They also provided feedback regarding how the City should address the impact.

STEP III – Community input

Public engagement is a valuable tool for informing an adaptation strategy, as well as gaining support for implementation. Therefore, community feedback was sought to assist in prioritizing climate impacts. Fortunately, in 2008, Prince George completed a survey that asked a large number of respondents to select impacts that would affect the City. The outputs of this questionnaire met the criteria of a quantitative assessment. Another opportunity to solicit public feedback occurred through the local Smart Growth sustainable planning initiative for Prince George. Researchers partnered with Smart Growth facilitators to integrate adaptation into the process and ask participants about adaptation at an information event. A total of 78 participants selected the top impacts, which they thought would affect the City in this qualitative exercise.

STEP IV – Creating the strategy

The outcomes of the three exercises were combined to determine a final list of adaptation priorities for Prince George. The data used for analysis were:

1. The average products of the risk scores for each impact determined by the City adaptation workshop participants, converted into a percentage of the total possible risk (25).
2. The percentage of respondents from the local quantitative survey who indicated how each impact would affect Prince George.
3. The percentage of respondents who selected each impact they thought would most affect Prince George in the Smart Growth evaluations.

Combining the three types of information was challenging. It was not practical to mathematically compare the different data sets to determine a final list of priorities, because the studies involved different methods, sample sizes and response options. Therefore, the method of complementary triangulation was employed. This method begins with an examination of the primary research (City adaptation workshop), and then uses the secondary research (Quantitative survey) and tertiary research (Smart growth evaluations) for discussion and comparison. Because the studies arrived at the same results, the outcomes are more legitimate, as they are not a function of a single methodology or response group.

The impacts were first generalized into categories and clearly fell into one of four different levels:

- Top Priorities: identified as the top impacts in all exercises
- High Priorities: ranked highly in all exercises
- Medium priorities: identified as a priority in most exercises
- Other priorities: important priorities that warrant further investigation, but are not properly represented by a risk assessment focused on negative physical impacts

The top impacts for Prince George are illustrated below in Table 4. Each of these impacts was researched in detail and described for the adaptation strategy. Examples of potential adaptation measures, summaries of actions occurring in Prince George (whether or not climate change is mentioned as a motivator) and recommendations for future actions were outlined. One important finding was that actions related to many of these impacts are already occurring. For example, Prince George is already taking many measures to reduce forest fire risk in the City. Therefore, the priorities for further action are not necessarily the same as the order shown below, because the City is already addressing some impacts.

Table 4: Priority impacts for Prince George

Level of Priority		Impact
Top Priorities	1	Forests
	2	Flooding
High Priorities	3	Transportation infrastructure
	4	Severe weather / emergency response
	5	Water supply
Medium Priorities	6	Slope stability
	7	Storm water
	8	Buildings and Utilities
Other Priorities	9	Health
	10	Agriculture
	11	New Residents and Businesses



STEP V - Incorporation and implementation

Through funding provided by the Natural Resources Canada Regional Adaptation Collaborative (RAC) project, Prince George has been able to continue with its adaptation research. The City has taken measures to incorporate adaptation into its ICSP, as well as into the draft of the OCP.

The community is looking more closely at several of the priorities outlined in the strategy. The City incorporated climate change projection information into its flood risk assessment, is examining how climate change is impacting road safety and road maintenance, and is also considering alternative types of pavement that may be better adjusted to warmer and wetter conditions. This work is ongoing, and outcome should be available on the Prince George website in the Spring 2012.

Barriers

- City staff workload: City staff members, who were actively involved in organizing the project, were very busy and had many projects on the go. Therefore, the work was frequently interrupted for weeks at a time, as they had to deal with other urgent issues. Staff members who participated in the workshop were also very busy and their time had to be managed carefully.
- Difficulty communicating climate information: climate information, particularly projections, is very confusing and difficult to communicate simply. Efforts must be made to share this information briefly and in an accessible format.

Results

- The climate information was used extensively in the process. It has also been referenced in the City's flood risk assessment and in a local sensitive ecosystem mapping project.
- The list of adaptation priorities and the adaptation strategy were important source documents for the ICSP and the draft OCP.
- The process of creating the plans and initiatives has created a great deal of local awareness and concern.
- The City is continuing actions to take measures regarding important local impacts. See the City of Prince George website for updates.

Responsibility

- The project was created through a partnership between the City of Prince George and the University of Northern BC. Many other groups have joined the project since then.

