



**CANADIAN STANDARDS
ASSOCIATION**

The Role of Standards in Adapting Canada's Infrastructure to the Impacts of Climate Change

Prepared by the Canadian Standards Association

February 2006

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The Role of Standards in Adapting Canada's Infrastructure to the Impacts of Climate Change

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The authors wish to acknowledge the financial support of the Climate Change Impacts and Adaptations Directorate, Natural Resources Canada, and thank all those who provided comments and contributions to this report.

Cite document as:

Girard, M and Mortimer, M 2006. **The Role of Standards in Adapting Canada's Infrastructure to the Impacts of Climate Change**

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1 Preface

This report is intended to provoke further thought and dialogue amongst policy-makers and practitioners on the role that codes and standards play in moving climate change adaptation solutions into mainstream practice. It describes their relationship to the design and operation of infrastructure works, and their influence upon climate change adaptation issues. It also underscores the importance of outreach strategies aimed at standards organizations and, suggests practical tools for outreach implementation.

Although often invisible to the public, standards affect safety, performance, environment, economics and service levels – they have a profound impact on Canada's diverse range of infrastructure systems.

The issues are broad and complex, as are the range of strategies that are evolving for effective adaptation. Furthermore, no single organization or authority has jurisdiction for all categories of infrastructure or all regions.

The discussion focuses on climate-sensitive, built infrastructure, with a particular emphasis on the role of the Canadian Standards Association (CSA) in developing infrastructure standards. Various elements and perspectives are used to describe the issues related to climate change impacts and how these affect Canada's infrastructure systems. Each section of the report is written as a somewhat self-contained area of discussion.

This report was prepared by the Canadian Standards Association (CSA), an independent, non-government, and not-for-profit organization with financial support from the Impacts and Adaptation Directorate, Natural Resources Canada (NRCan).

NRCan's Impacts and Adaptation Directorate has an important role in policy development and the prioritization of impacts and adaptation issues. This directorate is helping a growing number of stakeholders identify appropriate paths for adaptation in their respective fields. The Directorate co-ordinates the development of the National Climate Change Adaptation Framework and is an essential catalyst for research and knowledge sharing.

CSA has a long history of involvement in Canada's infrastructure and its built environment. As the largest standards developer in Canada, CSA manages more than 2,600 national standards and a broad range of subjects related to infrastructure including:

- Electrical transmission;
- Oil and gas transmission;
- Appliance installation codes;

- Energy production, such as offshore structures and nuclear power plants;
- Plumbing, drinking water, and wastewater systems and components;
- Building envelope science, mechanical and electrical systems;
- Transportation and communication structures, such as bridges and towers;
- Construction equipment, processes and materials;
- Design and testing of materials and systems;
- Occupational health and safety.

CSA, Infrastructure and Climate Change impacts

Within CSA's network of 9,000 members, there are 1,800 experts working on 83 individual technical committees. They deliver and maintain more than 260 existing publications that are directly related to infrastructure systems as well as adaptations and impact issues.

Approximately half of these CSA standards (48%), are aimed at commercial buildings and residential housing. The other half is comprised of standards covering Water (20%), Energy (17%), Transportation (11%), Occupational health and safety (2%), Communications (1%) and Culture, Recreation & Tourism works (1%).

This report focuses on CSA's existing publications, technical committees and member network, from the perspective of climate change impacts and adaptations issues. A wide range of physical loads and environmental phenomena that affect infrastructure systems were considered. Many of these issues affect several categories of infrastructure at once.

In the process of compiling this report, a number of questions came to the forefront. The complete list of these questions can be found in Appendix H.

This report is intended to:

- Contribute to the development of a pragmatic vision for the role of Canada's national standards network in the enhancement of adaptation capacity and prioritization of adaptation actions.
- Help familiarize policy-makers and decision-makers on the role of Canada's national standards network, and influence toward building adaptive capacity.
- Illustrate the importance of developing outreach strategies for key stakeholders within Canada's national standards network.
- Describe how and where codes and standards networks can be deployed and mobilized to address infrastructure adaptation issues.

Organization of the report

The report begins with a description of the categories of infrastructure and their lifecycle phases. An explanation of why these definitions are important is provided as well. This is followed by a discussion of Canada's network of infrastructure codes and standards, as well as the role of CSA within that network. This serves to illustrate the scope and breadth of issues that are influenced by standards.

Standards are often referenced by regulators and infrastructure owner/operators, particularly on issues such as safety and performance. A basic understanding of how regulators use and reference standards helps to round out the picture of how and where standards influence the climate change impacts and adaptations file.

Next, a non-technical overview is provided of the man-made and natural phenomena that act on infrastructure systems. Extreme weather events and incidents of chronic infrastructure deterioration are used to illustrate the challenges that infrastructure systems designers and operators are faced with.

A simple outreach and engagement tool for use within the standards community is presented. To illustrate how the tool could be deployed, the results of a scaled-down pilot trial are discussed.

Finally, the various findings are summarized. These could help to lay the groundwork for a coordinated national codes and standards strategy for accelerating progress towards enhanced adaptation of Canada's infrastructure to the impacts of Climate Change.

2 Infrastructure Categories and Lifecycles

Definition

Physical infrastructure is defined as the underlying foundation upon which the maintenance and growth of a community depends. It includes all core physical works (including the physical assets themselves and all associated fixed machinery and equipment) needed to supply the goods, services, facilities and institutions that are expected to be broadly accessible to citizens in a modern society.¹

Infrastructure Design Life and Infrastructure Lifecycle Phases

Adaptation and mitigation actions need to account for the variable lifecycles and service life of infrastructure¹⁵ (Auld, 2005). Lifecycle considerations are important to infrastructure planners, designers, owners and operators.

Generic Lifecycle Phases for Infrastructure Systems

The generic lifecycle phases shown here are applicable to most infrastructure categories. They are as follows:

1. Design/build
2. Operations, maintenance, routine repair
3. Major overhaul, retrofit, upgrade, additions and alterations
4. De-commissioning, demolition or divestiture
5. Transformation (i.e., change of use)

Factoring in Lifecycle Considerations

The timeframe for infrastructure design life varies by infrastructure category, and usually spans many decades. Furthermore, designers are constrained by finite resources, and must make prudent tradeoffs between initial capital cost and operating cost without compromising safety. Therefore, provisions made during the initial design phase will either make it easier or more difficult to capitalize on future opportunities to improve the resilience of infrastructure. For example, new technology or practices not available at the time of original design can be incorporated into existing infrastructure during a major overhaul or retrofit.

Table 1 shows typical service life timeframes and examples of significant lifecycle events for various infrastructure categories. Again, certain lifecycle events provide an opportunity to increase an infrastructure's adaptation capacity and resilience. Consideration of such events in early phases of design and build will help to improve resilience.

Table 1. Examples of typical infrastructure service life timeframes

STRUCTURE	PHASE	TYPICAL EXPECTED LIFECYCLE
Commercial Buildings	Retrofit Demolition	20 years 50-100 years
Housing	Additions and Alterations Demolition	15-20 years 60-100 years
Roads	Maintenance Resurface Reconstruction/Major Upgrade	Yearly 5-10 years 20-30 years
Bridges	Maintenance Resurface concrete Reconstruction/Major Upgrade	Yearly 20-25 years 60-100 years
Rail	Major refurbishment Reconstruction/Major Upgrade	10-20 years 50-100 years
Airports	Major refurbishment Reconstruction/Major Upgrade	10-20 years 50 years
Seaports	Major refurbishment Reconstruction/Major Upgrade	10-20 years 50-100 years
Dams/Water Supply	Major refurbishment Reconstruction/Major Upgrade	20-30 years 50 years
Waste Management	Upgrade Major Refurbishment	5-10 years 20-30 years
Sewers	Reconstruction/Major Upgrade	50 years

This table was re-printed courtesy of Environment Canada, Adaptations and Impacts Research Group, "Cities and Communities: The Changing Climate and Increasing Vulnerability of Infrastructure", Occasional paper #3, by Heather Auld and Don MacIver, January 2005. Page 16. (Original table was adapted from the Planning Institute of Australia, 2004).

Provisions made at early design phases can also help to enhance capability for dealing with future uncertainties. For example, actual future usage patterns, demographics, demand, and extreme climate thresholds may be far different than what was assumed at the time of design. There are existing practices that when employed, help to ensure that there is future opportunity to respond to changes in critical load thresholds. This also makes it easier to incorporate innovative technology and practice into existing infrastructure systems. Examples of such provisions that could be employed by infrastructure designers, owners and operators are:

- Scalability;
- Modular construction;
- Strategic planning for de-construction/de-commissioning;

- Plans for strategically phased obsolescence/replacement of critical sections or components.

Another reason for understanding and considering lifecycle is that it helps to fully scope the range of external loads and forces that need to be considered. An understanding of the uncertainties associated with external loads and forces helps to reduce the risk of premature deterioration and/or catastrophic failure.

The relative importance of various loads and factors change as an infrastructure asset moves through its service life. Some examples of the variables that must be considered to reduce the risk of premature deterioration are:

- Sub-standard construction or out-of-specification practices;
- Probability of insufficient or substandard routine maintenance, or maintenance that is deferred altogether;
- Operation for extended periods beyond the intended design capacity;
- Changing critical climate thresholds (i.e., actual critical thresholds that are much higher than those assumed at the time of design).

Ownership Costs and Demand Planning

Lifecycle considerations also have an impact on total cost of ownership, as well as on demand planning. For example, a focus on initial capital cost without consideration of maintenance issues could increase the overall cost of ownership and operation. From the perspective of demand, a capacity forecast that is too low or too high will have implications for the level of service attained from the system, as well as its useful service life. Again, specific lifecycle events can provide ‘windows of opportunity’ for adapting infrastructure to new demand profiles and/or increased or reduced external loads, due to climatic, or other physical phenomena.

For a more detailed description of each lifecycle phase, see Appendix A.

Infrastructure System Categories²

To support the infrastructure definition, eight categories were established to further elaborate on the definition shown above:

1. Transportation
2. Water
3. Energy
4. Communications
5. Solid Waste Management
6. Buildings
7. Culture, Recreation and Tourism Facilities
8. Other

Note: *Appendix A includes a more detailed description of each category*

3 An Overview of Canada's National Standards System and the Role of the Canadian Standards Association

Standards are used and referenced extensively throughout an infrastructure system's lifecycle from the design phase through to operation, maintenance and disposal. They cover a wide range of areas and topics related to policies, products, services, systems, processes, practices, principles, philosophies and strategies. They address a range of issues such as safety, environment, health, technology, performance, and trade.

Depending on their intended application, standards are structured using a combination of mandatory language and permissive language. For example, mandatory language is used to facilitate referencing in laws or contracts. Permissive or explanatory language is used to describe principles, concepts and practices.

Many national and international standards organizations encourage the use of performance-based approaches provided that there are practical methods to verify achievement of the stipulated performance. This is augmented with prescriptive guidance based on practical experience.

In the context of the national Canada's standard network, standards are often developed by organizations using committees of experts and employing processes that include a means for reaching consensus, balancing the interests of stakeholders, and ensuring that the process is transparent and accessible.

The Global and National Standards Network

The global and national standards network includes organizations that are formally accredited to develop standards as well as numerous other organizations that develop standards, but that are not formally accredited by national or international standards accrediting bodies. Typical applications and uses within infrastructure systems are described in the sections that follow.

- **Canada's National Standards System**

Canada's National Standards System (NSS) includes Standards Development Organizations (SDOs), and linkages to other international standards development organizations such as ISO, the International Organization for Standardization and IEC, the International Electrotechnical Commission. In addition to Canada's four accredited standards developers, more than 400 organizations have been accredited by the Standards Council of Canada to provide conformity assessments, accreditation, testing and calibration, audits and training services that support the implementation of standards.

