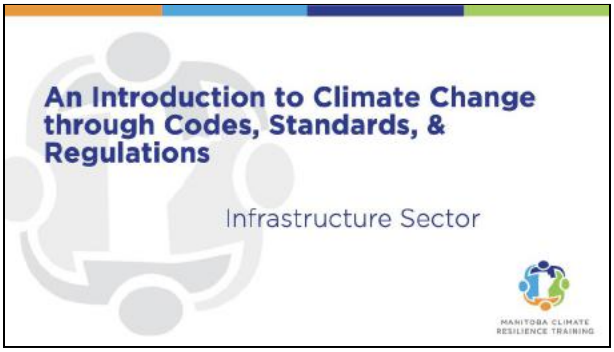
An Introduction to Climate Change Through Codes, Standards, & Regulations

These are handout notes to accompany the slides presented in the “Introduction to Climate Change Through Codes, Standards, & Regulations” MCRT course.



The Manitoba Climate Resilience Training (MCRT) Project is part of the Building Regional Adaptation Capacity and Expertise (BRACE) initiative of the Pan-Canadian Framework on Clean Growth and Climate Change. This Project aims to build the capacity and expertise of professionals (including engineers and planners), the business community in Northern Manitoba, and Indigenous organizations and communities to address the risks associated with climate change.

The goal of this Project is to develop and deliver a comprehensive suite of training and capacity building courses or modules that enhance climate knowledge and the uptake of tools and information that promote integrated engagement, networking, and hands-on learning opportunities. In doing so, the MCRT project Team is engaging with industry stakeholders, experts, and leaders to help create tailored approaches to integrate climate risk and opportunities into decision-making and planning within the Northern Business, Indigenous, Planning, and Infrastructure sectors in Manitoba.

Ultimately, the MCRT Project will support the Province’s Climate and Green Plan’s (CGP) vision for the province to be the most climate-resilient province in Canada.

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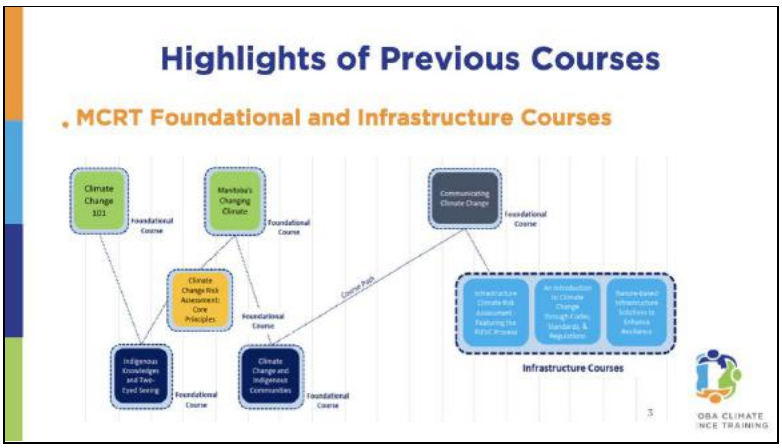
Highlights of Previous Courses



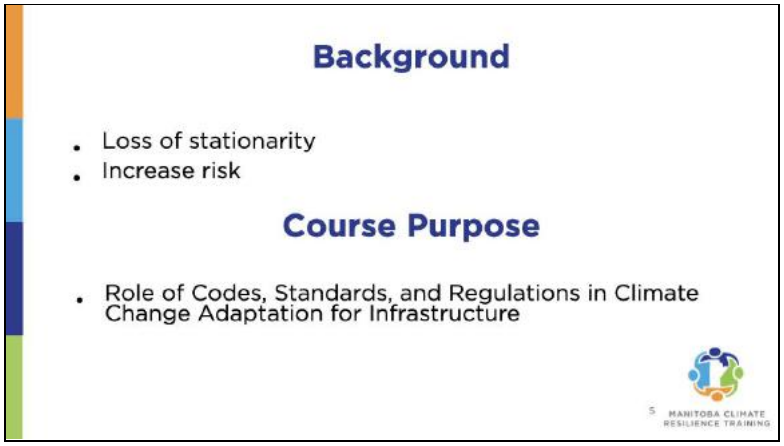
All of the previously delivered Manitoba Climate Resilience Training (MCRT) courses will be available to view until March 31, 2022 on the MCRT website at this link:

- https://mcrtproject.ca/courses/986-2/

We have identified the following, previously delivered courses as being part of an “Infrastructure Stream” of courses:

- Climate 101
- Indigenous Knowledge and Two-eyed Seeing
- Climate Change Risk Assessment: Core Principles
- Manitoba’s Changing Climate
- Climate Change and Indigenous Communities
- Communicating Climate Change
- Infrastructure Climate Risk Assessment featuring the PIEVC Process

Background & Course Purpose



Background

Canada's climate is changing, and warming twice as fast as the rest of the world; in the North, temperatures are rising three times as fast. Floods, wildfires, coastal erosion, permafrost thaw, heat waves, and other weather-related events are already having significant impacts on our society and our economy.

Much of today's buildings and infrastructure are designed, built, and operated according to standards that were written with a stable climate in mind. But as the climate changes, older standards are no longer enough to keep Canadians safe.

To address this gap, the Standards Council of Canada (SCC) and other regulatory bodies have been reviewing and updating standards and related guidance to help communities, businesses, builders, and infrastructure operators adapt. These efforts are continuing. They include flood risk assessment frameworks, standards for fire-resilient planning, as well as codes directed towards ensuring that the design, construction, and maintenance of buildings and infrastructure can better withstand the climate conditions of the future.

Course Purpose

The intention and purpose of this course is to have all participants understand the role that is played by Codes, Standards, and Regulations in regards to climate change adaptation for infrastructure design, construction, and operation and where to go for more information.

This course is intended to be an introduction to this subject. Red RIver College Polytechnic already has some more detailed courses on codes. If there is demand, they will develop and deliver further, more detailed training on codes in the key infrastructure areas:

- Buildings
- Transportation - Transportation infrastructure
- Water, Storm Water, Water Supply, & Wastewater

Agenda

These are the sections of the course and the main points that will be covered in each section:

Definitions

In this section, we will provide the groundwork information on the subject. This includes definition of the key terms so as to provide an understanding of, and the different roles played by Codes, Standards, and Regulations.

Current State & Limitations

In this section, we will provide an overview of the current state of how codes, standards, and regulations have changed in response to and in anticipation of changes in climatic conditions.

Practices / Changes

In this section, we will provide some indication of work that is currently underway for further changes to codes and changes that are anticipated in the future.

Challenges / Opportunities

Subject matter experts will present the current state of codes, standards, and regulations as they relate to the following aspects of infrastructure: Transportation - Transportation infrastructure; Water, Storm Water, Water Supply, & Wastewater; and Buildings

Breakout discussion groups

There will be facilitated breakout groups for each of the infrastructure aspects listed above. These sessions will provide an opportunity to share and discuss your experiences and challenges with your peers and with the presenters and other subject matter experts.

Presenters

This is some background information about the people who contributed to development and presented the material during the course session.