Time & Cost

- The City of Prince George provided \$14,000 in funding to UNBC toward the adaptation strategy.
- The City provided \$20,000 to PCIC for assistance in creating the climate change information.
- Numerous in-kind contributions were provided by representatives from many associations. These include the City of Prince George, PCIC, UNBC and the Fraser Basin Council.

- The overall timeline of the project from the initial partnership to the completion of the adaptation strategy was just under two years. There were significant breaks in between events and for creating documents. The process could be completed in less than six months if need be, if there were people dedicated to the project and the climate modeling information (if used) could be completed quickly.
- Since the adaptation strategy, significant additional funding has gone toward further work on the project.

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Key sources and references:

City of Prince George website:
<http://www.princegeorge.ca/Pages/default.aspx>

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Gibsons Harbour Area Plan Gibsons, British Columbia



THE PROJECT

Located in South-western British Columbia, the Town of Gibsons is a thriving coastal community that has been nicknamed the gateway to the Sunshine Coast. The town is accessed by a thirty-five minute ferry ride from West Vancouver's Horseshoe Bay ferry terminal. The town is approximately 4.2 square kilometers in size and has a population of approximately 4,300. It provides services to about 10,000 people who live in and around the town. Historically, forestry and fishing formed the town's economic backbone. More recently, tourism and retirement are emerging as growth sectors with a large percentage of the work force being in the service sector. Gibsons has two main commercial areas: "Upper Gibsons", which has a number of shopping malls, restaurants and services located on Highway 101, and "Lower Gibsons", the historic Gibsons Landing that surrounds the bustling wharf and Gibsons Harbour.

Gibsons faces a range of climate change related hazards. Oceanfront property, including moorage and fuelling facilities, are currently vulnerable to sea level rise and the associated risk of greater storm surge wave attack height. Increased precipitation and heavier spring frechette can contribute to increased soil moisture content, potentially affecting slope stability in some areas while increasing the nutrient and pollutant (runoff) load of creeks draining into the harbour. Increased runoff has the potential to impact protected eelgrass beds and the aesthetic quality of the waterfront.

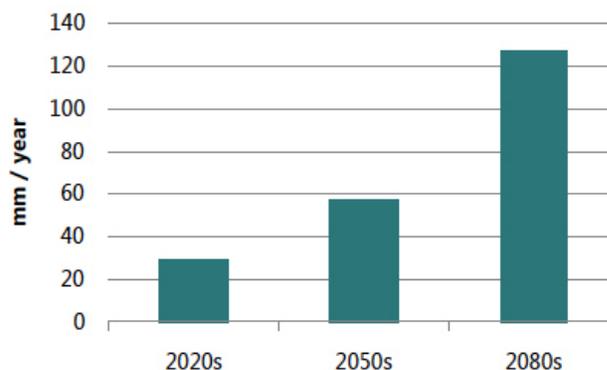
In 2009 a major development proposal in the Harbour Area failed to gain community or Council support. It was evident that, despite a number of comprehensive planning initiatives and policy implementation dating back to 1968, the community lacked a distinct vision for development of the area, even though its fundamental goals and aspirations had remained largely unchanged over this period. The events of 2009 shed light on this lack of clarity, which had led to the steady decline of the physical and economic fabric of the area.

Against this backdrop, the Gibsons Harbour Area Planning Project was initiated to provide a clear, practical, and verifiable vision for the Area that could be developed into an amendment to the Official Community Plan and result in implementable policy.

THE ESSENTIALS

Key Lessons

Running a research project on climate adaptation impacts and capacity in tandem with a land use planning process for a seaside area produced a more robust context for these emerging issues. Having participated in the climate adaptation research, Councillors and key stakeholders were well versed and more knowledgeable in discussing associated land use policies.



Projected Precipitation Change in South Coast Region (data from Canadian Climate Change Scenarios Network).



Goosebird Creek

Major Tools

No new tools were developed, though leading-edge policies were incorporated linking adaptation response to the lifespan of buildings and infrastructure (longer lifespan structures will require greater consideration of the future impacts of sea level rise).

THE SPECIFICS

Approach

In 2009 Gibsons became a community partner in an International Community-University Research Alliance project with researchers from the University of British Columbia. As part of a broader international study on climate change called C-Change, researchers interviewed staff, elected officials, and selected members of the community in order to establish priority environmental issues in the town. Once the primary environmental issues in the community had been identified, the doctoral fellow conducting research on the Gibsons component of the study worked with the Head Planner to develop sections of the Harbour Area Plan on environmental conditions and climate change.