- **Canada’s Accredited Standards Development Organizations (SDOs)**

In Canada, there are four accredited standards development organizations (Canadian Standards Association, Bureau de Normalisation du Québec, Underwriter’s Laboratories of Canada and the Canadian General Standards Board.) The Standards Council of Canada (SCC), a federal Crown Corporation reporting to the federal Minister of Industry, oversees the National Standards System.

The standards developed within Canada’s National Standards System must meet specific criteria. CSA’s accredited standards development process is summarized as an example.

CSA’s Accredited Standards Development Process:

Volunteer experts from all sectors of society, including business, industry, labour, government, environmental and consumer groups develop CSA standards. Subject-specific technical committees work with the guidance of a CSA project manager. The subject experts develop the technical content and the CSA manager guides and facilitates the process. The public is given an opportunity to comment on content.

Formal approval of content follows numerical requirements for consensus. Minority reports must be reviewed as well, and there is a specific process for addressing dissenting opinions in an inclusive manner since simple majority votes are not sufficient for approval.

CSA indemnifies its volunteer experts, provided that the development process and rules governing CSA standards are adhered to. Content of CSA standards must comply with relevant national and international treaties and laws related to safety, environment, competition, trade and culture.

Balanced representation or a ‘matrix’ of interest categories is established for each committee and must meet specific numerical requirements. Examples of typical interest categories for a technical committee include producers, owner/operators, regulators, consumers, consultants and academics. Further considerations include the balance between government, industry, not-for-profit organizations, and NGOs, as well as geographic representation.

Finally, all standards must be reviewed on a regular basis and the responsible technical committee must approve updates or withdrawals so as to ensure that standards remain relevant and useful.

In summary CSA’s consensus process and standards include these key elements:

- They are accessible to all stakeholders;
- Have committee members that are volunteers – experts within their field;
- Have balanced representation from all interest groups;
- Specific numerical requirements for formal approval of content;
- Provide opportunity for the public to comment;
- Require a mandatory review of every consensus standard every five years (minimum);

- Indemnify CSA volunteer contributors (members/subject experts) provided that they adhere to the process and associated rules;
- Reach consensus on content by a common process, regardless of technical committee or topic;
- Develop CSA standards that comply with relevant treaties and laws related to safety, environment, competition, trade and culture.

For a more detailed description CSA's requirements for balanced representation and participation, see Appendix G.

Findings

Standards are one of a range of policy instruments within the climate change adaptation toolkit.

Windows of opportunity for enhanced adaptation and capacity building are created as standards are reviewed and updated. This enables new research to be incorporated into mainstream practice on a regular basis.

Non-accredited Standards Developers

Many non-accredited organizations develop standards as well, and these organizations play an important role within infrastructure systems. While these organizations do not adhere to all requirements to be accredited under the National Standards System, they are an integral part of global and national standards networks and are highly valued by designers and system operators.

Other Standards Applicable to Infrastructure

There are numerous examples of documents that are not accredited by the Standards Council of Canada and nonetheless developed by both government, independents and industry-based organizations. Although they sometimes cannot be directly referenced in legislation/regulation, they are often included as conditions within contracts. For example, the Ontario Provincial Standards for Roads and Public Works (OPS), owned jointly by the Ontario Ministry of Transportation (MTO) and the Municipal Engineers Association (MEA), develops such standards. For a more detailed discussion on this, refer to Appendix J.

International and American Standards Applicable to Canadian Infrastructure Systems

A significant number of standards that have an impact on Canada's infrastructure originate from the United States and from the International Standardization Organization (ISO). In 2003, out of 267 new standards that were incorporated into the National Standards System, more than 70% were either adopted directly or adapted from international standards.

In situations where international standards are used for the design of weather-sensitive infrastructure (e.g., roads and water networks), care must be taken to ensure that they are reviewed by Canadian Stakeholders and adapted to Canadian climatic conditions. This is essential in light of Canada's changing climate.

The American National Standards Institute (ANSI) is the accrediting organization in the U.S. for American Standards developers and plays a similar role to the Standards Council of Canada. However, in contrast to Canada and European countries where there are only a few, or in some cases, a single accredited national standards development organization, there are more than 1,000 accredited standards development organizations in the United States. Requirements for accreditation of U.S.-based standards development organizations often differ significantly from Canadian requirements and furthermore, not all U.S.-based SDOs meet the requirements of international organizations such as ISO.

For example, requirements for balanced representation are often interpreted differently in different foreign jurisdictions, and in the case of the U.S., there is a broad range of interpretation around what constitutes balanced representation. This sometimes skews the balance between interest categories, particularly in the case of ANSI-accredited standards developers that are operated by industry associations, or professional societies, who often co-exist as accredited standards developers alongside independent, neutral, third-party organizations.

This often raises interesting and challenging policy issues for Canadian regulatory authorities, particularly from the standpoint of how best to adapt or adopt standards from such organizations for local use.

Appendix F provides an overview of the basic requirements that are outlined by ISO and how these are incorporated by CSA.

Adapting International Standards for Use in Canada

In situations where non-Canadian standards are used and referenced by infrastructure system regulators, designers and operators, unique Canadian needs related to natural phenomena, as well as Canada's safety and environmental requirements must be addressed. Canadian accredited SDOs as well as non-accredited standards organizations will often review and adapt international standards for use in Canada.

As an illustrative example of how extensively international standards are used, a listing of some of the notable U.S.-based, international and Canadian standards development organizations involved with road infrastructure are included within Table 8 of Appendix J.

4 An Overview of Climate, Loads and Infrastructure Systems

4.1 Exploration of climate phenomena, loads and other external impacts on physical infrastructure

Objective

The objective was to explore different ways of looking at inter-related issues to illustrate and describe:

- The role that CSA standards and committees have in various aspects of the infrastructure/adaptation file, including some insight into how CSA standards and committees influence or respond to such issues.
- Insights on how extreme weather events serve to improve the general understanding of climate phenomena that affect infrastructure. This includes an overview of the role of forensic investigations in improving overall knowledge.
- Opportunities for outreach efforts to policy or decision-makers, as well as CSA stakeholders.
- The multiple and complex cause-effect impacts, loads and stresses acting on infrastructure systems.

A review was conducted of anecdotal literature related to recent instances of extreme weather events and chronic conditions affecting infrastructure. This was augmented with a second alternative approach whereby infrastructure was viewed as a series of systems impacted by a wide variety of inter-related external factors including weather and other loads. A mapping of these external factors to various categories of infrastructure systems was attempted through the use of a prototype methodology, scaled down for a pilot test that was also conducted. A summary of the findings in both cases is included below.

Approach No.1

Review of examples of extreme weather events, chronic infrastructure conditions and responses to them

Overview

The impact of climate change, specifically of global warming, on Canadian infrastructure is widespread and varies by geographical location and make up. In Canada, the most vulnerable areas are those located on permafrost or on the coast.³

Urban areas are affected by changing climate as well. For example, cities, with their concentration of hard, impermeable surfaces, are sensitive to high intensity rainfalls. Flooding

will result when the capacity of stormwater systems is exceeded. While a changing climate may be a contributing factor to such situations, greater population densities, and siting considerations also contribute to the adverse impacts of recent severe weather events.

More than half of Canada’s GDP is sensitive to climate and extreme weather events.⁴ Weather-related disaster costs have increased five-fold between 1990 and 2003, at a cost of \$2.5 billion a year⁴. The maritime regions experienced ‘one in a hundred year’ events three years in a row, and Edmonton had two such events in two weeks.⁴

Five situations that were encountered during the literature review are listed within Table 2 below:

Table 2. Examples of extreme weather loads and chronic infrastructure conditions

Consequences of extreme weather events	Affected Infrastructure Systems
1. More frequent and more severe freezing and thawing cycles.	Transportation, Water, Buildings, Energy
2. Melting permafrost in the North	Buildings, Transportation
3. Wind damage	Buildings, Energy, Transportation
4. Extreme rain fall, flooding and ice storms.	Buildings, Water, Transportation, Energy
5. Coastal erosion	Transportation, Buildings, Water Energy

Analysis and comments

- Weather is one of a complex and interrelated range of load combinations and factors.
- Analysis is exacerbated by a combination of factors such as actual versus designed weather loads, out-of-specification or improperly specified design, as-built implementation versus intended design, and frequency of operation at the limit or over the limit of a system’s intended capacity.
- Issues are often cross-cutting, with multiple jurisdictions and stakeholders involved, sometimes making it difficult to reach consensus on where to invest and how to mobilize resources in the most beneficial manner.
- Premature deterioration will have an adverse impact on structural integrity, and has implications for maintenance schedules.

Findings

The cross-functional, multi-disciplinary nature of the CSA technical committee system makes it an effective forum for tackling complex issues such as those associated with the climate change adaptation/infrastructure file.

A formal survey of relevant CSA committees may be useful in determining to what extent CSA members are aware of key climate change adaptation issues, and the extent to which they can influence, impede or enhance adaptation strategies.

A more complete summary of the literature review is included within Appendix E. As much as possible, footnotes with references are included.

Approach No. 2

Mapping of impacts and load phenomena to infrastructure systems

Overview

Identifying tools and methodologies for decision-makers as well as developing a basic national adaptation toolkit is one of the recommendations by the Intergovernmental Climate Change Impacts and Adaptation Working Group (ICCIAWG) ¹⁶

Although a thorough exploration of possible tools and methodologies is beyond the scope of this report, it is apparent that it would be helpful to find or develop simple, easy-to-use, qualitative analysis tools.

Methodology

A working group made up of six CSA staff was drawn from departments associated with different infrastructure categories. The group consisted of one CSA staffer from the Electrotechnical program, two from the Energy & Utilities Program and three from the Buildings and Structures Program.

This working group carried out four tasks in an effort to develop a prototype method/tool intended for use by stakeholders engaged in analysis, priority setting, and outreach. The tasks were:

- Developing a list of external forces and phenomena impacting on infrastructure. The various attributes and physical characteristics listed were taken from literature reviews, as well as from the professional experiences of each group member.
- A commonly used matrix technique was adapted to create a pictorial decision-support diagram. (There are any variants of this type of a representation, commonly employed in fields such as management science, the quality movement, and operations research.)
- This prototype 'tool' was pilot-tested and a sample dataset was generated.

- A roundtable discussion on the usefulness of the tool and approach followed the pilot test and a scenario for use emerged (Refer to Exhibits 1 and 2 in the ‘Exhibits’ section of this document).

Analysis and Comments

Seven categories of external forces and phenomena acting on infrastructure systems were developed. Approximately 50 attributes, individual or in combination, were identified. These are listed within Appendix E.

After several iterations, the working group came to a consensus on the format for a two-dimensional matrix. A rating criterion with a simplified four-point rating scale was also employed. In a ‘real-world’ setting that would use experienced subject matter experts, a 10-point gradient would typically be used rather than the four-point gradient employed in the prototype. Nine items from the list of 50 attributes were selected and a table was constructed for the pilot test.

Four members of the working group participated in the pilot test and a hypothetical dataset consisting of 54 nodes was generated for discussion purposes.

There was also a discussion on what facilitation techniques would be required and what situations could be set up so as to engage ‘real world’ stakeholder groups in a scaled up version of the prototype exercise.

It was envisaged that CSA committees and volunteer expert members could be asked to select combinations of attributes to analyze and debate, and that such workshop-based, qualitative discussions could be used to further engage these stakeholders in climate change adaptation issues, as well as to establish meaningful patterns, priorities and trade-offs.

Findings

The test-group believes that there would be merit in finding a means to promote climate change impact issues to CSA members directly responsible for certain infrastructure standards (committees and standards are documented in Appendix B and Appendix K respectively). It was felt that exercises or workshops similar to the pilot test conducted, would be an effective way of engaging these members and building awareness of adaptation issues. There could be merit in developing the prototype tool further.

Exhibit 1 presents a generic format that could be adapted to present results and findings to non-technical audiences. Exhibit 2 illustrates the results of a fictitious scenario that further demonstrates its potential application.

Possible uses of a more fully developed and scaled-up version of the tool might include:

- To present complex inter-relationships between engineering, socio-economic and environmental issues to non-technical decision makers or government policymakers.