Richard Marshall, P.Eng. (Definitions / Current State)

Rick Marshall, P.Eng., is Design Manager at Bird Construction, where he leads a design-build team focusing on commercial and industrial projects. Rick has extensive knowledge in Code development due to 14 years of involvement in Canada's code development process as a voting member of two standing committees. He previously served as the EGM representative to the Building Standards Board and is a Commissioner on the Winnipeg Building Commission. Rick has a keen interest in durability, resilience, and life-cycle costing of buildings. He holds a Bachelor of Science degree in Civil Engineering from The Ohio State University, and a Master of Environment and Business from the University of Waterloo.

Kris Maranchuk, P.Eng. (Transportation)

Kristopher is a Professional Engineer who has a diverse background in Transportation Engineering and Civil Infrastructure through 20 years of experience in the public sector that includes project management, specification development, design, and construction.

Kristopher is currently the Applied Research Chair in Sustainable Construction with the School of Skilled Trades and Technologies at Red River College Polytechnic. His portfolio involves all construction disciplines covered by the Engineering Technologies, Trades, and Apprenticeship programs. His focus is developing and building research opportunities between students and industry related to sustainable construction practices, processes, and technologies.

Jeff O'Driscoll, P.Eng. (Water Management / Supply)

Jeff is a leader in assessing climate change resilience on infrastructure and holds the designation of Infrastructure Resiliency Professional (IRP). Jeff is a Civil Engineer with 30 years experience in engineering consulting. Jeff completed the first project applying the PIEVC Protocol Climate Risk Assessment Process developed by Engineers Canada for the City of Portage la Prairie Waterworks Infrastructure. Since this time Jeff has worked across Canada and internationally on climate change resilience projects.

Jeff is the Infrastructure Division Manager for Associated Engineering's Winnipeg office. Jeff is an associate for the Climate Risk Institute, a member of the Engineers and Geoscientist of

Manitoba Sustainable Development Task Group, Association of Consulting Engineers of Manitoba Board, American Waterworks Association Board, Canadian Water and Wastewater Association Climate Change Committee and chairs Associated Engineering's Climate Change Advisory Group.

Tammy Harper, M.Ed., B.A. (Buildings)

Tammy Harper is an Instructor in the Civil Engineering Technologies Department at Red River College Polytechnic, where she teaches Code related courses as well as Management and Leadership to the Construction Management Degree Program students.

Prior to moving to RRC, Tammy was the Chief Building Official for the Office of the Fire Commissioner. During that time, Tammy was responsible for leading the Building Safety Department and also taught code related courses and seminars and she also chaired code development committees at both the provincial and national level.

Most recently, Tammy was appointed to the Executive of the CCBFC - the Canadian Commission on Building and Fire Codes. She also served as Manitoba's representative on the Provincial Territorial Policy Advisory Committee of Codes (PTPACC) which provides policy direction to the CCBFC on future code development, and she chaired the Code Consolidation Committee for Section 9.36 Energy Efficiency for Housing and Small Buildings.

Tammy has a Master's degree in Education with a specialty in Adult Education, as well as Bachelor degrees in Economics and International Development, certificates in adult education, leadership as well as her LEED AP designation.

Contributors

There were a few additional people who contributed to the development of the course.

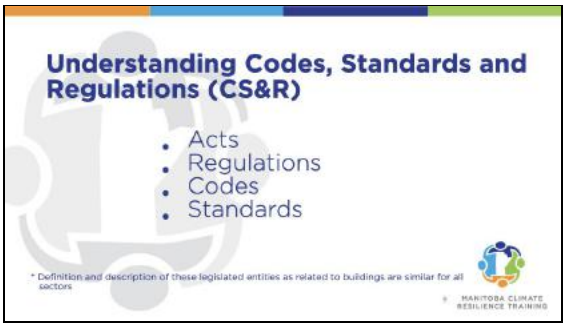
Shari Bielert, CET, M.Ed., B.E.S.

Shari Bielert has been Chair of the Civil Engineering Technology department at Red River College Polytechnic since 2015. She was an instructor in the Architectural/Engineering Tech, Environmental Engineering Technology, and Construction Management programs specializing in environmental management and sustainable buildings design and construction. In her capacity as chair, she encourages curriculum and applied research projects to incorporate innovation in the use of sustainable materials and methods in the design, construction, and operation of buildings and infrastructure throughout Civil Eng Tech programs.

Curt Hull, P.Eng

Curt Hull has been Project Director of Climate Change Connection since 2007. Prior to that, he worked for 25 years managing quality in a global electronics design and manufacturing enterprise. With Climate Change Connection, he has been working on climate change education and solutions with many organizations in active transportation, public transportation, sustainable buildings, sustainable energy, and local food and agriculture. He is Project Manager of the BRACE / MCRT project with Engineers Geoscientists Manitoba. He has also worked on sustainability projects with northern Manitoba First Nations communities.

Understanding Codes, Standards and Regulations (CS&R)



The construction industry is both highly regulated and complex – not only in Canada, but in all jurisdictions, around the world. Part of the complexity is due to overlapping jurisdictions and requirements. To work effectively as an engineer in this complex environment, it is vitally important to have a basic understanding of Canada's regulatory environment, and to be familiar with the core documents that govern our work. The sections that follow explain codes, acts, regulations, and standards – and how each of these relate and work together. While focusing on buildings, the basic regulatory structure also applies to infrastructure and to transportation.

How Regulations are Created

To fully understand regulations, we need to start at the very top with Canada's Constitution. Sections 91 and 92 of the Constitution Act list subject matters related to what each level of government is responsible for. The responsibility for building regulation – which is a property right – is exclusively given to the Provinces and Territories under Section 92.

Before there can be a regulation, there must be a law. Laws start with bills in the legislature. (This applies to both the Federal Parliament and to Provincial Legislative Assemblies). When a bill is passed by a legislature and receives Royal Assent, it becomes an Act. (An Act is also referred to as a Statute).

In Manitoba, there are two primary Acts which govern buildings – the Buildings and Mobile Homes Act, and the Fires Prevention and Emergency Response Act.

The Buildings and Mobile Homes can be found through this link:
https://web2.gov.mb.ca/laws/statutes/ccsm/b093e.php

The Fires Prevention and Emergency Response Act can be found through this link:
https://web2.gov.mb.ca/laws/statutes/ccsm/f080e.php

When legislators write Acts, they generally set out broad guidelines – of intent – while also establishing a mechanism for writing regulations. The broad guidelines which are set forth in the Buildings and Mobile Homes Act include the following:

- Definitions
- A mechanism for establishing and maintaining a building construction code
- Assignment of enforcement of the Act to municipalities

Procedures for building permits and occupancy permits
Procedures for inspections and the right of entry by inspectors
Procedures for hearings and appeals
Offenses, and a mechanism for penalties for those offenses

Regulations

The specifics of an Act are dealt with through regulations. What is a regulation?