Here, projected climate changes and impacts for the Gibsons region were outlined based on the results of a review of scientific literature, existing climate data, and information on local environmental issues gained from interviews and discussions with members of the community. These findings were combined with information specific to the infrastructure and environmental conditions of the town in order to identify risk areas. Following this, researchers from C-Change worked to integrate regional climate data with local geographical information provided by the Town to develop a visualization model of climate change impacts specific for Gibsons.

This visualization model has two principal benefits. First, it makes it possible to define risk more clearly by enabling researchers to assign probabilities to specific climatic events that would cause damage to infrastructure, such as levels of inundation resulting from sea level rise and storm surge. Second, it permits staff to provide estimates of damage resulting from the projected climate changes. This data can be used to construct a Structured Decision Model (SDM) to assist planners in weighing the financial costs of adaptation against those of inaction under multiple climate change scenarios and at various timescales.

The basic components of the SDM (for a particular scenario and timeframe) are as follows:

Climate change risk (cost of inaction) is defined as: (risk = impact (\$) x probability of occurrence)

Viability (cost effectiveness) of adaptation options is defined as: (viability = (cost of adaptation (\$) x probability of success) minus risk.

Opportunity cost was included in the calculation of all \$ values. The purpose of including opportunity cost is to help determine the optimal time for the implementation of adaptation options.

Steps

The planning project was carried out in 3 phases.

Phase 1

This phase began with a public workshop attended by over 200 residents to review previous plans and issues that had been identified, as well as to compare them with current issues and aspirations. A second public workshop followed, in which residents were directly engaged in further exploration, enhancement, and prioritization of issues. This process of community engagement helped to crystallize an initial statement of project goals:

- Accommodate anticipated growth
- Re-invigorate and ensure the ongoing vitality of the Harbour Area



- Create a vision for the Harbour Area that responds to the concerns and aspirations of the community as they have been raised historically, and as they have been ascertained through the current process of community consultation

The results of these workshops formed the basis for a design charette aimed at articulating a Vision Plan for the Harbour Area that would address the issues that had been identified and meet project goals.

Four distinct precincts were identified in this Vision Plan, each with its own character, function, and role within the Harbour Area. A key core sub-area was defined in each of these precincts and planning options were developed as examples of the kind of development that could occur within the boundaries of community acceptance, meet project goals, and yet be flexible enough to respond to economic scrutiny and unforeseen opportunities that might arise.

The inter-related issues of climate change, sea level rise, and environmental sustainability were identified amongst the constellation of issues selected in the first phase as important to the community. Consequently, a section of the Phase 1 plan provided an overview and direction for developing strategies with regard to these issues.

Phase 2



In Phase 2, each of the precincts and core sub area planning options was subjected to the scrutiny of objective economic analysis to evaluate the viability of various options. This analysis substantiated the vision plan and also provided a rational basis for modification (within the bounds of the plan's built-in flexibility) to ensure the plan's viability and ultimately the revitalization of the Harbour Area.

Next, a digital visual model of the Harbour Area was created. This was an important tool to illustrate the impact of planning variations to Town Council and the community. Multiple viewpoints of the model were visually expressed and for each viewpoint the existing condition, the theoretical condition at the proposed build-out defined at the charette, and the modified plans were displayed in animations that could "morph" into one another. Together with "flyovers" and photomontage, these techniques expanded the accessibility of plans, sections, and sketches by bringing to life the otherwise

dry numbers of statistical profiles and economic analysis.

Phase 3

Building on the plan developed in Phase 2, a comprehensive Area Plan was prepared as an amendment to the Official Community Plan (OCP).

Based on the dialogue with the public and Council during the previous phases, the originally stated goals were expanded and made more specific to become:

- Retain the scale and character of the Harbour Area
- Make the waterfront fully accessible, physically and visually, retaining the sense of proximity to nature
- Ensure environmentally responsible and sustainable planning and development
- Support and enhance social and cultural activity in the Harbour Area
- Ensure the economic viability of the Harbour Area, recognizing the unique role the harbour plays in the local economy and the economic history of the area

A number of specific policies for incorporation into the OCP were then identified. These were based on an examination of project goals, the section on economic and cultural initiatives, and urban design guidelines. The latter included policies directly addressing sea level rise as a result of climate change, using information provided by a climate adaptation researcher.