- In conjunction with facilitation techniques, to adapt the methodology for use in analyzing the degree to which combinations of external forces affect infrastructure. This would accelerate the prioritization of adaptation/infrastructure issues and could point to areas for deeper exploration.
- It could also be used within outreach initiatives aimed at organizations such as CSA (via committee meetings, workshops, focus-groups or symposia), so as to engage highly technical subject-matter experts, who may have a widely varying degree of knowledge or interest in climate change impacts issues.

4.2 The relationship between climatic thresholds and the use of codes and standards by designers, agencies and regulatory authorities responsible for infrastructure

Weather Data

Mainstream infrastructure design establishes a prudent balance between capacity, resilience, cost, reliability and durability without compromising safety. Furthermore, many existing standards and codes rely heavily on statistical models based on historical weather data in order to establish infrastructure design parameters and thresholds. This is a fundamental building block of the current practice.

Normal mainstream practice assumes that past weather extremes will represent future weather conditions. Under changing climate and weather conditions, this assumption will no longer apply. The 1995 National Building Code of Canada included a section explaining the growing uncertainties that climatic design values will be subjected to under changing climate conditions.

However, the literature reviewed points to evidence that historical weather patterns may not be as relevant in the future as they were in the past. If weather data is indeed no longer as relevant as in past, then this has a profound impact on the capacity for structural infrastructure systems to adapt. Many leaders and practitioners within the structural and infrastructure design communities have been aware of this issue and related debates for many years. However, until a more fully developed toolkit exists and is proven, implementation of alternative mainstream responses will be minimal.

Up-to-date climatic design values are needed to reflect the latest state of the changing climate. This will help infrastructure designers and owners to take actions to avoid or mitigate premature deterioration, reduce the overall cost of ownership, and improve service levels. These are fundamental building blocks of adaptive capacity, and provide a means of avoiding adaptation deficits. While a changing climate is one possible driver for good design practice, it is not the only driver.

There are a range of tools techniques and design parameters that could incorporate considerations that go beyond currently established minimum safety thresholds. Examples include lifecycle economics, parameters for enhanced durability, performance-based standards and codes, along with test or verification methods that assure that specified performance parameters have been achieved.

Appendix C provides examples of the inter-relationship between CSA standards, regulations, climatic data and other references. It lays out the sources of information that infrastructure system designers and operators rely upon.

Finding

Direct dialogue between the climate community, the structural design and infrastructure systems, community and policy-makers is essential. This is particularly important in the case of buildings, structures such as bridges and towers, as well as electrical transmission networks.

Responsibility for Climatic Data

Until such time as a radically different approach to structural design emerges, high quality, reliable climatic data with sufficient geographic dispersion and density, will remain a key element of designing, building and operating resilient infrastructure systems. Presently, responsibility for the maintenance of climatic data resides primarily with the federal government.

Limitations in Climatic Data and the Importance of Local Knowledge

Climatic data information for Canada is primarily provided for specific locations. In some cases (CSA standards), climatic design fields are presented in map format. Experienced meteorologists and climatologists who translate the site-specific data analyze the basic climate data. It is collected using standard observing protocols and is interpolated for required locations and elevations, except where standards include mapped design values. For example, the environmental (climate) data within the National Building Code of Canada (NBCC) is given for representative towns and cities.

Uncertainties increase for the analysis and interpolation of climatic design information for more remote locations and higher elevation sites (e.g., parts of British Columbia.), where the basic climate data needed to drive the analysis is scarce. For example, climate data may not be available or representative of higher mountain sites or northern locations. Other uncertainties are introduced by poorer quality basic climate data and by short datasets that may not capture the true variability of the climate field.

Past fiscal constraints led to situations where climatic design values were not updated for many years or decades.

The federal government, through Environment Canada, provides a service that will give advice for locations that are not specifically listed in references such as the NBCC. Also, there is no single source database for identifying anomalies in local information. For instance, the City of

Hamilton has different environmental conditions due to the proximity of the Niagara Escarpment. City planners know this but non-local designers may not. Therefore, local knowledge and experience is often important.

Role of Research, Empirical Data, Statistical Analysis and Forensic Studies

Structural design relies heavily on both empirical research and complex statistical analysis in order to develop the mathematical models and equations that structural designers rely upon. Extensive empirical research, and thorough lab testing is augmented by complex computer modeling and analysis. Historical climatic data is used to establish the statistical profile for the ‘real world’ loads that are the basis for this research, testing, modeling and analysis. Reliable data documented in a consistent manner and over long time periods is essential to infrastructure system designers.

Extreme weather events sometimes result in infrastructure system failures and chain-reactions with catastrophic consequences. These usually include a combination of human injuries or fatalities, environmental damage, and economic loss. Many examples of recent extreme weather events were encountered during the literature review and are documented within Appendix E. Forensic studies are typically carried out as a result of such extreme events. These studies are helpful in establishing cause-effect relationships and patterns. Therefore, these forensic investigations are essential elements toward knowledge building and they contribute to the development of applied adaptation strategies.

Much of this research enters the mainstream of practice via CSA’s technical committees and the standards that they develop. Hence, a robust research and development community focused on the infrastructure/adaptation file and its proactive involvement with CSA technical committees will help to enhance adaptation.

Regulatory Authorities and Infrastructure Systems

Regulatory authorities vary by infrastructure category and region, and examples are provided in Appendix D which serves to illustrate the diversity and complexity of regulatory jurisdictions related to infrastructure systems.

Since safety and environment are of paramount importance in the practice of structural design, most structural design standards are used extensively by regulatory authorities and are often referenced in rules, regulations and/or legislation.

Impacts of various climatic characteristics and thresholds on Infrastructure systems

The examples listed below demonstrate how climatic characteristics impact various categories of an infrastructure system.

- **Climatic Thresholds for Electrical Transmission Systems**

Electrical transmission systems are affected if climatic thresholds dramatically change over time. Uncertainties in the climatic design information also affect the vulnerability of systems. Prime areas of concern for electrical transmission systems are changes to the statistical return periods for ice loading and wind.

Beyond the structural aspects of the systems themselves, major climatic shifts can have an impact as well on an electrical utility's economics and level of service to customers. For example, hotter, more humid summers put additional stress on distribution and transmission systems and individual components due to increased demand and electrical load shortening of their service life and/or increasing maintenance costs. Milder winters can affect a utility's cash flow due to reduced load, or a dramatically changing seasonal load profile. This is of particular concern in the province of Québec where electricity is still the predominant energy source for heating homes and buildings.

- **Design of Structures for Occupancy (buildings), Transportation and Energy Transmission Systems**

While most of the identified categories of infrastructure are impacted by weather phenomena and changing climatic thresholds, they are a particularly important consideration when designing buildings and structures for transportation and energy transmission systems. For example, this includes buildings for occupancy by people or equipment, transportation bridges, transmission towers for electricity and communications, as well as high capacity pipelines for oil and gas, and structures for large, industrial wind-energy turbines.

Designers must consider a wide array of physical and mechanical loads that relate to the intended use of infrastructure systems, works and networks, as well as natural phenomena such as seismic loads and a wide array of weather-related loads.

- **Design and Siting of Wind Energy Systems**

Large industrial wind energy systems are unique from other infrastructure systems in that they will experience extreme vibration and dynamic loading not experienced in other types of infrastructure. Furthermore, in cold climates such as Canada, there are unique conditions and hazards to consider.

At present in Canada, wind energy installations are mostly located in areas such as wind farms, where access by the public is restricted, and where there is little risk of human injury or property damage. However, in regions with warmer climates such as parts of Europe, sites that are closer to areas where the general public has access are more common. Should this become a common practice in Canada as well, regulations and codes would have to address these situations.

Findings

- Climate-related data that is critical to infrastructure system designers and operators. Particular attention should be focused on improving Canada’s observation network and improving their coordination across jurisdictions. This will help to address the need for up-to-date climatic design values.
- The regulatory, codes and standards landscape, and jurisdictional responsibilities are broad and complex. No comprehensive mapping of responsibilities and jurisdictions currently exists. Such a mapping for various infrastructure systems, on a region-by-region basis would serve as a valuable decision-support tool for policy-makers.

4.3 Profile of CSA Technical Committees involved in infrastructure

CSA technical committees and their publications related to climate change adaptation/infrastructure systems were extracted from CSA’s databases. Filtering and sorting criteria were established using the definitions and categories for infrastructure systems that were outlined earlier within this report. The dataset was further refined using the expert judgment of CSA staff.

CSA’s Standards are developed and maintained by CSA technical committees. Appendix B lists the CSA technical committees that are responsible for developing and maintaining standards and publications related to infrastructure.

83 different CSA technical committees were identified as having a role in the infrastructure/adaptations file. This includes approximately 1,800 of CSA’s estimated 9,000 members.

Table 3 identifies the breakdown of how these CSA technical committees map to infrastructure categories. Any instance where a technical committee’s work affects more than one infrastructure category is also shown.

Table 3.

Analysis of CSA's existing Infrastructure Standards related to Climate Change Adaptation

Table 3A: Overview

Infrastructure Category	# of Stds	
	Identified	% of Total
Buildings	136	49%
Water	56	20%
Energy	47	17%
Transportation	30	11%
Other	6	2%
Communications	2	1%
Culture, recreation and tourism	2	1%
	Total observations*	279 100%

* Note: stds in more than one category were counted more than once

Table 3B: Detailed

Infrastructure Category	# of Stds	
	Identified	% of Total
Standards related primarily to adaptation:		
Water systems (potable, waste, storm, fire protection)	56	21%
Buildings (less EE & HVAC)	36	14%
Energy (Electrical Transmission)	24	9%
Energy (Oil & Gas)	23	9%
Buildings and Transportation	18	7%
Transportation	12	5%
Occupational Health and Safety	6	2%
Communications	2	1%
Culture, Recreation & Tourism (Children's play structures)	2	1%
Standards related to both mitigation and adaptation:		
Buildings - HVAC Systems Stds	57	22%
Buildings - Energy Efficiency Stds	25	10%
	Total # of Standards	261 100%

4.4 Inventory of CSA codes and standards related to the impacts and adaptation/infrastructure systems file

Approximately 260 of CSA’s 2,600 publications are related to the infrastructure/impacts and adaptations file. These are reliant on climatic data in many forms. The results of the analysis are included in Table 4 (below) and a complete listing of all relevant CSA standards is shown in Appendix K.

Table 4A. Breakdown of CSA technical committees by Infrastructure Category (Total identified committees = 83)

% of identified Committees	Infrastructure Category
50 %	Buildings
22 %	Transportation
17%	Energy
9 %	Water
1 %	Communications
1 %	Culture, recreation and tourism
0 %	Other
0 %	Waste management

Table 4B. Incidence of identified CSA Technical Committees that have an influence in more than one Infrastructure category

% of identified committees	Incidence of committees affecting multiple infrastructure categories
70 %	One category only
23 %	Two categories
8 %	More than two categories

5 FINDINGS

The implementation of these findings would help toward the development of a coordinated national standards strategy for enhancing adaptation to climate change:

1. The existing framework related to infrastructure systems regulatory jurisdictions, laws, codes and standards is complex. A more comprehensive understanding and overall mapping of the codes and regulatory landscape for infrastructure would be helpful. Additional focus and investment in this area would result in a more complete decision-support toolkit for policymakers.
2. Opportunities for enhanced adaptation and capacity building are created as standards are reviewed and updated. A multitude of CSA infrastructure standards have review cycles of between two and five years. This enables new research, technology and practices to be incorporated into mainstream practice on a continual basis.

The cross-functional, multi-disciplinary and balanced nature of the CSA technical committee system provides effective and accessible forums for tackling complex issues. Committee meetings, augmented with specific workshops and symposiums are highly effective outreach tactics.