A regulation can be defined as ***"delegated legislation"***. In very simple terms, the Act sets out a broad outline of intent, and then the Act delegates the authority to "someone else" to write regulations, which deal with specifics. The "someone else" can be a person, a body, or a ministry. In the case of the Buildings and Mobile Homes Act, that person or body is defined in the Act as the "member of the Executive Council appointed by the Lieutenant Governor".

The three main regulations that currently govern buildings in Manitoba are:
Regulation 31/2011 – The Manitoba Building Code,
Regulation 213/2013 – the Manitoba Energy Code for Buildings, and
Regulation 32/2011 – The Manitoba Plumbing Code

The regulations can be found on the Manitoba legislative website through this link:
https://web2.gov.mb.ca/laws/regs/index.php?act=b93

Building Codes

What is a Code? A Code can be defined very simply as "a set of rules". Codes tell the designer and builder what he or she *must* do.

How did the building code come about? Before we had a National Building Code, the Provinces generally delegated the responsibility for buildings to municipalities, and this delegation resulted in a hodgepodge of regulations across Canada. Variations from one municipality to the next made it very difficult for designers, product manufacturers, and contractors to conduct business in more than one region. In 1937, the Federal Department of Finance asked the National Research Council to develop a "model building regulation" that could be adopted by all municipalities in Canada. The result of that initiative was the publication of the first edition of the National Building Code in 1941. There are now four model National Codes – the National Building Code, The National Fire Code, the National Plumbing Code, and the National Energy Code for Buildings. The model codes are updated on a 5-year cycle. (Publication of the 2010 editions has been delayed by the Covid-19 pandemic).

It is important to understand that the model Codes have no legal bearing unless and until they are adopted by the Provinces and Territories – as a regulation – in accordance with the governing Act.

Circling back to the Manitoba regulations, Regulation 31/2011 adopts the National Building Code (version 2010) as the Manitoba Building Code, with some Manitoba-specific additions and revisions. The actual regulation is a short pdf document. So a user needs to have a copy of the

Manitoba regulation, and a copy of the National Building Code, and further needs to cross-reference the Manitoba changes (additions and revisions) with the National Building Code.

The National Code documents are now available as free downloads for the Codes Canada website, through Federal government funding.

NBC 2010 can be found through this link:
https://nrc-publications.canada.ca/eng/view/object/?id=cbd245df-bc91-4033-a538-fb20fcf536a1

Standards

What are Standards? The Standards Council of Canada defines a Standard as *"a document that provides a set of agreed-upon rules, guidelines or characteristics for activities or their results".* In simple lay terms, a code can be thought of what you MUST do, and a standard as HOW you go about doing it.

Code - WHAT you MUST do
Standard - HOW you go about doing it

Standards establish, for diverse fields and industries:

- accepted practices
- technical requirements
- standard definitions of terms

A technical standard is therefore an established "norm" or requirement regarding a technical system. Standardization may address any or all of the following:

- the design of systems or equipment
- construction methods and techniques
- installation procedures – for materials, for systems, or for equipment – and,
- testing procedures

Standards in Canada are governed by the Standards Council of Canada, which is a federal Crown Corporation that reports to Parliament through the Minister of Industry. These Standards Development Organizations (or SDOs) are likely very familiar:

- CSA Group - formerly Canadian Standards Association)
- ULC - Underwriters Laboratory Canada
- ISO - International Standards Organization
- NFPA - National Fire Protection Association
- ASTM International - formerly known as American Society for Testing and Materials
- ANSI - American National Standards Institute

Standards can be mandatory, or they can be voluntary. Standards are distinct from Acts, Regulations and Codes – but are most often referenced within them. Following through what has been covered above – when a standard is referenced within the body of a Code, and when the code is adopted into a regulation, then the standard becomes mandatory.

Standards in the Building Code

The National Building Code references numerous standards. The majority of the standards that are referenced are contained in Table 1.3.1.2. of Division B of the Code. There is also a separate Table 5.10.1.1. in Part 5 – Environmental Separation – which contains standards that related to building envelope issues only.

Summary

So – to recap – the Constitution gives the authority for regulating building design and construction to the Provinces and Territories. The Province and Territories pass legislation in their legislative assemblies. The legislation delegates the authority to write the specific rules to a person or body that is defined in the legislation. To make a complex task easier – and to promote harmonization across the country – the Federal government has established (and maintains) a set of model codes that can be adopted – with or without changes – by each jurisdiction. The code then becomes the regulation when the regulation adopts it. The code in turn references specific standards. The standards establish norms for the design of systems or equipment, the construction methods and techniques, and installation and testing procedures.

Example

Here's an example to further illustrate the relationship between codes and standards:

Let’s assume that a designer chooses to design a particular industrial building under paragraph 3.2.2.72 in the building code. Clause 3.2.2.72.a) states that the building must be sprinklered throughout. Sentence 3.2.5.12 states that automatic sprinkler systems must conform with NFPA-13 – the standard for Installation of Sprinkler Systems. NBC Table 1.3.1.2 states that NFPA-13 (2007) is the applicable document.

In Manitoba, the Building and Mobile Homes Act sets forth the mechanism for writing the regulations. The regulation (Reg 31/2011) adopts the national code as the Manitoba Building Code, with some Manitoba-specific changes. The MBC tells the designer what he or she MUST do – which is to install an automatic sprinkler system within a particular building. The NFPA standard that is referenced within the Building Code tells the designer and the contractor how to design, install, and test the sprinkler system.

Current State of Regulations, Codes, and Standards

This chapter will review the current state of regulations, codes, and standards – including the means and methods for updating the regulations and standards, the responsiveness to change, and the acceptance and adaptation by industry.

Canada's Code Development System - How the National Codes are Developed

Working on behalf of the Canadian Commission on Building and Fire Codes (CCBFC), the National Research Council of Canada (NRC) publishes five National Model Construction Codes, in English and in French, which as noted in the previous chapter, must be adopted by a regulatory authority in order to come into effect. In some cases, the Codes are amended and/or supplemented to suit regional needs, and then published as provincial codes.

The **National Building Code of Canada (NBC)** addresses the design and construction of new buildings and the substantial renovation of existing buildings.
The **National Fire Code of Canada (NFC)** provides minimum fire safety requirements for buildings, structures and areas where hazardous materials are used, and addresses fire protection and fire prevention in the ongoing operation of buildings and facilities.
The **National Plumbing Code (NPC)** covers the design and installation of plumbing systems in buildings and facilities.
The **National Energy Code of Canada for Buildings (NECB)** provides minimum energy efficiency requirements for the design and construction of all new buildings and additions save farm buildings and those buildings falling under the scope of NBC Part 9.
The **National Farm Building Code (NFBC)** provides relaxations of the requirements in the NBC to address the particular needs of farm buildings.

To assist in the application of the codes, explanatory material is published in the form of user's guides. Descriptions of all the published documents and ordering information are available under National Model Construction Codes and Guides/Provincial Codes.

There is also a fifth national code which falls outside of the Code Development System. The Canadian Electrical Code, CSA 22.1 – is developed and maintained by CSA Group.