A revised land use plan with new land use categories based on the findings of the planning process was then prepared.

Barriers

Public awareness of climate adaptation was limited. This proved to be an initial barrier, although it was alleviated by the Town's participation in the research partnership. In addition, communities find it difficult to think strategically about long-term (100 + year) events and impacts. Finally, a lack of budget to respond to now known risks arising from climate change can fuel a sense of helplessness. In the Town's case a multi-million dollar sewer main will need to be reinforced or moved in the medium term. This issue is exasperated by the lack of provincial and federal funding for addressing this issue.

Results

The most important result of the project is an increase in local awareness of climate change impacts and issues. In addition, the accumulated information on impacts in advance of receiving major development applications will enable more intelligent discussions as to appropriate adaptation responses on individual sites in the Gibsons Harbour Area. Researchers gained a greater understanding of the state of public knowledge, of public perceptions of climate change, and how to engage the public in climate change adaptation planning.

Responsibility

The project was collaborative and led by the municipality's Planning Department, but involved the contribution of numerous consultants and partnering organizations, including:

- Matrix Architecture and Planning Inc. (Paul Lebofsky)
- G.P. Rollo and Associates Land Economists
- Pottinger Gaherty Environmental Consultants (Susan Wilkins)
- MVH Urban Planning & Design
- Don Wuori Landscape Studio
- C-Change Coastal Climate Adaptation Strategies (Nathan Vadeboncoeur)

Time & Cost

The Harbour Area Planning Project had a total budget of \$123,834 and was completed in three phases from 2009 – 2012 (final adoption 6 March 2012). As a participant in the C-Change study, the Town was not responsible for researcher hours and expenses. However, the Town made an in-kind contribution to the C-Change project by giving staff time for interviews valued at \$1,000.

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Interim Flood Construction Levels Vancouver, British Columbia



THE PROJECT

Rising levels of greenhouse gases in the earth's atmosphere are trapping heat causing land and sea ice melt, thermal expansion of the oceans and changing weather patterns. The results are rising sea levels and an increase in the frequency and severity of storms and flooding. The City of Vancouver has been planning for such climate change impacts for a number of years.

Flooding resulting from sea level rise is one of the key impacts identified in the City's adaptation planning process. Subsequent to the May 2011 release of associated provincial guidelines: [Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use](#) (the Guidelines), flooding is currently a high priority.

Flood hazard management was a provincial responsibility until 2004 when the Province devolved the responsibility to municipalities. In place of publishing standards, the Province switched to publishing guidelines to direct municipalities in developing bylaws, policies and plans for flood management.



Courtesy of Tourism Vancouver

The 2011 Guidelines set recommended sea level rise planning levels based on available global sea level rise projections from the scientific literature. They recommend a methodology for incorporating sea level rise into flood-proofing measures, most notably dikes and flood construction levels (FCLs).

Dikes have long been a flood hazard management tool for both river and coastal flooding. While numerous municipalities in the lower mainland maintain many kilometers of dikes, the City of Vancouver has relied on other tools such as flood construction levels (FCLs) and setbacks. FCLs are minimum heights for building construction to keep living spaces and areas used for storage above potential flood levels. The City's current Flood-Proofing Policies apply FCLs ranging from 3m to 3.5m above the Greater Vancouver Regional District (GVRD) datum in flood prone areas such as portions of False Creek, English Bay, Burrard Inlet and Fraser River shorelines.

Since the government of British Columbia last published sea level rise projections in 2008, there have been advancements in the understanding of land and sea ice melt. The provincial government's scan of recent projections is illustrated below in Figure 1 by the grey band.

The Province chose a median line (red line in Figure 1) to recommend figures for BC sea level rise planning and policy as described in Table 1 below. Once a development timeframe is chosen, the associated sea level rise number is added to elevations for tide, storm surge and wave action to calculate final FCLs.