3. Further evaluation of the needs related to the development of new national standards could enhance adaptive capacity-building. Examples of high priority issues already identified are, storm-water management, rehabilitation of existing infrastructure systems, and acute vulnerabilities in Northern infrastructure and coastal regions. National standards do not presently exist in these areas.
4. Climatic load data that is referenced and/or used by codes and standards is critical to infrastructure designers and operators. As climate continues to change, predictive models with sufficient detail and resolution to be useful at the local community level has become more and more important.

Presently, the climatic loads used by designers are sometimes based on historical data that is no longer representative of future conditions. This is of great concern to infrastructure designers since many infrastructure works are intended for extremely long service life – up to 100 years in some cases.

Canada's infrastructure designers rely on a strong climatic observation network, its coordination across jurisdictions and world-class analytical expertise. Access to high quality, reliable climatic load data is an essential element of designing resilient infrastructure.

5. Canada's codes and standards network is ubiquitous and influential. However, awareness of the implications of climate change impacts and adaptation varies amongst its stakeholders. Implementation of coordinated outreach efforts will help to ensure that the full potential of the codes and standards network is harnessed toward improving the

resilience of Canada's infrastructure.

There are effective, proven tools and techniques for engaging codes and standards stakeholders. Further consideration should be given on how to deploy them as part of outreach and awareness initiatives. Examples of such tools and techniques include: facilitated workshops during standards committee meetings, as well as supplemental workshops, symposiums and facilitated discussions.

6 Endnotes and References

- ¹ This is based on a definition that CSA first proposed in a research report prepared for Infrastructure Canada, 31 March 2005, 'Mapping Canada's Regulatory and Standards Landscape'. This definition has been refined since that time.
- ² These categories have been derived from several sources, most notably:
 - (i) Draft report prepared for Infrastructure Canada, 31 March 2005 "Mapping Canada's Regulatory and Standards Landscape...Prepared by CSA Staff"
 - (ii) Draft definition and listing prepared by the Secretariat to the, Public Infrastructure Engineering Vulnerability Committee (PIEVC), Canadian Council of Professional Engineers, September 2005
- ³ Natural Resources Canada. Climate Change Impacts and Adaptation: A Canadian perspective. By Fiona J. Warren. 2004.
<http://adaptation.nrcan.gc.ca/perspective_e.asp>.
- ⁴ Girard, Michel. "Raising the Bar: Adapting Canadian Infrastructure to a Changing Climate" *CSA Annual Conference* 21 June 2005.
- ⁵ Natural Resources Canada. Permafrost and Climate Change. 20 August 2002.
<<http://sts.gsc.nrcan.gc.ca/permafrost/climate.html> >
- ⁶ Bentley, Molly. "Earth' permafrost starts to squelch" *BBC News* 29 December 2004. <
<http://news.bbc.co.uk/2/hi/science/nature/4120755.stm> >.
- ⁷ Doucette, Keith. "N.S., Nfld. Brace for Ophelia" *Canoe Network News*. 16 December 2005.
<<http://cnews.canoe.ca/CNEWS/Canada/2005/09/15/1218363-cp.html>>.
- ⁸ Natural Resources Canada. Sensitivities to Climate Change in Canada-Rivers, 12 May 2003.
<<http://sts.gsc.nrcan.gc.ca/adaptation/sensitivities>>.
- ⁹ Natural Resources Canada. Discover Canada through National Maps and Facts. 5 April 2005.
<http://atlas.gc.ca/site/english/maps/environment/naturalhazards/majorfloods/floods_stats_new.html>.
- ¹⁰ *About Inc., A New York Times Company*. Canadian Ice Storm in 1998.
<<http://canadaonline.about.com/cs/weather/p/icestorm.htm>>.
- ¹¹ Environment Canada. Major Freezing Rain Event Hammers New Brunswick - February 2003. 17 November 2003.
< http://www.atl.ec.gc.ca/weather/severe/nb02-03_e.html>.
- ¹² Perry, Charles. *Times & Transcript*. N.B. ice storm ranks among year's Top 10 weather stories. 30 December 2003.
< <http://canadaeast.com/apps/pbcs.dll/article?AID=/20031230/TTEBRIEF/312300002/-1/FRONTPAGE>>.
- ¹³ Environment Canada. Climate Change. 11 April 2005.
< <http://www.ec.gc.ca/soer-ree/English/headlines/ind4.cfm#7> >.

- ¹⁴ Natural Resources Canada. Coastal Sensitivity to Sea-Level Rise. <<http://atlas.gc.ca/site/english/maps/climatechange/potentialimpacts/coastalsensitivitysealeve/riise/1>>.
- ¹⁵ PP 15 –17, Environment Canada, Adaptation and Impacts Research Group (AIRG), Cities and Communities: The Changing Climate and Increasing Vulnerability of Infrastructure, Occasional Paper #3, By Heather Auld and Don MacIver, January 2005.
- ¹⁶ The National Climate Change Adaptation Framework, Final Draft, 2005, Prepared by the Intergovernmental Climate Change Impacts and Adaptation Working Group. Available at: http://www.adaptation.nrcan.gc.ca/new_e.asp

References in this document were also made from:

- ¹⁷ Environment Canada. Adaptation and Impacts Research Group (AIRG), Cities and Communities: The Changing Climate and Increasing Vulnerability of Infrastructure, Occasional Paper #3, by Heather Auld and Don MacIver, January 2005.

7 Exhibits

Exhibit 1

Sample Decision-support Matrix on Infrastructure Impacts/Adaptation priority setting.

Infrastructure Category or categories considered: _____

Impact or issue or series of issues assessed: _____

Attributes considered: _____

Examples of impacts or consequences to assess:

Injury

Fatality

Financial impact

Loss of use

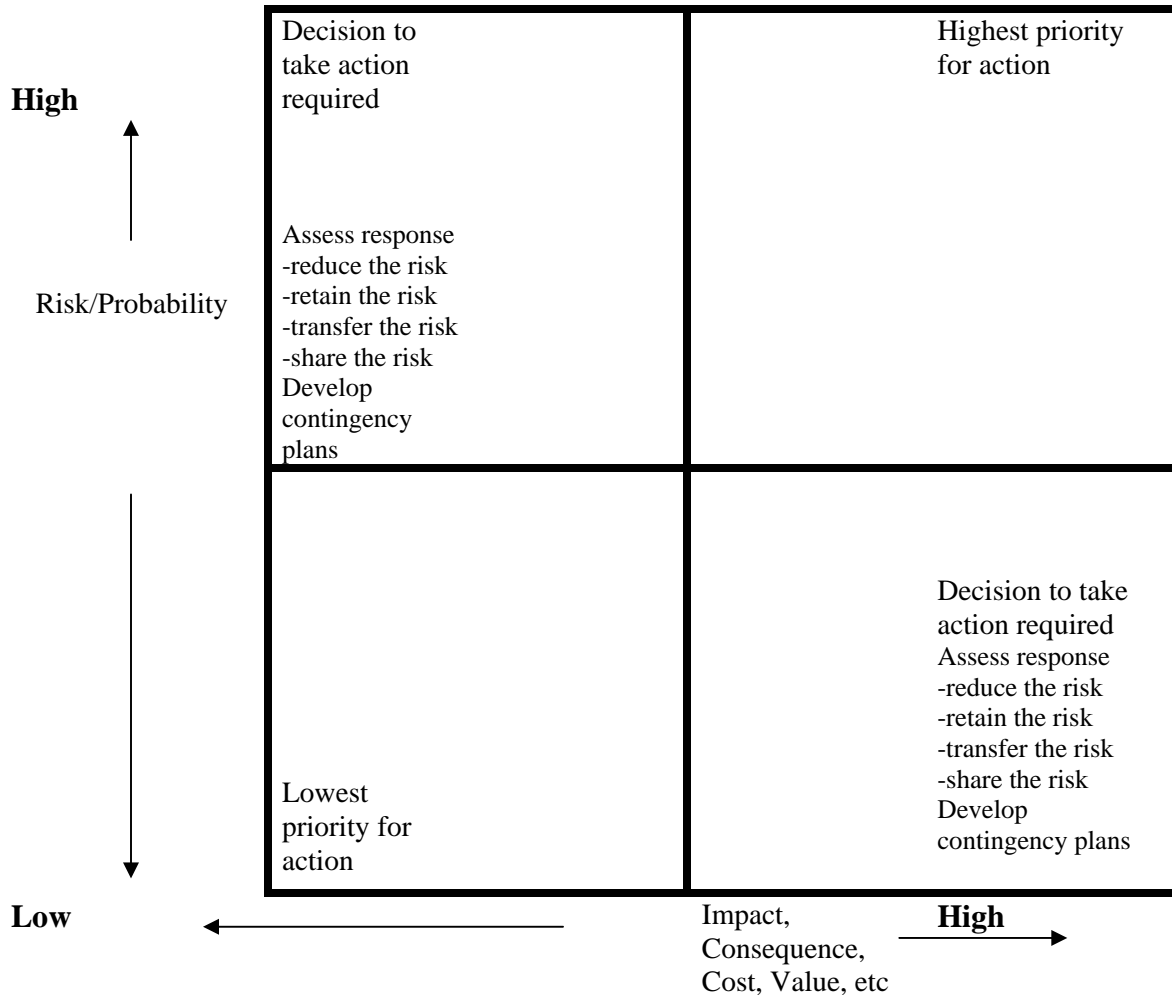


Exhibit 2

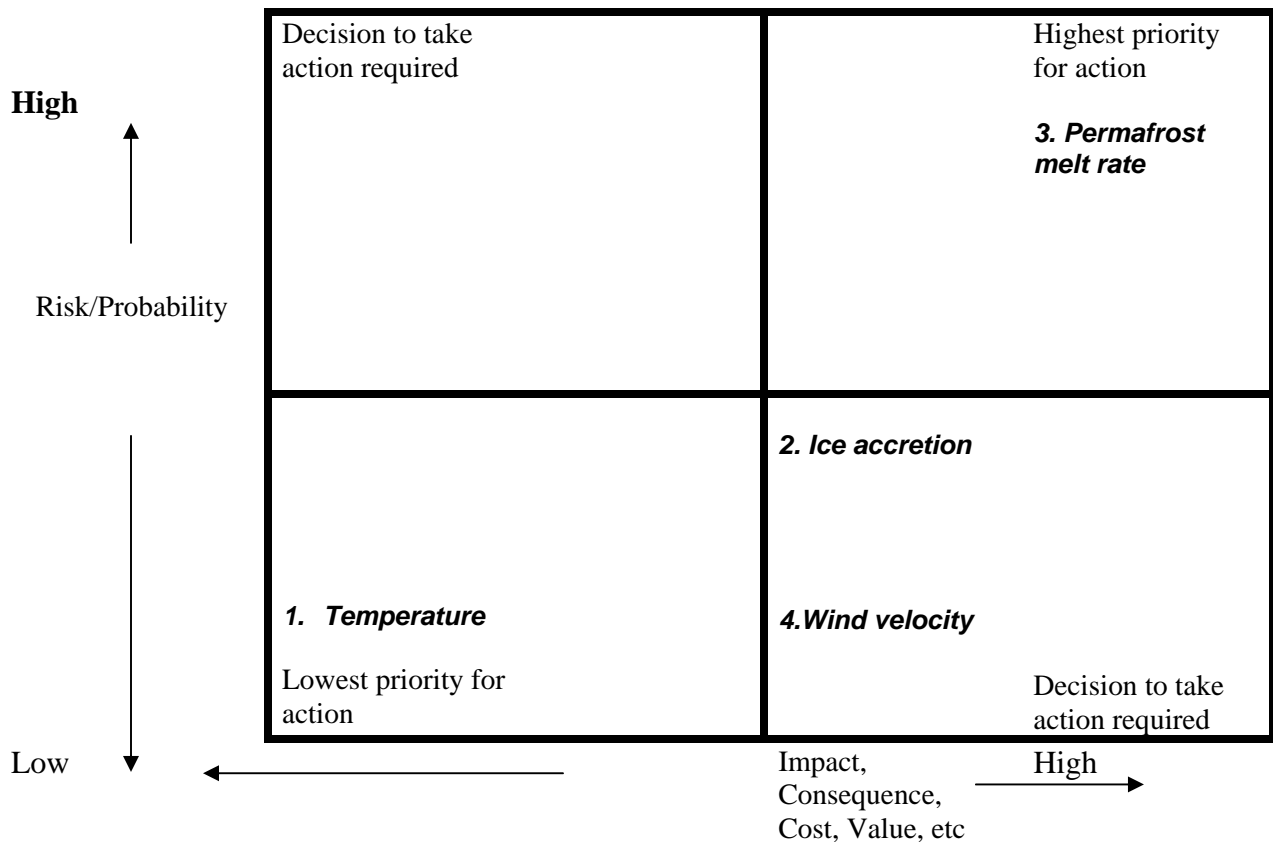
Example of how a decision-support Matrix on Infrastructure Impacts/Adaptation priority setting might be employed.