Historical background

Under the British North America Act and its successor, the Constitution Act, responsibility for building regulation in Canada rests with the provinces and territories. This responsibility was generally delegated to municipalities, which, not surprisingly, resulted in a multiplicity of regulations being developed over time as each municipality tried to deal with its own needs. These variations from one municipality to the next made it very difficult for designers, product manufacturers and contractors to conduct business in more than one region. It was also very difficult for national programs supporting housing and other construction work to be implemented. Thus, in 1937, the federal Department of Finance asked NRC to develop a model building regulation that could be adopted by all municipalities in Canada. The result of that initiative was the publication of the first edition of the NBC in 1941.

The post-war construction boom fuelled the demand for a revised NBC, particularly one that did not require houses and small buildings to be designed by architects and engineers. To respond to the needs of an industry that was rapidly expanding, NRC established the Division of Building Research (DBR), which became the NRC Institute for Research Construction in 1986 and NRC Construction in 2012. One of DBR's original mandates was to provide research support for the NBC.

In 1948, NRC created the Associate Committee on the National Building Code whose mandate was to update and maintain the NBC on an ongoing basis and provide for broad input. The Associate Committee revised the NBC in 1953 and has subsequently published new versions about every five years. The NBC 2010 is the 13th edition. In 1956, NRC created the Associate Committee on the National Fire Code, which produced the first edition of the NFC in 1963. The NFC 2010 is the 9th edition. In October 1991, the two Associate Committees were replaced by the CCBFC.

Changes to the system

A number of economic realities — increasing globalization, free trade, harmonization of standards, demands for better quality and performance, and a major shift from new construction to rehabilitation — created the need to make the codes more dynamic, more responsive, and better able to accommodate innovation. The CCBFC addressed this need by identifying opportunities to improve the code development system in several significant ways. Two key initiatives were subsequently undertaken:

- to establish a coordinated provincial/territorial/national code development system
- to convert the National Model Construction Codes into objective-based codes

Converting these codes to an objective-based format has made them more accommodating to innovation by clarifying their scope as well as the intent behind their requirements. Objective-based codes provide additional information that helps proponents and regulators determine the minimum

performance that must be achieved, thereby facilitating the evaluation of new products and construction techniques and the assessment of code conformance.

Scope and application of the National Model Construction Codes

In Canada, building and fire codes are developed cooperatively with the goal of achieving compatibility. Generally, when a new building code is adopted, it is not applied retroactively: existing buildings that comply with the code in effect at the time of their construction are generally not required to be upgraded so that they comply with the new code. Unlike building codes, however, fire codes may contain retroactive requirements that apply to all buildings, regardless of when they were built.

The NBC is concerned with health, safety, accessibility and the protection of buildings from fire or structural damage. It applies to the construction of new buildings and to the demolition or relocation of existing ones. It also applies when a building's use changes or when it is significantly renovated or altered. Some provincial building codes also address energy conservation.

The **NFC** applies to buildings and facilities already in use and regulates activities that create fire hazards. It contains requirements regarding the maintenance of fire safety equipment and egress facilities, and provides direction on the safe use of combustible materials and dangerous goods in both new and existing buildings or facilities. It also requires fire safety plans in anticipation of emergencies. In sum, the NFC aims to reduce the likelihood of fires, particularly those that may present a hazard to the community, and to limit the potential damage caused by fires as well as by the handling and storage of hazardous materials.

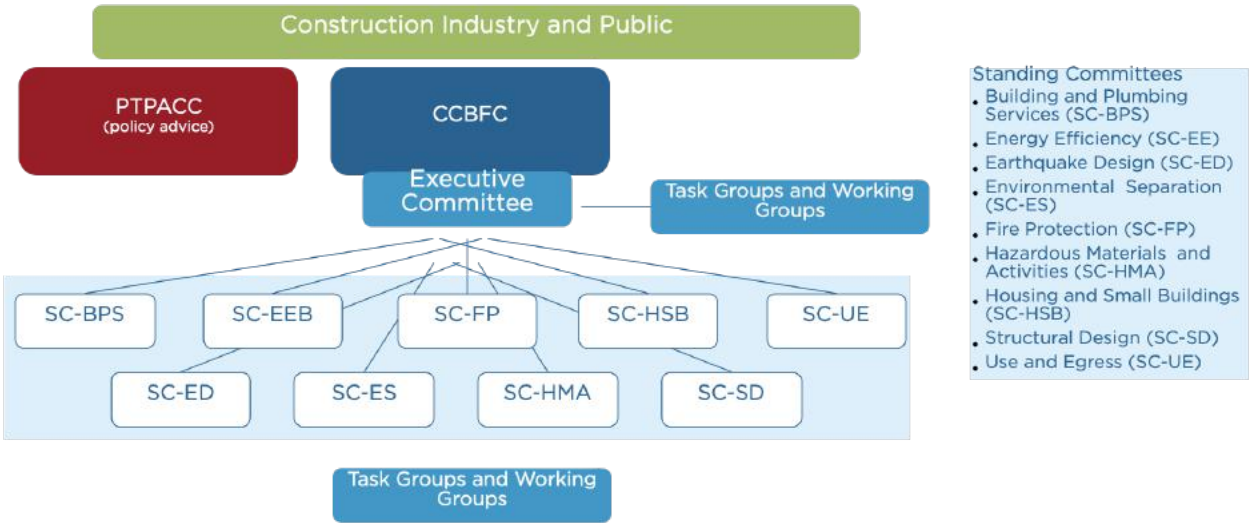
The **NPC** is concerned with health, safety, and the protection of buildings or facilities from water and sewage damage. It covers the design and installation of plumbing systems in buildings and facilities. It applies to the construction of new buildings and to the demolition or relocation of existing ones as well as when a building's use changes or when it is significantly renovated or altered.

The **NFBC** addresses the special nature of the occupancies of non-residential farm buildings. Farm buildings that do not qualify under specific criteria are required to conform to the NBC in all respects.

The **NECB** was designed to complement the building codes. It sets out minimum requirements for energy efficiency that may be adopted in whole or in part into provincial or territorial legislation and codes or, alternatively, used as guidelines for the construction of energy-efficient new buildings.

Canada's Code Development System

This graphic shows the structure of the model code development system.



Canadian Commission on Building and Fire Codes (CCBFC)

The overall authority is the **CCBFC – the Canadian Commission on Building and Fire Codes**. The Commissioners are volunteers who are selected for their expertise. Many are engineers or architects. The CCBFC has an Executive Committee which is a subset of the overall membership. The role of the CCBFC is to set broad policy and to adopt changes to the four model codes. Policy advice is given to the CCBFC by an organization known as PTPACC – the Provincial and Territorial Policy Advisory Committee on Codes. The representatives on PTPACC are selected by the Provinces and Territories.

The CCBFC develops Canada's National Model Construction Codes through a committee-based process and formally approves all Code documents and technical revisions prior to publication by NRC.