Figure 1: Recent Projections of Expected Global Sea Level Rise
 Source: Draft Policy Discussion Paper, BC Ministry of Environment

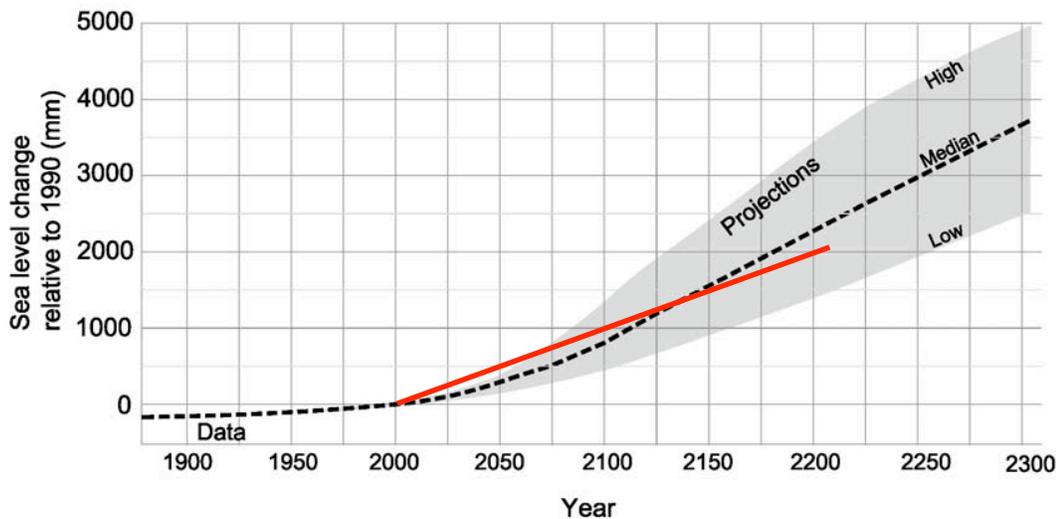


Table 1: Sea Level Rise Recommendations for BC Sea Dike and Coastal Flooded Land Management Guidelines

Development Timeframe	Global increase in mean sea level
Lifespan to Year 2050	0.5 m
Lifespan to Year 2100	1.0 m
Lifespan to year 2200	2.0 m

There were several drivers pushing the City to act on the Guidelines within a reasonable timeframe. Firstly, planning for climate change adaptation is a priority in the City’s Corporate Business Plan and the planning process to date has identified sea level rise as a significant impact. Secondly, a new neighbourhood site in the city was raised 1m following discussion with City staff and the results of a study commissioned by the developer. Thirdly, a window of opportunity exists with considerable development around the False Creek shoreline currently being planned. Other drivers include the due diligence of incorporating best available information and avoiding potential future liability.

To build awareness and understanding around the Guidelines, the City partnered with the Province to convene a workshop including municipal staff, developers and engineers from across the lower mainland. Ensuring a livable and resilient region in the face of sea level rise will involve collaboration among City departments and with external stakeholders. City staff began discussions with Port Metro Vancouver, the Vancouver International Airport, the Vancouver Economic Commission, the Fraser Basin Council and others.

The City partnered with Port Metro Vancouver to undertake a coastline engineering study to apply the Province’s methodology to 80 coastline sites across Vancouver. The deliverables will include recommended FCLs for all flood-prone areas and are expected in March 2012. The City intends to amend the Flood-Proofing Policies to implement revised FCLs that reflect the predicted sea level rise. In the meantime, staff agreed that interim measures were warranted given the upcoming coastal developments.

An internal staff group drafted options for interim measures that ranged from remaining at current FCLs to requiring independent studies from developers. Recommended interim measures were presented, along with a scan of other municipalities’ actions in the region, to City management. The Urban Development Institute (UDI) Technical Committee was updated throughout the process and provided feedback on draft interim measures.

Communication with applicants and staff began early in the process and a formal customer letter was sent to all development applicants detailing the Interim FCL approach. Notice of changing FCLs was also added to Flood-Proofing Policies online, while frequently asked

questions and key messages were drafted for Corporate Communications. A workshop with City Council was followed by a memo to Council outlining the Interim FCL approach.

Prior to formally amending the Flood-Proofing Policies, the City will encourage applicants with projects in identified flood hazard areas to meet an interim FCL equal to the current applicable FCL plus 1 metre (Interim FCLs).

Until the Flood-Proofing Policies are amended, the City will require the following:

- Building permit application: Staff and applicant will collaborate to ensure resilient building measures are applied and/or construction to Interim FCLs.
- Development permit application: Designing to Interim FCLs will be strongly encouraged or required, particularly if permit issuance is not expected prior to amendment of Flood-Proofing Policies. Senior City staff will exercise discretion in applying Interim FCLs with consideration of timing, project size and investment to date, and location specifics.
- Rezoning applications: It is expected that the majority of projects in this stage of development will be required to meet new FCLs at the time of development and/or building permit issuance. All planning at this stage should be based on Interim FCLs until new FCLs are issued later in 2012.