Infrastructure Category or categories considered: Low-rise buildings in permafrost regions

Impact/Issues assessed: Impact of weather loads on Building Structural elements

Attributes considered:

1. Temperature variability magnified
2. Ice accretion
3. Faster Permafrost melt rate
4. Increased Wind pressure/velocity



Conclusions:

- Permafrost melt rate attribute is highest priority for action. Cost of remediation too high. Develop response plan including assigning responsibility and providing financial support
- Although ice accretion and wind velocity are also concerns, not to the same extent – explore other options if possible: Higher factor of safety? Longer return period?
- Temperature variability is a low priority issue. Consider accepting the risk.

8 Appendices

Appendix A: List of the typical lifecycle and categories of Infrastructure

Typical Infrastructure lifecycle phases:

Generic lifecycle phases:

1. Design/Build
2. Operations and Maintenance
3. Overhaul, retrofit, and upgrade
4. De-commissioning or divestiture
5. Transformation

Detailed Description of typical lifecycle phases:

(1) Design - Build Phase – includes all work associated with the planning and approvals processes, as well as designing, constructing, and commissioning various infrastructure assets.

Sub-phases include:

- (a) Client needs assessment
- (b) Concept development
- (c) Initial financing
- (d) Environmental Assessments; Investigate approvals and permits
- (e) Plan and Design
- (f) Obtain Approvals and Permits
- (g) Construction phase financing
- (h) Construct or Manufacture
- (i) Interim inspections
- (j) Commission and Test
- (k) Final inspections, sign-offs and turnover to operator or owner

(2) Operations and Maintenance Phase – includes all of the activities associated with operations, maintenance and repair of infrastructure assets. Sub-phases include:

- (a) Operation
- (b) Maintenance
- (c) Repair
- (d) Ongoing financing, including the ongoing management of:
 - Operating and maintenance costs;
 - Project debt principal repayment;
 - Project debt interest repayment;
 - Federal, provincial, municipal taxes;

- Bonds or other borrowing instruments
- Reserve accounts
- Equity returns

(3) Retrofit - Upgrade Phase - Includes all of the activities associated with: major retrofit or upgrade of the asset for the same use; Restore the asset to original form; or transform the asset for another use, other than what it was originally designed for. Sub-phases are the same as design/build sub-phases. See also Transformation phase.

(4) De-commissioning – Demolition - Divestiture Phase – includes all of the activities associated with safely decommissioning, dismantling and recycling an infrastructure asset, including financing or divestiture. Sub-phases include:

- (a) De-commission
- (b) Demolish
- (c) Salvage and recycle
- (d) Dispose or process non-recyclable waste
- (e) Divest

(5) Transformation Phase – includes all of the activities associated with remediation of a contaminated infrastructure asset such as a brownfield site. Sub-phases are:

- (a) Pre-remediation testing and analysis
- (b) Remediation planning and risk assessment
- (c) Remediation financing
- (d) Remediation implementation
- (e) Post-remediation monitoring (if applicable)

Infrastructure Categories – Detailed description:

- (1) Transportation – segmented by mode of transportation (includes related structures, communication and control networks, switching systems, signage, safety and lighting systems) and including all installed assets and equipment:
 - (a) Toll Roads, Arterioles, Collectors, Highways, Freeways, Motor vehicle Bridges, Tunnels, and traffic control
 - (b) Pedestrian and cycle ways (sidewalks, footbridges, bike paths, etc)
 - (c) Canals, seaways, seaports, harbours and marinas, dry docks, ferry services
 - (d) Aerodromes, including terminals, runways, maintenance facilities and air traffic control
 - (e) Railways, railway bridges, rail freight terminals
 - (f) Public transit ways and terminals (dedicated roadways, railways, light rail transit, subways and tunnels)
 - (g) Border crossings

- (2) Water – segmented by type and use and including all utility-owned installed assets and equipment:
 - (a) Potable water (drinking water) systems – filtration plants, distribution systems, reservoirs, sub-surface aquifers, lakes and streams)
 - (b) Grey water systems (emerging area – primarily for inside building use)
 - (c) Irrigation systems
 - (d) Storm water sewer systems, drainage systems, conservation areas and floodways, spillways and flood plains
 - (e) Sanitary sewer systems – drainage systems, piping networks and treatment facilities

- (3) Energy – includes all utility-owned, installed assets and equipment. Systems segmented by energy type (includes generation, distribution, transmission and related utility-owned equipment, overhead and buried structures and related equipment).
 - (a) Electricity networks – residential and industrial – dams and reservoirs, coal, methane, nuclear, oil and diesel, and hydraulic generating stations, power grids and transmission systems, metering equipment, etc.
 - (b) Gas and oil pipelines – pumping stations, pipelines, compressor stations, meters and regulators, etc.
 - (c) Carbon dioxide pipelines and distribution systems
 - (d) District energy distribution systems including piping systems for chilled or hot water and steam
 - (e) Alternative energy specialties – categorized by energy sources
 - (i) Wind
 - (ii) Solar
 - (iii) Bio-mass
 - (iv) Digester gas

- (4) Communications – includes all utility owned, installed assets and equipment for broadband, other digital data, video, audio and telephony systems such as satellites, towers, cables, trenches, transmission facilities exterior to buildings, servers, network and all communication equipment inside (e.g., cell phone SIM cards) and outside buildings (e.g., satellite dishes) – characterized by transmission mode:
 - (a) Wireless digital networks
 - (b) Wireless analog networks
 - (c) Hardwire digital and analog networks
 - (d) Fibre optic digital networks

- (5) Solid waste management (includes transfer stations, processing facilities, landfills, incinerators, operations and administration facilities, etc) – segmented by material type, and whether or not waste is recyclable, non-recyclable, hazardous, or non-hazardous:

- (a) Organic materials and composts (plant and animal products), recyclable paper and plastics, non-recyclable construction demolition items and debris
 - (b) Hazardous household waste (paints and chemicals)
 - (c) Hazardous industrial, petrochemical and petroleum waste
 - (d) Recyclable petrochemical and petroleum waste
 - (e) Hazardous heavy metals
 - (f) Tires and automotive
 - (g) Recyclable electrical and electronic components
 - (h) Hazardous non-recyclable electrical and electronic components
- (6) Buildings – includes all national, provincial/territorial, municipal and local buildings such as civic offices, public works and operational facilities, emergency response buildings, police buildings, hospitals, schools, colleges and universities, penitentiaries, libraries, research facilities, and weather stations, research facilities. Also included in this category are commercial/retail complexes that are considered to be essential for providing an array of goods and services to urban communities. These works are classified by size and type of structure:
- (a) Low rise housing and small buildings as covered in National Building Code Part 9 – “Housing and Small Buildings”
 - (b) High-rise residential, Commercial and Industrial buildings as covered in National Building Code part 4, 5, and 6 (Structural Design, Environmental Separation and Heating Ventilating and Air Conditioning)
 - (c) Grey fields - under-utilized or abandoned commercial and industrial facilities of any size or description
- (7) Culture, Recreation and Tourism Facilities– includes all major recreational and cultural facilities- categorized by asset type:
- (a) Amusement parks
 - (b) Campgrounds
 - (c) Picnic and day-use areas
 - (d) Golf courses and ranges
 - (e) Cross-country trails
 - (f) Downhill ski areas
 - (g) Beaches
 - (h) Casinos
 - (i) Cultural centers
 - (j) Greenbelts
 - (k) Heritage and Historical buildings (see 'buildings' as well)
 - (l) Heritage and Historical sites

- (m) Horticulture and botanical gardens, greenhouses
 - (n) Indoor and Outdoor museums (see buildings as well)
 - (o) Leisure centers and facilities
 - (p) Playgrounds, sports fields,
 - (q) Sports stadiums and arenas
 - (r) Theatres
 - (s) Urban indoor parks and facilities
 - (t) Outdoor parks and facilities
 - (u) Walking trails
 - (v) Wilderness parks and wildlife reserves
- (8) Other infrastructure types – categorized by use or purpose
- (a) Coastlines, estuaries, breakwaters, seawalls and other structures to protect against land erosion and/or severe weather
 - (b) Greenfields – undeveloped land that is not used for farming or recreation
 - (c) Pits and Quarries - strategic mineral resources such as construction aggregate quarries (stone, crushed stone, and gravel pits)
 - (d) Greyfields – developed land that is not currently in use (see ‘buildings’ as well)
 - (e) Brownfields – contaminated land containing toxic wastes

Appendix B: List of CSA technical committees responsible for Standards related to the Infrastructure and Climate Change Impacts and Adaptation

Table 5.

CSA Technical Committees		
#	File No.	Name
1	A101	Bituminous Roofing Materials (A123 Series)
2	A106	Ventilators for Buildings (A93)
3	A119	Performance Standard for Windows (A440)
4	A121	Energy Performance of Doors and Wall Systems (A453)
5	A124	Factory Built Houses (A277, Z240 MH Series, Z240.10.1)
6	A125	Steel Building Systems (A660)
7	A126	Park Models (Z241 Series)
8	A152	Concrete Materials and Construction (A23.1/A23.2)
9	A154	Concrete Poles (A14)
10	A156	Precast Concrete Paving Elements (A231.1 & A231.2)
11	A157	Qualification Code for Concrete Testing Laboratories (A283)
12	A159	Concrete Construction for Housing and Small Buildings (A438)
13	A160	Precast Concrete (A23.4 & A251)
14	A164	Concrete Roof Tiles (A220 Series)
15	A166	Hydraulic Cement and Supplementary Cementing Materials (A3000 Compendium)
16	A252	Air Supported Structures (S367)
17	A253	Antenna Towers (S37)
18	A254	Code of Practice on the Demolition of Structures (S350)
19	A257	Engineering Design in Wood (O86.1, O86.1.1, S307, S347)
20	A259	Limit States Design (S408)
21	A260	Masonry Design (S304, S304.1)
22	A261	Reinforced Concrete Design (A23.3)
23	A262	Scaffolding for Construction Purposes (S269.1, S269.2, S269.3)
24	A263	Steel Structures for Buildings (S16, S16.1, S16.1.1)
25	A264	Strength Design in Aluminum (S157, S157.1)
26	A265	Construction of Preserved Wood Foundations (S406)
27	A267	Parking Structures (S413)
28	A271	Canadian Highway Bridge Code (S6)
29	A272	Designing for Durability (S478)
30	A276	FRP Structural Components and Reinforcing Materials for Buildings (S806)
31	A277	Seismic Risk Reduction (S832)
32	B101	Emergency Electrical Power Supply for Buildings (C282)
33	B102	Installation Code for Oil Burning Equipment (B139)
34	B103	Installation Code for Solid Fuel Burning Equipment (B365)