Standing Committees

Technical work on the Codes is done by nine Standing Committees, each of which tackles a part of a code, or in some cases, multiple parts. The voting members of these committees and groups are drawn from all segments of the construction industry: regulators, fire services, architects and engineers, manufacturers and product suppliers, building owners and developers, and building users. They are appointed as individuals, not as delegates from a specific association or company, and are selected in a way that provides representation from all geographic regions of the country. The typical standing committee will have between 20 and 24 members. The Standing Committees - and their areas of expertise - are:

- Building and Plumbing Services - NPC and Part 6 of the NBC
- Earthquake Design - Seismic parts of Part 4 of the NBC
- Energy Efficiency - NECB
- Environmental Separation - Part 5 of the NBC
- Fire Protection - Parts of Part 3 of the NBC

- Hazardous Materials and Activities - NFC
- Housing and Small Buildings - Pat 9 of the NBC
- Structural Design - Parts of Part 4 of the NBC
- Use and Egress - Parts of Part 3 of the NBC

Each of the Standing Committees sets up short-term task groups, working groups and advisory groups to study specific issues and make recommendations. If a particular topic overlaps parts of the code, joint task groups between standing committees may be established.

At the start of the code cycle, the standing committees establish work plans. Each standing committee has four basic duties, which are included in the work plans:

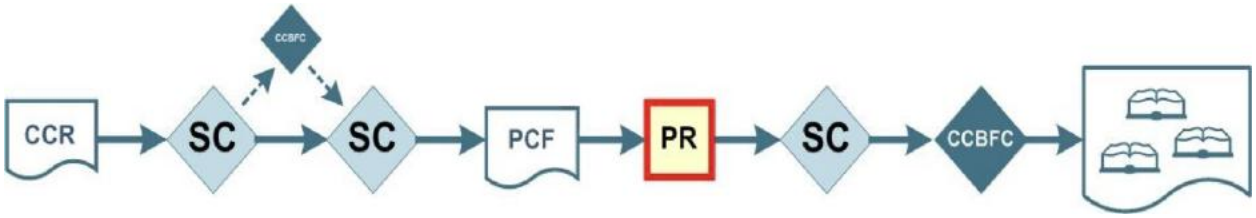
- First, they study code changes that are priorities of the CCBFC or PTPACC, which are assigned to the Standing Committee by the CCBFC
- Secondly, they may study code changes that the Standing Committee itself wants to tackle. These tasks must be approved by the CCBFC to be added to the work plan.
- Thirdly, they review code change requests submitted by the public.
- And lastly, every Standing Committee reviews updated versions of standards for inclusion in the codes. This is typically done in the last year of a code cycle, so that the most recent version of a standard can be referenced.

The Code Change Process

The flowchart below shows the procedure for changing the codes.

First, a code change request – or CCR – comes in from a proponent. Anyone can request a code change – change requests are submitted online through the Codes Canada website, by completing and submitting a fillable form. The Codes Canada staff screens and analyzes the CCR and then assigns it to one or more of the Standing Committees. The Standing Committees then meet and debate the CCR and decide whether to work on it - or not - some CCRs are outside the mandate of the code and therefore must be rejected. Some are considered to have merit but are thought to be minor tasks – these are usually assigned to existing task groups or working groups. If a standing committee decides that a CCR has merit but requires major study and work, then permission must be granted by the CCBFC to add the CCR to the Standing Committee's work plan. Some CCRs will have policy implications - these need to flow up to the CCBFC for policy advice, and then back down to the Standing Committee.

Following work on the CCR, a Proposed Change Form – or PCF – is prepared. The PCF will include the changes, the rationale behind the changes, and a cost-benefit analysis.



The Standing Committee then approves the PCF to go forward to public review. Public reviews are held most years – other than the last year of a code cycle – for two months in the fall, usually in November and December. Public review is done online through a website, and anyone can register and provide comments. Following the Public review period, the Codes Canada staff organizes and summarizes the comments, and then the Standing Committees meets to review every comment. They will then decide to proceed with the change as-is, to amend it based on comments received, or to withdraw it. The Standing Committees themselves do not have the authority to change the code – their authority only extends to recommending changes to the CCBFC for adoption.

The actual code change must be approved by the CCBFC, and the changes are also vetted by PTPACC. The final step is for the changes to be voted on by the CCBFC. Once passed, the actual wording is reviewed by editors, translated into French, and then finally published in the next version of the Code. An important note is that **final decisions on the technical content of the Codes are made by the committees of volunteers, not by NRC staff.**

Because the provinces and territories review the final version of the proposed changes from a policy perspective and identify their concerns before they are submitted to the CCBFC, a period of about 20 months is required from the time the standing committees decide on the final changes they are going to recommend, until the Code documents are published. This means that proposals for changes to the current codes must be received by the standing committees at least two years before the end of the cycle. *This entire process can take a very long time to accomplish.* It is typical that a code change can take an entire 5-year code cycle – and sometimes even longer – to be considered and implemented.

Development of Standards

The standards organizations have similar mechanisms for revising and updating standards.

National Standards of Canada are developed using international standard development best practices, while safeguarding the interests of Canadians. National standards of Canada may be nationally developed, or they may be adoptions of international standards. When developing standards, the Standards Development Organizations consider factors such as timing, funding, and committee structure.

The general steps in the development process are similar to the building codes development process:

- identifying the need for the standard
- reviewing the existing standards landscape - does a standard already exist?
- engaging affected stakeholders

- notifying the public at the project start
- developing the standard - which is done by technical experts
- public consultation
- reviewing comments received, and revising as necessary - by the technical committee
- voting on (approval) of the standard
- prompt publication
- maintenance of the standard – periodic revisions or re-affirmation

Updating Standards for Climate Risks

Starting in 2016, the Climate-Resilient Buildings and Core Public Infrastructure Initiative, with funding from Infrastructure Canada, and led by the National Research Council, undertook a number of projects to integrate climate resilience into building and infrastructure design guides, codes, and standards.

Related to buildings, CSA Group re-wrote CSA S478 (which was previously a guideline) into a Standard that can be referenced in the NBC. CSA also developed a new standard on Performance Requirements for Climate Resilience of Low Slope Membrane Roofing Systems (CSA A-123.26) to address wind-related climate risk associated with this roof type.

CSA Group and **ULC** have both updated a number of standards to include climate change adaptation considerations and have plans to update more standards in the future.