The 1m interim approach meets the anticipated increase in global mean sea levels by the year 2100 as recommended in the provincial guidelines. City staff agreed 2100 was an appropriate planning horizon given the lifecycle of most infrastructure.



A staff working group for sea level rise will report to the Climate Change Adaptation Steering Committee with recommendations for amending the Flood-Proofing Policies and further analysis to develop site specific adaptation measures. Continued regional collaboration will be facilitated by the Fraser Basin Council's Joint Program Committee for Integrated Flood Hazard Management and other initiatives.

THE ESSENTIALS

Key Lessons

- Balance between complacency and panic: Implementing an interim approach ensures the City is moving in the right direction while planning and undertaking a more in depth option analysis.
- Adaptive Management: There are many unknowns and much uncertainty associated with planning for climate change. Leaving a range of adaptation actions open for implementation in the future is imperative. Missing the window of opportunity to raise substantial new development on the waterfront would have narrowed the potential solutions available to us in the long run.
- Climate change impacts and adaptations cross departmental lines. Adaptive capacity of the organization will be limited if inter-departmental collaboration is not facilitated within budget and work planning cycles.
- Flexibility in application: One blanket approach of raising FCLs by 1m without site-specific considerations would be impossible. Departments will have to work together, and with the applicant, to arrive at appropriate solutions for infill and other complex sites.

Major Tools

To support interim FCLs several tools are being used:

- A new layer in the staff VanMap (a Web-based map system incorporating a large variety of City of Vancouver information) can be easily accessed to determine whether development applications are in the expanded flood prone areas of the city.
- A new covenant was drafted and will be applied where applicants decide not to take City advice to raise FCLs. In those cases where covenants exist already, they will be amended.
- Resilient building measures are garnering increased consideration.

Tools that may facilitate investigating broader, area-specific response strategies to sea level rise include:

- Multiple scenario risk-based analyses could be used to explore options for long-term sea level rise response in neighbourhoods such as False Creek.
- The Collaborative for Advanced Landscape Planning (CALP) visualization group at UBC worked with the community of Delta to build understanding and obtain feedback on three approaches to planning for sea level rise: hold the line, managed retreat or build up. The ability to illustrate these scenarios provided a strong tool for engagement. <http://www.calp.forestry.ubc.ca/news/case-study-sea-level-rise-adaptation-in-delta-at-aaas-conference-feb-19/>

THE SPECIFICS

Approach

The methodology used for the engineering study can be found in the 3 volumes of guidelines published by the Province: http://www.env.gov.bc.ca/wsd/public_safety/flood/structural.html#climate

Steps

- Workshop with Province, engineers, developers, municipal staff, etc. on the new guidelines.
- Partner with the Port to undertake an engineering study to apply provincial methodology to coastline.
- Draft alternative interim approaches and present to Management Team.
- Agree to interim approach and present draft for feedback to the Urban Development Institute.
- Create and disseminate support tools and communication materials.
- Finalize interim approach and hold a workshop with Council.
- Follow up with a memo to Council.
- Implement interim FCLs and communicate with clients and staff.
- Initiate working group to recommend next steps for sea level rise response.

Barriers

- Finding transferable examples of sea level rise response actions that apply locally is challenging. Many similar locations have dikes and vulnerability, risk, regulations, jurisdiction, etc. that are all locally specific.
- Guidelines with no clear direction on the complexities of implementation or potential funding sources for what could be huge studies or capital projects are barriers in and of themselves.
- Regional coordination with respect to the Guidelines and adaptation measures is imperative yet challenging to organize in a condensed timeframe.

Results

The most significant result of this project was a 1m increase in existing flood construction levels.

Responsibility

City staff undertook the project with some input from consultants who carried out the coastline engineering study. Port Metro Vancouver partnered with the City to undertake the study.