CSA Technical Committees		
#	File No.	Name
35	B105	(Joint) Mechanical Flue Gas Exhausters (B255)
36	B106	Oil Burning Appliance Standards (B140 Series, B211 & B212)
37	B107	Portable Containers for Petroleum Fuels & Portable Fuel Tanks for Marine Use (B306)
38	B109	Power Operated Flammable Liquid Fuel Dispensers (B346)
39	B110	Solid Fuel-Fired (B366.1)
40	B116	Storage, Handling, and Dispensing of Aviation Fuel (B836)
41	B201	Asbestos Cement Drain and Sewer Piping (B127)
42	B202	Backflow Preventers and Water Pressure Reducing Valves (B64 & B356)
43	B203	Cast Iron Soil Piping (B70)
44	B204	Drains and Interceptors (B79 & B481)
45	B205	Groove and Shoulder Type Mechanical Pipe Couplings (B242)
46	B208	Plumbing Fittings (B125)
47	B209	Plumbing Fixtures (B45)
48	B211	Septic Tanks (B66)
49	B219	Plastic Pressure Piping (B137 Series)
50	C236	International Standards
51	C401	Heating, Ventilation, Air Conditioning and Refrigeration
52	C402	Industrial Equipment
53	C403	Residential Equipment
54	C403.15	Dehumidifiers (C749)
55	C403.16	Ceiling Fans (C814)
56	C416	Ventilation Requirements for Housing (F326)
57	C419	Performance of Lighting Equipment
58	C420	Renewables
59	C511	Overhead Electrical Distribution Systems
	C511	Underground Electrical Distribution Systems
60	G104	Corrugated Steel Pipe Products (G401)
61	G152	Certification of Welding Inspectors and Inspection (W178.1 & W178.2)
62	G153	Safety in Welding, Cutting, and Allied Processes (W117.2)
63	G156	Welding of Bridges, Buildings and Machinery (W59)
64	G160	Welding of Reinforcing Bars (W186)
65	J101	Gas Appliances and Related Accessories
66	J109	Carbon Monoxide Detectors
67	J112	Natural Gas Powered Vehicles and Fuelling
68	J113	Installation Code for Natural Gas and Propane Appliances (B149)
69	K106	Pipeline Materials (Z245 Series)
70	K110	Petroleum and Natural Gas Industry Pipeline Systems and Materials (Z662)
71	K119	Storage of Hydrocarbons in Underground Formations (Z341)

CSA Technical Committees

#	File No.	Name
72	S272	Proponent Guide to Public Involvement
73	S298	Emergency Planning for Industry (Z731)
74	S320	Diving and Caisson Systems
75	S323	Code for Suspended Equipment Operations (Z91)
76	S329	Safeguarding of Machinery (Z432)
77	S333	Work Injuries (Z795)
78	S349	Overhead Travelling Cranes
79	S704	Children's Playspaces & Equipment (Z614)
80	Z953	CANDU Nuclear Power Plant Systems and Components (N285A)
81	Z955	Overall Quality Assurance for Nuclear Power Plants (N286 Series)
82	Z958	Reactor Control Systems, Safety Systems & Instrumentation for NPP (N290)
83	Z961	Fire Protection in CANDU Nuclear Power Plants (N293)

Appendix C: Planning and design of infrastructure - illustrative examples

Infrastructure systems designers and operators rely on multiple data sources and require a range of skills and knowledge. This appendix provides examples of the inter-relationship between CSA standards, regulations, climatic data and other references that infrastructure designers rely upon.

The infrastructure system designer's role is complex and diverse. They are responsible for ensuring that all relevant physical and mechanical loads are considered during the planning and design phase in order to assure the safety, reliability and economy of a project as well as an acceptable level of service-delivery.

Illustrative examples:

- **Structural design of buildings used for occupancy by people and/or equipment**

Designers rely on three sources in order to execute the structural design of a building. The first source is National Building Code of Canada (NBCC) and/or various provincial building codes. These codes set the load factors and load combinations, and provide environmental conditions and directions on determining loads. These loads are independent of a specific construction material (i.e., they apply to steel, concrete, masonry, aluminum, wood). The benefit of this approach is a single dataset, regardless of type of structural material employed. This makes design more straightforward, lower cost and with appropriate safety and reliability.

The second information source is the individual structural design standards based on material type (steel, wood, masonry, concrete, aluminum) or application. With the exception of structural glass, CSA provides all other application and material-specific structural design standards used in Canada today. These individual design standards provide specific design requirements for a particular material or application that are to be used with the National or Provincial Code's general requirements (i.e., the design approach changes with different construction materials, components and sub-assemblies).

Finally, application-specific and material-specific design manuals and handbooks provide additional guidance on how to implement specific requirements, findings, and practices.

- **Design of bridges and offshore oil and gas production platforms**

There are situations where designers can rely primarily on a single source or a dual source for design, rather than the multiple sources that are required for buildings described above. An example of this would be the Canadian Highway Bridge Design Code, CSA S6. This standard combines the load and environmental information normally summarized in a building code, with the specific design requirements of a standard, and the recommendations and practices normally found in an application-specific, designer's handbook. In this case, it wouldn't necessarily be required to refer to any other sources but other sources may be used to fill in additional material. When this is done it aids designers by eliminating the inefficiencies inherent with searching for necessary information through a multitude of relevant documents. Another example would be the CSA Offshore Oil and Gas Structures Standards. These standards combine the environmental

and load information of a building code with some of the specific information of a typical standard with requirements and specifications for various equipment and materials.

- **Oil and gas transmission pipelines**

The CSA standards for these systems specify general requirements related to safety, reliability and performance and designers augment this with region-specific climatic data and application-specific structural design handbooks.

- **Electrical transmission systems**

CSA publishes the Canadian Electrical Code that includes standards for electricity distribution and transmission systems. For example, to apply C22.3 No. 1 - Overhead Systems and C22.3 No. 7 - Underground Systems, utility engineers also utilize, take into account, or apply the following:

Equipment and material standards (e.g., insulators, poles, conductors, transformers etc.) are also important reference sources, as are electrical and civil engineering expertise and a utility's own in-house guidelines.

Electrical utility structure designers must also consider load profiles and system characteristics that are specific to their particular utility system along with their design philosophy. For example, system voltage, radial versus loop design, urban versus rural routings, long versus short feeders all must be taken into consideration by the designer and individual characteristics vary across the country. The CSA code sets the minimum requirement in this case, with some local utilities opting to exceed minimum requirements in some situations.

System planning considerations such as existing and estimated future electrical load growth, new technologies, and load diversity are also important considerations as this will affect the design of the structure's mechanical and physical attributes.

More On... electrical transmission systems design methods:

CSA C22.3 No.1 - Overhead Systems allows a choice between two design methods; Deterministic Design and Reliability Based Design. Both design methods are weather dependent and include analysis and modeling based on data collected by Environment Canada.

- **Deterministic Design**

This method uses a table specifying radial ice thickness at an assumed ice density and horizontal wind loading. Maps divide the country into medium, heavy and severe loading areas.

Additional load factors are specified in the CSA standard.

- **Reliability Based Design**

This more recent method uses wind speed references and icing maps based on a 50-year return period. Factors are specified to allow design for a longer return period (100, 150, 300 years or longer). It is up to each utility to determine the appropriate return period for the specific transmission line and geographic region. Numerous other factors are specified to address considerations such as terrain, combinations of wind and gusting, and drag on structural members.

Presently, the Reliability Based Design method is used by some of the transmission utilities based in Quebec, Ontario & British Columbia.

Appendix D: Authorities responsible for infrastructure - illustrative examples

Although there are variants between jurisdictions and as well, between infrastructure categories, most regulatory authorities employ CSA standards as well as the standards of other organizations in various ways. Here are some examples by type of infrastructure category along with a brief discussion of jurisdictional responsibility.

Buildings

A national model code for buildings is developed and maintained by the National Research Council's Canadian Codes Centre, which is responsible for the secretariats for the Canadian Commission on Buildings and Fire Codes (CCBFC) as well as the Provincial/Territorial Policy Advisory Committee on Codes (PTPACC). Additionally, each province/territory has its own building code and has the option of adopting the national model code, 'as is' or by adapting and/or augmenting the model code as it sees fit.

The national model codes establish a consensus of the provinces and territories on the minimum acceptable requirements in three subject areas related to buildings. They consist of the National Building Code (NBC), the National Fire Code (NFC) and the National Plumbing Code (NPC). With the move toward an objectives-based approach, which was introduced in the 2005 editions of the national codes, all requirements in the 2005 NBC are linked to one or more of the NBC's four top-level objectives of safety, health, accessibility, fire and structural protection of buildings. The provinces and territories adopt or adapt these model national codes for their individual regulations. Enforcement and inspections are usually the responsibility of the municipalities and in some cases, provincial/territorial agencies.

Electrical transmission systems

Electrical transmission systems in Canada are regulated by provincial/territorial bodies. They are often government agencies but more recently, some jurisdictions have transferred the regulatory responsibility to an independent agency governed by a board of directors. Ontario's Electrical Safety Authority is an example of this transferred responsibility.

Oil and gas transmission systems

Oil and gas pipelines are regulated at two levels. On a national level, the National Energy Board (NEB) has jurisdiction. The NEB is an agency that reports to the Minister of Natural Resources Canada. There are also provincial/territorial regulatory bodies. These operate either as agencies within a provincial/territorial ministry or more recently in some provinces, as independent agencies governed by a board of directors. Ontario's Technical Standards and Safety Authority is one such example. This function was formerly the responsibility of the Ontario Ministry of Consumer and Commercial Relations.

Transportation structures such as bridges, along with roads, highways and walkways

These are regulated by Provincial/Territorial Ministries of Transportation for inter-urban roads and highways and by local urban and rural municipalities for streets and city roads. Standards are referenced via regulations, provincial territorial standards, and municipal by-laws. Additionally, standards are often referenced in contract specifications and tenders. Referencing of standards in contracts and tendering documents is very common in situations where a regulatory authority is also an owner-operator of the system. The Ontario Ministry of Transportation is an example of an agency that operates both as a regulator and an owner-operator.

Wind Energy Structures

Although standards and codes exist for these structures in Europe, the regulatory environment in Canada is still evolving. Presently, CSA is working with this industry sector to adapt ISO/IEC standards and model codes for use in Canada.

The industry and its stakeholders are interested in doing so particularly in areas such as loading, tower design, materials and foundation design to enable a consistency of approach and to better address unique Canadian needs. The intent is to harmonize as much as possible with the existing ISO/IEC standards and supplement them to address design issues for low temperature and icing conditions in various Canadian regions.

For example, CSA standard # F416, “Wind Energy Conversion Systems – Safety Design and Operation Criteria,” was published in 1987, but was never used as a mandatory regulatory reference. It is based on a CSA structural design standard # S37, “Antennas, Towers, and Antenna-Supporting Structures,” but was not intended to provide guidance for larger “utility-sized” wind turbine structures.

More On... Wind Energy Structures

Climatic hazards

Various climatic conditions that are prevalent in Canada can shut down wind turbine operations. Extreme wind gusts, lightning, ice accretion, cold temperatures, offshore winds, sandstorms, hail and wind-driven snow are all deleterious to wind energy operations.

Low temperature considerations

Low temperatures affect materials used in the fabrication of industrial wind turbines. The mechanical properties of structural elements such as steel and composite material change in cold climate conditions. Steel becomes more brittle and its energy absorbing capacity and deformation properties are both reduced. Composite materials, due to unequal shrinkage of their fiber/matrix components, will be subjected to a residual stress. If this stress is sufficient, it can result in microcracking in the material. These microcracks reduce both the stiffness and the impermeability of the material, which can contribute to premature deterioration. Similarly, low temperatures can also damage the electrical equipment. When power is applied to these machines after they have been standing in the cold for a long period, the windings can suffer from a thermal shock and become damaged.

Appendix E: List of climate phenomena, loads and other external impacts on physical infrastructure

Impacts and phenomena were divided into several categories:

1. Characteristics of climatic load events
2. Characteristics of natural phenomena other than weather/climate events
3. Characterizations of extreme weather events
4. Consequences that might arise as a specific load condition approaches the maximum design capacity
5. Physical, mechanical, chemical or biological conditions that are deleterious to an infrastructure system
6. Consequences of physical, mechanical, chemical, biological conditions or combinations thereof
7. Other factors that could affect the magnitude of future impacts or ability to adapt.