CSA Group

The following is a non-comprehensive list of standards that have been published with climate change adaptation considerations

- CSA Standards can be purchased at: https://www.csagroup.org/store/

Building Specific:

- CSA A123.26:21 Climate Resilience of Low Slope Membrane Roofing Systems
- CSA A440S1:19 Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440-17, North American Fenestration Standard/Specification for windows, doors, and skylights
- CSA A440.2:19/A440.3:19 Fenestration energy performance/User guide to CSA A440.2:19, Fenestration energy performance
- CSA A440.4:19 Window, Door and Skylight Installation
- CSA S478:19 Durability in Buildings
- CSA S500:14 (R2019) Thermosyphon foundations for buildings in permafrost regions (New edition underway)
- CSA S501:21 Moderating the effects of permafrost degradation on existing building foundations
- CSA S502:14 (R2019) Managing changing snow load risks for buildings in Canada's North (New edition underway)
- CSA Z240.10.1:19 Site Preparation, Foundation, and Installation of Buildings
- CSA Z800:18 Guideline on Basement Flood Protection and Risk Reduction

Other structures and community:

- CSA S6:19 Canadian Highway Bridge Design Code (CHBDC)
- CSA S37:18 Antennas, Towers, and Antenna-Supporting Structures
- CSA S503:20 Community drainage system planning, design, and maintenance in northern communities
- CSA S504:19 Fire resilient planning for northern communities
- CSA S505:20 Techniques for considering with high winds and snow drifting and their impact on Northern infrastructure
- CSA S900.1:18 Climate Change Adaptation for Wastewater Treatment Plants
- CSA W200:18 Design of Bioretention Systems
- CSA W201:18 Construction of Bioretention Systems
- CSA W202:18 Erosion and sediment control inspection and monitoring
- CSA W203:19 Planning, design, operation, and maintenance of wastewater treatment in northern communities using lagoon and wetland systems
- CSA W204:19 Flood Resilient Design for New Residential Communities
- CSA W205:19 Erosion and sedimentation management for northern community infrastructure
- CSA W208:20 Erosion and sediment control, installation and maintenance
- CSA PLUS 4011:19 Technical guide: Infrastructure in permafrost: A guideline for climate change adaptation
- CSA PLUS 4011.1:19 Technical Guide: Design and construction considerations for foundations in permafrost regions
- CSA PLUS 4013:19 - Technical Guide: Development, Interpretation and Use of Rainfall Intensity-Duration-Frequency (IDF) Information: Guideline for Canadian Water Resources Practitioners

Descriptions of each of the above standards can be found on the CSA Communities website at:

- Buildings and Structures: https://community.csagroup.org/docs/DOC-125110
- Canada's North: ://community.csagroup.org/community/climate-change-resilience/pages/canadas-north
- Flooding: https://community.csagroup.org/community/climate-change-resilience/pages/flooding

CSA - New Standards (currently in development):

CSA S900.2 Structural Design of Wastewater Treatment Plants

- CSA W210 Prioritizing flood resiliency in existing residential communities
- CSA W211 Management standard for stormwater system

CSA Training

CSA Group training modules available:

- CSA-ISO 31000:2018 Risk Management for Climate Adaptation & Resilience
- NISI Standards and Climate Change in Canada's North (Free)
- NISI S500 Online Training (Free)
- NISI S501 Online Training (Free)

- NISI S502 Online Training (Free)
- NISI S503 Online Training (Free)
- NISI S504 Online Training (Free)
- CSA S6:19 Overview of Changes - Online Training

CSA Training can be found at: https://www.csagroup.org/store/

CSA - Future Work in Building Resiliency:

The following represents a partial list of standards that, with additional enhancements, could increase resiliency within the National Model Codes:

- CSA A500 Building Guards
- CSA A370-14 Connectors for Masonry
- CSA C282-09 Emergency Electrical Power Supply for Buildings
- CAN/CSA O80-14 Series Wood Preservation (CAN/CSA O80.1, O80.2, O80.3)
- CSA S406-16 Permanent Wood Foundations for Housing and Small Buildings
- CSA S269.1-16 Falsework for Construction Purposes
- CSA S269.2-16 Access Scaffolding for Construction Purposes

CSA - Buildings Research

CSA Group invests in research to support standards development in a number of areas, including climate change adaptation. The following are a sample of the research papers that have been published or are currently underway:

- Towards a Guideline for Assessing Climate Change Vulnerabilities of Northern Airports
- Use Category for Preservative-Treated Wood in Northern Regions Containing Permafrost
- Investigating Standards for Small Water and Wastewater Systems in Canada's North
- Environmental DNA Standardization Needs for Fish and Wildlife Population Assessments and Monitoring
- Canada's North – Exploring the Environmental, Societal & Economic Challenges Facing Canada's Northern Communities.
- Structural Design of Wastewater Treatment Plants
- Climate Change Adaptation for Masonry Standards (In progress)

CSA Research reports are freely available at: https://www.csagroup.org/standards/standards-research/

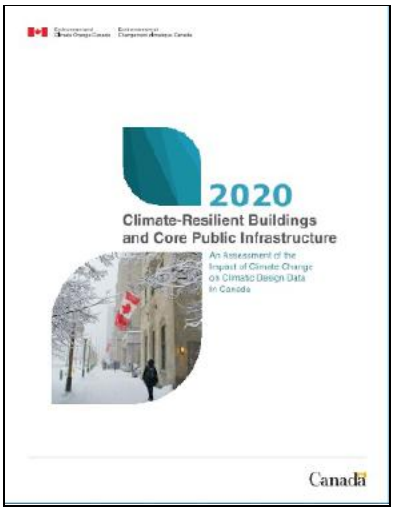
ULC Standards

ULC Standards has revised the following standards as part of the Climate-Resilient Buildings and Core Public Infrastructure Initiative *(except as noted*)*:

- CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials
- CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- CAN/ULC-S102.2, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies
- CAN/ULC-S107, Standard Methods of Fire Tests of Roof Coverings

- CAN/ULC-S134, Standard Method of Fire Test of Exterior Wall Assemblies
- CAN/ULC-S601, Standard for Shop Fabricated Steel Aboveground Tanks for Flammable and Combustible Liquids
- CAN/ULC-S602, Standard for Aboveground Steel Tanks for Fuel Oil and Lubricating Oil
- CAN/ULC-S603, Standard for Steel Underground Tanks for Flammable and Combustible Liquids
- CAN/ULC-S603.1, External Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids
- CAN/ULC-S652, Standard for Tank Assemblies for the Collection, Storage and Removal of Used Oil
- CAN/ULC-S653, Standard for Aboveground Horizontal Steel Contained Tank Assemblies for Flammable and Combustible Liquids
- CAN/ULC-S655, Standard for Aboveground Protected Tank Assemblies for Flammable and Combustible Liquids
- CAN/ULC-S656, Standard for Oil-Water Separators
- CAN/ULC-S668, Standard for Liners Used for Secondary Containment of Aboveground Flammable and Combustible Liquid Tanks
- CAN/ULC-S670, Standard for Aboveground Nonmetallic Tanks for Fuel Oil and Other Combustible Liquids
- CAN/ULC-S677, Standard for Fire Tested Aboveground Tank Assemblies for Flammable and Combustible Liquids
- CAN/ULC-S675.1, Standard for Volumetric Leak Detection Devices for Underground and Aboveground Storage Tanks for Flammable and Combustible Liquids
- CAN/ULC-S675.2, Standard for Nonvolumetric Precision Leak Detection Devices for Underground and Aboveground Storage Tanks and Piping for Flammable and Combustible Liquids
- ANSI/CAN/UL/ULC 180, Standard for Combustible Liquid Tank Accessories
- ANSI/CAN/UL/ULC 1316, Standard for Fibre Reinforced Underground Tanks for Flammable and Combustible Liquids
- ANSI/CAN/UL/ULC 2258, Standard for Aboveground Nonmetallic Tanks for Fuel Oil and Other Combustible Liquids
- CAN/ULC-S716.1, Standard for Exterior Insulation and Finish Systems (EIFS) - Materials and Systems
- CAN/ULC-S716.3, Standard for Exterior Insulation and Finish Systems (EIFS) - Design Application
- ANSI/CAN/UL/ULC 1201, Standard for Sensor Operated Backwater Prevention Systems
- CAN/ULC-S716.2, Standard for Exterior Insulation and Finish Systems (EIFS) – Installation of EIFS Components and Water Resistive Barrier *(*revised by ULC outside of the Climate-Resilient Buildings and Core Public Infrastructure Initiative)*

Climatic Data and Loads



One of the most exciting initiatives undertaken by the Climate-Resilient Buildings and Core Public Infrastructure was an assessment of the impact of climate change on climatic design data in Canada.