Time & Cost

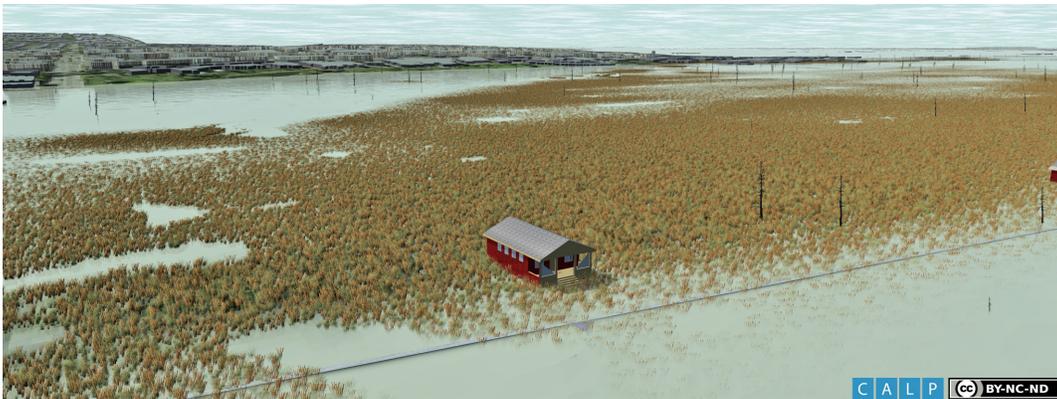
The cost of the engineering study was approximately \$80,000. Initial meetings on the Guidelines occurred in August 2011 and the interim approach was implemented at the beginning of January 2012.

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Flood Management Planning in Delta Delta, British Columbia



South Delta - Sea Wall View Managed Retreat Scenario (hypothetical year 2100) 1.2 metres of sea level rise

THE PROJECT

The Corporation of Delta is a low-lying municipality at the mouth of the Fraser River delta, at considerable risk from climate change induced sea-level rise and storm surges. While the Province of British Columbia provides guidelines and tools for flood risk management, it is the responsibility of local governments to define their flood hazards, integrate these with land use planning policies and implement sufficient flood protection. Uncertainty in climate science and the lack of effective engagement tools make it difficult for local governments to build public support for flood-related policy and action. Previous research using climate change response options, including flood scenario visualization, has proven effective in developing community awareness and support for adaptation needs.

In the context of the British Columbia Regional Adaptation Collaborative (RAC) the Delta project built on existing research and knowledge of local climate change vulnerability to identify, visualize and evaluate hard and soft adaptation options to coastal flood risk due to sea level rise. The project explored how visualizations--based on local climate science of sea level rise, storm surge, and increased storm water-- can advance land use planning decision-making and implementation for adaptation to anticipated flood issues. The project strives to support the municipal decision-making and policy development for flood management in the Corporation of Delta, BC.

As a local climate change adaptation case study, the project also aims to inform the development of new guidelines and other adaptation tools, including science-based visualization techniques, in order to support municipal decision-making and related land use planning in other BC communities.

THE ESSENTIALS

Key Lessons

Data-driven visualizations can assist planning practitioners to assess options and deal with the inherent uncertainty in climate science. A key success of the project was that, through the use of 3D visualizations, municipal staff members were willing to look at a broad range of options and discuss wide-ranging policy implications. Previously this would have been unlikely. For example, staff was willing to discuss a “managed retreat” from the coastline and its associated policy implications (see title page).

As well, the visualizations are going to be used across municipal departments to build climate change adaptation awareness across municipal staff, as well as with Council.

Another contribution of the project is making sense of the policy landscape, as it pertains to flood adaptation, by mapping out where the different policies reside (various municipal policy documents; provincial legislation; federal legislation) and how the multiple policies relate to each other. This work is ongoing.

Major Tools

The Delta project is one case study in a larger set of projects funded by GEOmatics for Informed DEcisions (GEOIDE) that is testing the effectiveness of geo-visualization tools and participatory processes to support decision-making around climate change. The main tool developed through this project is data-driven visualizations. We have found that these visualizations aid greatly in the understanding and awareness of adaptation options and their associated policy implications. Visualizations assist decision-makers in dealing with the inherent uncertainty in climate science. Through the visualizations we were able to get municipal staff to look at, and talk about, a range of future adaptation options, some of which were difficult to address previously.

THE SPECIFICS

Approach

The goal of the project was to generate a range of adaptation options or scenarios to inform future climate change planning in Delta. To achieve this goal, the project used an iterative process developed by the University of British Columbia’s (UBC) Collaborative for Advanced Landscape Planning (CALP), called the Local Climate Change Visioning (LCCV) Process. This process is adaptable for any local government working on climate change visioning. For more information, see CALP’s LCCV Guidance Manual. Pond et al. 2010. <http://www.calp.forestry.ubc.ca/news/viz-guidance-manual/>

Steps

The Delta Local Climate Change Visioning process took place in three phases.