The list below was developed through literature review, and as well, by canvassing CSA staff from various program areas related to infrastructure systems.

Listings:

Characteristics of climatic load data (typically reported as a range of values with an associated probability distribution or set of plots/curves, for a specified return period, on a region-by-region basis):

- Temperature
- Humidity
- Ice accretion
- Wind pressure/ velocity
- Freeze-thaw cycles
- Critical rain & melt sequences
- Critical temperature sequences
- Weathering indices (30 d, 30 d + snowmelt, etc)
- Probable maximum precipitation
- Offshore events such as ice-flows, ice scour
- Wind-driven rain/wind driven precipitation

Characteristics of natural phenomena other than weather/climate events (established via empirical studies for specific locations or regions at a point in time, or over a period of years depending on attribute):

- Soil stability
- Permafrost melt rate
- Seismic activity, intensity and frequency
- Change in water level
- Shoreline erosion (as a result of wave action)

Characterizations of extreme weather events (i.e., a climatic load that has reached a specific defined threshold or boundary condition for magnitude and intensity):

- Ice-storm
- Windstorm
- Rainstorm
- Tsunami/tidal wave
- Tornado/cyclone
- Gale/Hurricane
- Drought

Consequences that might arise as a specific load condition approaches the maximum design capacity of the infrastructure system:

- Flooding
- Erosion
- Shutdown
- Gridlock
- Reduced mean time between failure
- Reduced mean time to maintenance
- Unrecoverable failure (e.g. collapse, or damage beyond repair)
- Repairable damage
- Injury
- Fatality
- Degraded human health or health in wildlife populations

Physical, mechanical, chemical or biological conditions that are deleterious to an infrastructure system, arising as a consequence of man-made, natural, environmental and climatic factors or combinations thereof:

- Contamination by deleterious organics (e.g., mould growth)
- Contamination by deleterious chemicals
- Insect infestation
- Oxidation/corrosion/chemical attack (e.g., de-icing salts used on roads)

Consequences of physical, mechanical, chemical, biological conditions or combinations thereof that are deleterious to an infrastructure system:

- Change in maintenance, repair and overhaul profile
- Write-off due to an unrecoverable system or component failure
- Increased safety risk
- Increased health risk

Other factors that could affect the magnitude of future impacts or ability to adapt:

- Generally accepted safety thresholds
- Level of service expected
- Capacity and load profile
- Load and demand forecasting

- Maintenance, repair and overhaul profile
- Risk tolerance of stakeholders
- Planned service life
- Security risks
- Emergency planning
- Environmental impact assessment
- Community values and belief systems

Consequences of extreme weather and other impacts on infrastructure systems

Here are the results of the literature review:

1. Freezing and thawing cycles

An increase in the frequency and severity of ground freezing and thawing cycles and heat deformation has been observed on Canada's \$100-billion road systems.

The following phenomena have been observed with more frequency:

- Rutting of pavement
- Cracking
- Frost heave and seasonal deformation stress

2. Warmer air temperatures

The melting permafrost in northern regions is affecting buildings and transportation. The greatest increase in Canadian air temperature over the last century has been recorded in the Western Northwest Territories (1.7°C). Here, the temperature of the permafrost is approaching the melting point of ice.⁵

The specific impact of melting permafrost upon infrastructure is dependent on the underlying soil conditions. These include: the combination of melting permafrost and unstable soil conditions could lead to landslides, creep, and soil failure, which in turn, could result in increased vulnerability to failure and/or premature degradation of civil infrastructure works such as railways, roads, pipelines, pile foundations, buildings, and bridges.

Canadian examples of melting permafrost can be found in Ellesmere Island, where more frequent episodes of detachment (landslides) have been experienced over the last quarter decade.⁶

3. Wind damage

It is predicted that more frequent and severe episodes of wind damage will occur as a result of global warming. In 2003, seven deaths were attributed to hurricane Juan and it caused over \$100 million in insurable damage.⁷

Some other recent events of wind damage involved wind speeds of up to:

150 km/h in Alberta, 2003

118 km/h in PEI, 2000

110 km/h in New Brunswick, 2000

113km/h in Manitoba, 1999

4. Extreme rainfall, flooding and ice storms

- Increased rainfall and flooding

Despite falling levels of many rivers, more intense rainstorms are likely to lead to more severe river flooding, particularly on the Atlantic coast and the Great Lakes - St. Lawrence basin.⁸

The most severe example of flooding on Canadian soil occurred in 1996 on the Saguenay River Valley, when 290mm of rain fell over a 36-hour period. This resulted in \$1 billion in damages. Impacts to infrastructure included the destruction of major bridges and roads and downed power lines.⁹

Other examples of recent extreme episodes of flooding include:

In 1999, the Maritimes received 200mm of rain in one day. This episode resulted 10m whitecaps and overflowing rivers, which in turn, damaged infrastructure by way of washed-out of roads and bridges and the destruction of buildings and wharves.¹¹

In 1987, Montréal, Quebec received 100mm of rain in one-hour. This episode caused an estimated \$94 million in damage. Impacts to infrastructure included the flooding of major expressways, backed up sewer systems and closure of subways systems.⁹

- Ice storms

An increase in the magnitude of ice storm episodes in Eastern Canada has been observed.

In 1988, 85mm (Ottawa) to 100mm (Montreal) of freezing rain fell over a five-day period. This resulted in 28 deaths; 945 injured; 600,00 evacuated and \$5.4B in losses.¹⁰

In 2003, New Brunswick experienced 50 mm of freezing rain over 24 hours. This storm left 63,000 people without power, led to collapsed buildings and power lines and to losses far greater than those of the 1998 ice storm.^{11,12} Damage to infrastructure included the collapse of transmission towers and power lines, which instigated a chain of events leading to the malfunction of telecommunications, transportation, banking and financial systems, drinking water supplies, and energy infrastructures.

5. Coastal erosion

As global temperatures rise, oceans warm up, and polar ice caps melt, the overall sea level will rise. This phenomenon will be devastating to low-lying coastal areas where flooding would be prevalent.

In addition, it is estimated that the effects of changing rainfall and evaporation patterns will result in the decreased water levels of Canada's Great Lakes by up to 1m.¹³ The impact of lower water levels in the Great Lakes is expected to affect transportation, energy and health sectors by way of decreased depth in navigation channels (also causing stranded docks and harbours), decreased water quality, and the loss of hydroelectric capacity, to name a few.³

Canadian regions highly sensitive to climate change and erosion include Atlantic Canada and parts of the Beaufort Sea coast¹⁴. An example of extreme erosion, exacerbated by rising sea levels is the flooding of Charlottetown, Prince Edward Island by a storm surge in January 2000¹⁴.

Findings

The team is not aware of any national or regional standards related to land-use management and community sitting practices in coastal regions. However, the literature review indicates that coastal erosion has a profound and crosscutting impact on civil infrastructure and could have major economic and health consequences for Canadians.

Appendix F: Policies on international standardization: An overview of ISO Guide 59 (Excerpted from CSA SDP-1 “Policies Governing Standardization”)

The following is an excerpt from CSA’s publications on policy and practices associated with standardization and the CSA consensus process. CSA’s consensus process is designed to align with the requirements of ISO/IEC Guide 59, which outlines the principles that international standards must follow.

The table (below) maps the specific ISO/IEC requirements to the CSA’s documentation of its consensus process. Professional guidance and facilitation of the standards development process by CSA staff is augmented by training programs that are offered at no charge to CSA’s volunteer technical committee members and chairs.

For ISO/IEC Guide 59 clauses and corresponding CSA process references, see next page:

ISO/IEC Guide 59:1994 clauses	CSA Policy
Clause 5.2: Standards shall not be written as a means to fix prices, nor to exclude competition or otherwise inhibit commerce beyond that necessary to meet requirements of relevant technical regulations or other legitimate sectorial or local requirements for compatibility, environmental protection, health and safety.	Competition (see Clause 4.2.4)
Clause 5.3: When international standards exist or their completion is imminent, they, or their relevant parts, shall be used as the basis for corresponding national or regional standards, except where such international standards or relevant parts would be ineffective or inappropriate, for instance because of an insufficient level of protection or fundamental climatic or geographical factors or fundamental technological problems.	Harmonization (see Clause 4.4.2)
Clause 5.4: Standards should not be written so as to allow them to be used to mislead consumers and other users of a product, process or service addressed by the standard.	Users' needs (see Clause 4.4.3)
Clause 5.5: Standards shall neither be written nor adopted so as to discriminate among products on the basis of the place of origin.	Promoting and facilitating trade (see Clause 4.4.1)
Clause 5.6: Whenever possible, in order to leave maximum freedom for technical development, the requirements of standards shall be expressed in terms of performance rather than design or descriptive characteristics.	Freedom for technical development (see Clause 4.4.4)
Clause 5.7: Administrative requirements relating to conformity assessment and marks of conformity or other, non-technical issues should be presented separately from technical and/or performance requirements.	Administrative requirements relating to conformity assessment and other non-technical issues (see Clause 4.4.5)
Clause 5.8: Standards should not be drafted in terms that include the use of a patented item unless the use of such an item is justifiable for technical reasons, and the rights holder agrees to negotiate licences with interested applicants, wherever located, on reasonable terms and conditions.	Reference to patent rights (see Clause 4.4.6)
Clause 6.1: Participation in standardization processes at all levels shall be accessible to materially and directly interested persons and organizations within a coherent process as described in this clause.	Participation (see Clause 4.2.1)
<p data-bbox="191 1253 1019 1423">Clause 6.2: With a view to harmonizing standards on as wide a basis as possible, the standardizing body shall, in an appropriate way, give priority to playing a full part within the limits of its resources in the preparation by relevant international standardizing bodies of international standards regarding subject matter for which it either has developed or adopted, or expects to develop or adopt standards.</p> <p data-bbox="191 1430 1019 1598">Clause 6.3: At international level, national participation in the standardization process is organized under the auspices of the appropriate national standards body which is the member of the relevant international standards organization. National members shall ensure that their participation reflects a balance of national interests in the subject matter to which the international standardization activity relates.</p>	Participation in international standards development activity (see Clause 4.2.5) and Participation (see Clause 4.2.1)

(Continued)

ISO/IEC Guide 59:1994 clauses	CSA Policy
<p>Clause 6.4: At regional level, participation in the consensus standardization process, which is organized to suit the particular needs of the technology and the region, should always reflect a balance of national and regional interests in regional standardizing work. Opportunities for effective and meaningful contributions from countries not within the region should be organized under the auspices of the national standards bodies of those countries and should be done in cooperation with the international standards organizations in which membership is common.</p> <p>Clause 6.5: At national level, participation should be organized by standardizing bodies and national standards bodies according to their respective consensus-building procedures which should provide for balanced representation of interest categories such as producers, buyers, consumers, etc. Opportunities for effective and meaningful contributions from other countries should be organized under the auspices of the national standards bodies of those countries and should be done in cooperation with the international and regional standards organizations in which membership is common.</p>	<p>Participation in international standards development activity (see Clause 4.2.5) and Participation (see Clause 4.2.1)</p>
<p>Clause 7.1: In order for standards to be mutually consistent and free from contradiction for the largest possible user communities, standardization activities should be actively, but voluntarily coordinated at and between international and regional levels, and within each country.</p> <p>Clause 7.2: Coordination responsibility at international level should rest with each international standards organization.</p> <p>Clause 7.3: Coordination responsibility at regional level should rest with each regional standards organization.</p> <p>Clause 7.4: Coordination responsibility at national level should rest with the national standards body.</p> <p>Clause 7.5: Coordination responsibility between regional and international standardization activities should rest with the bodies concerned. In particular, regional standardizing bodies shall make every effort to avoid duplication of, or overlap with, the work of relevant international standardizing bodies.</p> <p>Clause 7.6: Coordination of standardization activity between regional standards organizations and national standards bodies outside the region in question should be organized under the responsibility of these bodies in consultation with the international standards organization in which membership is common.</p>	<p>Coordination (see Clause 4.3.7) and Notification of activities (see Clause 4.3.8)</p>

Appendix G: An overview of the CSA Consensus Process - Excerpts from CSA notes for members, SDP 4.1

This appendix contains an excerpt from a handbook prepared for CSA members. Since its publication, the name, “CSA International” has been changed to, “CSA Group”, which includes:

- The Canadian Standards Association (CSA) – An accredited standards development organization
- The Quality Management Institute (QMI) – An accredited quality and environmental management systems registrar
- CSA International – An accredited product safety and performance certification and testing organization.