The research, conducted by Environment and Climate Change Canada, Pacific Climate Impacts Consortium, and RWDI, developed future-looking climate data, including temperature, precipitation and wind data, based on over 660 locations across Canada to be used by building and infrastructure codes and standards. This data will be implemented in the 2025 Canadian Highway Bridge Design Code (CHBDC), and will be submitted for consideration by the committees of National Building Code (NBC) in the 2025 Code cycle.

The full research report can be found here:
https://climate-scenarios.canada.ca/?page=buildings-report-overview&

For building designers, climatic loads are found in Appendix C of the National Building Code. These loads are compiled by Environment and Climate Change Canada and the Meteorological Service of Canada and reviewed by a Joint Task Group which includes members of several of the Standing Committees. The climate loads listed are historical data, and may not be representative of the loads that could be experienced in the future.

The report includes links to excel spreadsheets that estimate the impact of climate change under various scenarios. It includes commentary on the type of climate models that were run, and the confidence levels – from very high low to very low – and the assessed likelihoods – from virtually certain to exceptionally unlikely – for each probability.

The scope of this report – which is over 100 pages long, not including the climate change projection spreadsheets, which are accessed through hyperlinks – is too complex to discuss in this introductory seminar. Some of the data is presented in percentage changes rather than numerical values. However, to demonstrate the probable impact of climate change on Winnipeg, one of the authors of this seminar reviewed the spreadsheets and worked through calculations.

Tables

First, looking at future temperature fluctuations

Scenario	Year this scenario may be reached	Design Temperatures, deg-C				Degree days below 18C (HDD)
		January		July		
		2.5% ℃	1% ℃	Dry ℃	Wet ℃	
NBC 2010		-33	-35	30	23	5670
NBC 2015		-33	-35	30	23	5670
+0.5 C	2020	-31	-32.8	31.3	24.0	5394
+1.0 C	2035	-29.6	-31.5	31.9	24.5	5182
+1.5 C	2048	-28.4	-30.2	32.7	25.1	4940
+2.0 C	2059	-27.2	-29.0	33.4	25.6	4718
+2.5 C	2069	-25.2	-27.0	34.1	26.2	4483
+3.0 C	2080	-23.6	-25.3	34.5	26.5	4302
+3.5 C	2091	-21.7	-23.5	35	26.9	4108

Secondly, a look at rain events

Scenario	Year this scenario may be reached	15-minute rain, mm	One day rain, 1/50 occurrence, mm	Annual rain, mm	Annual total Precipitation, mm
NBC 2010		28	108	415	500
NBC 2015		28	108	415	500
+0.5C	2020	29.8	115	424	507
+1.0C	2035	31.3	121	442	521
+1.5C	2048	32.9	127	457	534
+2.0C	2059	34.3	132	474	547
+2.5C	2069	36.0	139	489	557
+3.0C	2080	37.4	144	508	572
+3.5C	2091	38.8	150	526	585

Next, a look at wind events

Scenario	Year this scenario may be reached	Driving Rain Wind Pressure, Pa	Hourly Wind Pressures, Pa	
			1/10 return	1/50 return
NBC 2010		180	0.35	0.45
NBC 2015		180	0.35	0.45
+0.5C	2020	185	0.353	0.458
+1.0C	2035	190	0.356	0.464
+1.5C	2048	200	0.358	0.469
+2.0C	2059	201	0.356	0.466
+2.5C	2069	202	0.360	0.476
+3.0C	2080	202	0.363	0.480
+3.5C	2091	204	0.365	0.487

And lastly, a look at ground snow loads

Scenario	Year in which this scenario may be reached	Snow Load, kPa, 1/50 return	
		Ss	Sr
NBC 2010		1.9	0.2
NBC 2015		1.9	0.2
+0.5C	2020	1.80	0.2
+1.0C	2035	1.76	0.21
+1.5C	2048	1.70	0.21
+2.0C	2059	1.60	0.2
+2.5C	2069	1.50	0.19
+3.0C	2080	1.41	0.18
+3.5C	2091	1.32	0.17

Current Practices & Upcoming Changes (Transportation)

Current Practices

- Acts:
  - Highway Traffic Act
- Regulations:
  - No specific regulations outside of the Highway Traffic Act
- Codes:
  - No specific codes exist for roads (not part of any building codes)
  - Bridges are either
    - AASHTO LRFD Bridge Design Specifications
    - Canadian Highway Bridge Design Codes
- Standards:
  - Provide guidance for transportation agencies
- Best Practices:
  - Guide the industry as a whole and are typically followed but not recorded

Upcoming Changes

- Standards:
  - Public agencies are shifting towards more sustainable materials and specifications
    - Greener concrete, asphalt, specification alignment, etc.
- Regulations:
  - Federal carbon changes may affect how infrastructure regulations are developed

Agencies providing standards/guidance on test methods

- Canadian Standards Group (CSA)
- American Association of State Highway and Transportation Officials (AASHTO)
- ASTM International (formerly American Society for Testing and Materials)

Geometric Design Guide for Canadian Roads - Transportation Association of Canada (TAC)

- Provides guidance on roadway design standards
- Agencies free to adapt based on geographic location and specific applications (ex: Manitoba Infrastructure “Blue Sheets”)

AASHTO LRFD Bridge Design vs. Canadian Highway Bridge Design Code (CSA S6:19)

- Provides guidance on roadway design standards
- Uses a global or Load and Resistance Factor Design Methodology
- Agencies are free to make changes to the standards based on geographic location and specific applications (ex: Manitoba Infrastructure “Blue Sheets”

Manual of Uniform Traffic Control Devices for Canada

- Provides guidance on roadway traffic control devices (signs, delineation, etc.)