Phase one, Participatory Scenario Building & Indicator Definition, took place in the first year of the project. Key activities included the project initiation, establishment of a Citizens' Working Group, participatory definition of local climate change scenarios, and early exploration of adaptation options and key indicators, including an indicators "wish list". Some key indicators included the total length of raised dikes and roads; area of agricultural lands protected and unprotected; total value of protected and unprotected land; gain or loss of intertidal zone and riparian habitat; and overall community preference.

Adaptation options were applied to specific locations and mapped. The main outcome of phase one was a set of scenario frameworks based on local knowledge and localized climate science data, and a draft set of indicators with which to compare the scenario frameworks.

The second phase, Data and Modeling of Visioning Package, took place in the second and third years of the project. In this phase, the team used the draft scenario frameworks generated in phase one, and gathered additional data to create preliminary visualizations. These visualizations were then tested through multiple review workshops with Delta staff, the Citizens' Working Group, and invited experts. Invited experts included provincial and consulting coastal and flood safety engineers, a regional economist and a federal climate adaptation scientist.

The visuals were revised and refined based on the feedback received. At the same time, the indicators were refined and measured across social, environmental, and economic issue areas. The main outcome was a final set of visualizations for the scenario frameworks, and indicators with which to compare them. These final packages were presented to Delta staff, the Citizens Working Group, and invited experts for final feedback and refinement.



Ladner - Aerial View, Hold the Line Scenario (hypothetical year 2100)
1.2 metres sea level rise



South Delta - Aerial View, Reinforce and Reclaim Scenario (year 2100)
1.2 metres of sea level rise

The final phase, Policy Implications, Capacity Building & Dissemination, used the Visioning Packages and on-going policy review to draft a set of policy implications for each scenario. These were brought to Delta staff and then finalized in a report. A technical report was also prepared to share key project lessons related to data gathering and modeling. Project outcomes will be presented to Delta Council, and will be disseminated through a dedicated website.

Barriers

Data acquisition – modeling is expensive, and data can be difficult to obtain:

Data acquisition (particularly updated hydrological modeling for sea level rise dike breaches) delayed the project outputs significantly, though we still expect to finish on schedule. Resources were available in this project for modeling and some data acquisition, but this is unlikely to be replicable across all municipalities.

Communicating risk /probability of future climate change events:

One of the issues we have grappled with is how to determine and communicate risk and probabilities of future risk events under climate change. For the Delta project, the challenge was to assess Delta's risks of flooding due to climate change. The probability of sea level rise is 100%, but the probabilities of storm events (surge in particular) are not yet well understood within downscaled climate science. In addition, the project has been dealing with probable longer-term, cumulative impacts, rather than single events, which is more difficult for conventional risk and engineering approaches to accommodate.

Communication of large amount of data and visual information:

It is continually challenging to communicate the vast amount of data that necessarily goes into credible modeling of future climate change scenarios. It is also challenging to ensure that visual information is credible.

Results

CALP has produced a set of 2D and 3D visualizations based on local hydrological modeling for sea level rise and storm surge dike breaches, as well as visualizations and indicators for scenarios including “Hold the Line”, “Reinforce and Reclaim”, “Managed Retreat”, and “Build Up”.



Ladner - Dike View, Build Up Scenario (hypothetical year 2100)
1.2 metres sea level rise

The visual materials are being used with staff and a Citizens’ Working Group to assess the policy implications and social acceptability of the various adaptation options. The goal is to provide the Corporation of Delta with a set of policy recommendations for a range of hard and soft approaches, and a set of visuals to use for community engagement to build support for adaptation needs.

Secondly, in our on-going work with Delta, we will be providing workshops for staff across municipal departments, in order to facilitate both sea level rise awareness, and also the mainstreaming of climate change adaptation planning within various departments. In other words, climate change awareness and planning should be operationalized within Delta more quickly due to this project.

Responsibility

The Collaborative for Advanced Landscape Planning (CALP) at the University of British Columbia partnered with the Corporation of Delta and the BC Ministry of Environment.

Authors of the project included: Kristi Tatebe; Sara Barron; Ellen Pond; David Flanders; Jeff Carmichael; Glenis Canete; Stuart Cohen; Sara Muir Owen; and Stephen Sheppard.

Time & Cost

The project took place over three years. Costs ranged from approximately \$50,000 - \$100,000 per year, not including many generous in-kind contributions.

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