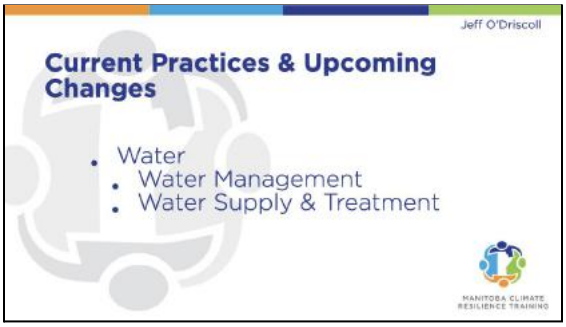
Challenges:

- Regulatory bodies are reluctant to change
    - Need a ‘top – down’ approach
- Industry is semi-reluctant to change
    - Cost – benefit analyses need to be performed
- Climate change and resilience is a long-term goal
    - Short-term benefits?
    - Initial investments?
    - Non-renewable materials are becoming harder to source

Opportunities:

- Infrastructure is vital to our supply chain (COVID-19 has reinforced this)
- Many industry groups are looking at changes to become ‘greener’
    - Regulatory agencies need to adapt
- Many working groups are being formed (even locally) to discuss climate change and greener processes / materials
    - Concrete, Asphalt, Recycled Materials, etc.

Current Practices & Upcoming Changes (Water)



Current Practices - Water Management

- Regulations
    - Many related to resource management.
    - Do not provide specific guidance on Climate Change
- Codes
    - Not codified area of Infrastructure
- Standards
    - New Standards on Flood Resilient Design of Communities and IDF Curves
- Best Practices
    - Most CC guidance through best practices
    - CWRA, CWWA, Dam Safety Association, Intact Centre, etc.

Current Practices - Water Supply and Treatment

- Regulations
    - Safe Drinking Water Act, Environment Act
    - Do not provide specific guidance on Climate Change
- Codes
    - Building Code, Plumbing Code, Energy Code, etc.
- Standards
    - Flood Resilient Design of Communities and IDF Curves
    - AWWA, CSA, NSF
- Best Practices
    - Most CC guidance through best practices
    - CWWA, Intact Centre, etc.

Standards

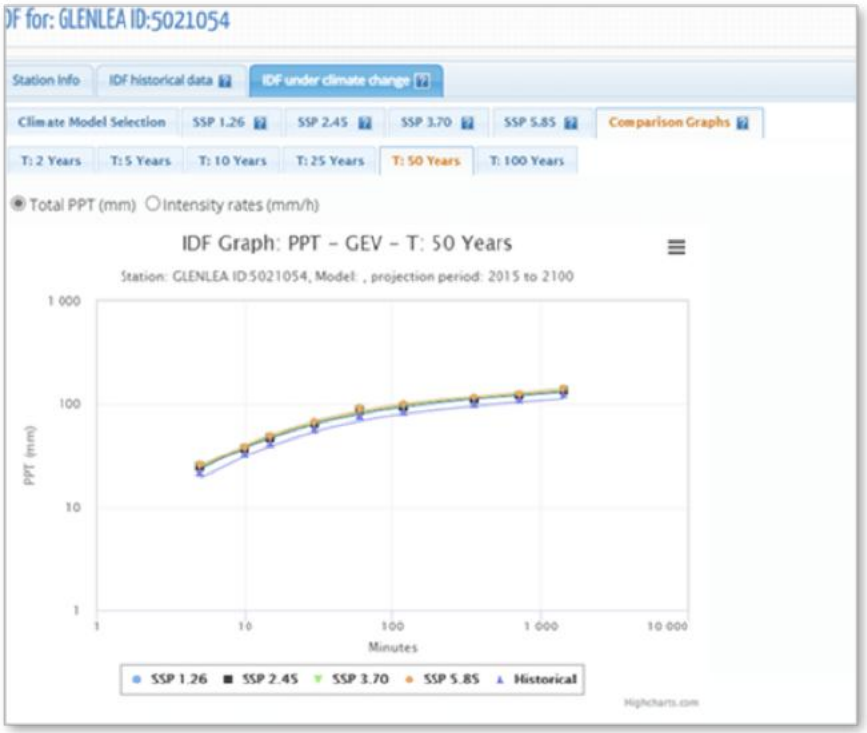
Canadian Standards Association

- **CSA W204:19** Flood Resilient Design of new Residential Communities
- **CSA W210** Prioritization of Flood Resilience Work in Existing Residential Communities (Publication Pending)
- **CSA W211** Management Standard for Stormwater Systems (Publication Pending)
- **CSA PLUS 4013:19** Development, interpretation and use of rainfall intensity-duration-frequency (IDF) information

- **CSA W200-18** Design of Bioretention Systems
- **CSA W201-18** Construction of Bioretention systems
- **CSA S900.1:18** Climate change adaptation for wastewater treatment plants
- **CSA W203:19** Planning, design, operation, and maintenance of wastewater treatment in northern communities using lagoon and wetland systems

Best Practices

- Standards Council of Canada
    - Guide for Integrating Climate Change Adaptation Considerations into Canadian Standards
- Ouranos
    - Standardization guidance for weather data, climate information and climate change projections
- Engineers Canada
    - Developing a Stormwater Quality Management Standard considering a Changing Climate
- Intact Centre for Climate Adaptation
    - Developing Canadian Standard for New Flood Resilient Residential Communities and Existing Communities
- Intensity-Duration-Frequency (IDF) Tools
    - IDF-CC Tool 5.0- Western University, Institute for Catastrophic Loss Reduction and Facility for Intelligent Decision Support
    - CSA PLUS 4013:19 Development, interpretation and use of rainfall intensity-duration-frequency (IDF) information



- Flood Hazard Mapping
    - Critical for understanding risk and guiding future development
    - Strong push to produce flood hazard maps for communities
    - Inventory of methods for estimating climate change-informed design water levels for floodplain mapping (NRC, March 2019)
- Dam Safety
    - Ouranos
    - Flood Frequency Analysis and Dam Safety in the 21st Century Climate
    - Developed two flood frequency methods for incorporating climate change into flood frequency analysis
    - Probable Maximum Floods and Dam Safety in the 21st Century Climate (2021)
- Water Management Hydrology
    - Climate Adaptation though ‘Brute Force’
    - Increase design threshold (e.g. 1:100 to 1:200)
    - Heavy analysis or no regrets action (more resilience – 10% safety factor – rule of thumb).
    - Act and then prove later and tweak
- Water Supply and Treatment
    - Incorporate Climate Risk Assessment in Operation, Planning and Design

Current Practices & Upcoming Changes (Buildings)

Current Practices

- Codes
  - CCBFC and Code adoption
- Regulations
  - MBC does not provide specific guidance on Climate Change
- Standards
  - Updates for the Construction Codes
- Upcoming Changes
  - Current and future Codes

CCBFC and the 2020 Codes

- To be published in February 2022
- Will introduce Tiered Energy Codes for Housing and Buildings
  - National Energy Code for Buildings
  - NBC Section 9.36 Energy Efficiency in Houses and Small Buildings
- In 2023/2024 there will be a further update of standards published as an Errata.

Province of MB and 2020 Codes

- Adoption /Harmonization of Codes
- No Regulations for Climate Change or Resiliency
  - Building and Mobile Homes Act
  - Climate and Green Plan Act
  - Energy Act

“In flux” is the name of the game

- Highlights for future Codes in Energy Efficiency
- Bill 38
- Adoption of Construction Codes 2015/2017
- Enforcement and Compliance
- When things are in flux there is also opportunity for great change

- Codes are the minimum standard, nothing prevents anyone from going above
- Climate Data Changes