This excerpt provides supplemental information on composition of committees and interest categories.

3 Participants and organizational structure

3.3 Committee composition

3.3.1 General

To qualify as a consensus standard, a standard must be developed and approved by a broad group of affected parties or their representatives. CSA standards are developed by volunteer committees made up of representatives of groups such as manufacturers, government, consumers, academics, and others affected by the product or service covered by the standard. This ensures that no one group dominates the development of a standard. While consumers may not be represented on every committee, the technical committees that vote on the standards always include users or the people who are directly affected by the product or service.

3.3.2 Interest categories

Committees are formed according to a matrix system, i.e., the membership is made up of representatives from different interest categories affected by the standard. To ensure balanced representation, there are procedures for establishing the minimum and maximum number of voting members from each interest category. These procedures are described in detail in the *CSA Directives and guidelines, Part 1 (CSA-SDP-2.1)*.

For committees that prepare standards concerning products, most materials, and some services, the following interest categories typically apply:

- a) producer interest;
- b) user interest;
- c) regulatory authority; and
- d) general interest.

Table 1 set out an example of a balanced committee matrix. Balance of representation means that the actual number of voting members in any one interest category is not more than the sum of the actual number of voting members in the two smallest interest categories (see CSA-SDP-2.1, Clause 3.3.4).

Although these categories typically apply to a committee, there may be other interest categories that represent the stakeholders affected by a standard.

Table 1
Sample Committee Matrix

Code	Interest categories	Minimum no. of members	Maximum no. of members
PI	Producer interest	4	6
UI	User interest	4	6
RA	Regulatory authority	4	6
GI	General interest	4	6

Appendix H: List of questions that arose during the project

- **Questions from the perspective of the NRCan Impacts and Adaptation (I & A) Directorate's mandate:**

1. What groups of stakeholders can be engaged in the adaptation of initiatives via the Canadian Standards Association? What is the current state of engagement of these stakeholder groups?
2. Recognizing that key risk areas in Canada include: Arctic/North, Coastal zones, Prairie water, Great Lakes/St. Lawrence water levels, Infrastructure, Communities and hazards, identify the areas where the work of CSA has an impact presently, and in the near future.
3. How can CSA and its member network be used to tap into domestic and international stakeholders in order to establish mechanisms of collaboration related to impacts and adaptations strategies related to physical infrastructure works?
4. What role can existing and/or new standards, such as those developed and maintained by CSA, play in the implementation of the National Adaptation Framework with provinces and territories?
5. What role can or should CSA standards have toward incorporating the best available climate change knowledge into federal criteria, regulations and guidelines for planning long-term investments such as infrastructure?
6. Can CSA standards or related products/services be used to accelerate the adoption of sound knowledge and practices related to adaptation alternatives for key sectors, regions, communities and populations, and in what specific areas?

- **Questions pertaining to climate phenomena and other loads and impacts on physical infrastructure:**

7. How did this study define and categorize physical infrastructure systems?
8. Which natural phenomena (e.g., seismic events), weather attributes, changing weather trends (i.e. climate change), and related loads have an impact on physical infrastructure?
9. How are impacts (i.e., natural phenomena, weather events, capacities and loads that are related to an infrastructure asset's intended use) considered by practitioners and designers today?
10. How easy/difficult is it to identify the extent to which a category or sub-category of physical infrastructure is sensitive to a weather events or related impact?
11. What are the attributes and characteristics of climate and weather that impact on various categories of physical infrastructure systems? How do these characteristics interact with other loads and impacts acting on an infrastructure system?
12. To what extent are deterministic versus probabilistic models used in the design of weather-sensitive infrastructure systems?
13. What risks are considered as part of today's practices?

• **Questions pertaining to next steps, early actions, and high priority areas for further investigation:**

14. What are the reference sources used for infrastructure planning and design practices?
15. Describe the regulatory environment affecting infrastructure and how does it correlate to impacts and adaptation issues?
16. How do various jurisdictional responsibilities, regulatory regimes, standards and codes interact?
17. To what extent are various industry sectors already investing in research related to climate change impacts and adaptation?
18. Can the inter-relationships between infrastructure systems and external loads and impacts be mapped to serve as a decision-support tool for identifying areas where there are significant risks, impacts or vulnerabilities?
19. What existing climatic data is used in the design and planning of infrastructure, and are there gaps that should be addressed?
20. Are there early gains that could be made by doing things differently? If so, how and where?

• **Questions pertaining to codes and standards in Canada:**

21. To what extent do standards influence climate change adaptive capacity-building as it relates to physical infrastructure systems?
22. Under what circumstances can standards facilitate/impede change?
23. How does Canada's National Standards System work?
24. Is there a linkage between Canada's National Standards System and international standards? If so, what is it?
25. How are standards and codes developed? Where possible, compare/contrast the development processes of the various organizations involved.
26. What is the difference between accredited and non-accredited standards?
27. What is a consensus-publication versus a non-consensus publication?
28. On a category-by-category basis, how are mandatory, permissive and informative guidelines employed for infrastructure systems, and what affect does this have on resilience and adaptive capacity?
29. What are the relationships between standards, codes and instruments such as regulation, verification and enforcement?
30. What organizations have jurisdiction for regulation, verification and enforcement and how consistent is it from region-to-region for various categories of weather-sensitive physical infrastructure systems and assets?

- **Questions pertaining to the Canadian Standards Association:**

31. What are the specific weather-sensitive, physical infrastructure assets and systems that are addressed by CSA, and to what extent?
32. What are the inherent benefits/limitations in the current standards development process for standards that deal with physical, weather-sensitive infrastructure?
33. To what extent do standards for infrastructure rely on high quality climatic data and research?
34. How will the content of CSA standards and related services evolve or change in response to significant changes in climate patterns? Are there mechanisms in place to facilitate the necessary changes, and how effective are these?
35. What specific climatic data characteristics do standards depend upon and what climatic loads and related conditions do they address?
36. Are there gaps that can be addressed by augmenting existing standards or by developing new standards?
37. Can CSA and its member network be used to accelerate or enhance the capacity to adapt physical infrastructure systems to the impacts of climate change and if so, how?
38. What role can CSA take toward awareness building, knowledge dissemination and education related to adaptation and impacts issues?

Appendix J: More information on the use of non-accredited standards, American and international standards for infrastructure construction in Canada

Many documents that are not registered by the Standards Council of Canada are considered to be standards. Although they are often not directly referenced in legislation/regulation, they are often included as conditions within contracts for the design and construction of infrastructure.

As an illustrative example, the Ontario Provincial Standards as well as references to non-Canadian standards are discussed within this Appendix.

Ontario Provincial Standards

A number of organizations representing contractors, consulting engineers, manufacturers, and their associations are actively involved in the work of the Ontario Provincial Standards (OPS). Ontario Provincial Standards for Roads have been in use since 1984 and has developed a number of standards for the construction and maintenance of highways and roads. The standards include areas such as grading, pavements, drainage and tunnels, general construction, electrical, water mains, structural and general conditions of contracts. They refer to relevant Canadian standards and codes, and international codes and standards when relevant. OPS also manage the development and production of construction drawings, construction and material specifications, and contract tendering documents for road works. Additionally, the OPS secretariat has responsibility for managing and coordinating the ministry's Designated Sources for Materials (DSM), the channeling of Ontario road products evaluation through external agencies, and liaising with an external sources registry holder.

Examples of other non-accredited standards and publications referenced in Ontario and pertaining to highways and roads

The table that follows is an excerpt from a study prepared for Infrastructure Canada ('The Regulatory and Standards Landscape of Canada's Public Infrastructure' – March 31, 2005). It illustrates the number and diversity of non-accredited Canadian publications, US-based standards and international standards that are used to construct roads and highways in Ontario. These standards are often cited as required specifications in contracts.

In situations where non-Canadian standards are utilized and referenced, evaluation by Canadian stakeholders is required to ensure that unique Canadian needs related to natural phenomena, as well as Canada's safety and environmental requirements are addressed.

Table 6

Name of Organization	Number of Standards Referenced by Ontario Road Authorities	Country/ Accrediting Organization
AASHTO (American Association of State Highway and Transportation Officials) - Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 23rd Edition	95	USA/ none
ACI - American Concrete Institute	15	USA/ANSI
ANS - American National Standards	8	USA/ANSI
ASME - American Society of Mechanical Engineers	2	USA/ANSI
ASTM - American Society for Testing and Materials	725	USA/ANSI
AWWA - American Water Works Association	152	USA/ANSI
CCIL - Canadian Council of Independent Laboratories	4	Canada/None
CEN - Comité Européen de Normalisation/European Committee for Standardization/Europaisches Komitee fur Normung	5	Europe/CEN
CGSB - Canadian General Standards Board	56	Canada/SCC
CSA - Canadian Standards Association	193	Canada/SCC
FM - Factory Mutual	173	USA/None
ISO - International Organisation for Standardisation	28	Switzerland/ISO
ISSA - International Slurry Surfacing Association	11	USA/None
MTO - Ministry of Transportation, Ontario	9	Canada/None
Municipal – Regional Municipalities of Ontario	8	Canada/None
National - Canadian Acts and Regulations	2	Canada/ Not applicable
NCHRP – National Council Highway Research Program	36	Not Applicable
NMS - National Master Specification	252	Canada/None
Ontario - Statutes, Regulations, etc	29	Not applicable
OPS – Ontario Provincial Standards	3	Canada/None
Other - Standards of accredited organizations or other agencies	97	Various
SSPC - Society for Protective Coatings	128	USA/None
UL - Underwriters Laboratory Inc.	23	USA/ANSI
ULC - Underwriters' Laboratories of Canada	30	Canada/SCC
Total number of publications	2084	
Number of Canadian publications	586	
Number of US publications	1332	
Number of other publications	166	

Appendix K: List of CSA Standards that are related to Infrastructure and Climate Change Impacts and Adaptation

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub-Category	Name of CSA Standard	CSA Standard Number
1	Energy	Electricity Networks	GENERAL REQUIREMENTS FOR PRESSURE-RETAINING SYSTEMS AND COMPONENTS IN CANDU NUCLEAR POWER PLANTS	N285.0
2	Energy	Electricity Networks	ZIRCONIUM ALLOY WIRE FOR FUEL-CHANNEL SPACERS	N285.6.5
3	Energy	Electricity Networks	MANAGEMENT SYSTEM REQUIREMENTS FOR NUCLEAR POWER PLANTS	N286
4	Energy	Electricity Networks	GENERAL REQUIREMENTS FOR CONCRETE CONTAINMENT STRUCTURES FOR CANDU NUCLEAR POWER PLANTS	N287.1
5	Energy	Electricity Networks	EXAMINATION AND TESTING REQUIREMENTS FOR CONCRETE CONTAINMENT STRUCTURES FOR CANDU NUCLEAR POWER PLANTS	N287.5
6	Energy	Electricity Networks	PRE-OPERATIONAL PROOF AND LEAKAGE RATE TESTING REQUIREMENTS FOR CONCRETE CONTAINMENT STRUCTURES FOR CANDU NUCLEAR POWER PLANTS	N287.6
7	Energy	Electricity Networks	IN-SERVICE EXAMINATION AND TESTING REQUIREMENTS FOR CONCRETE CONTAINMENT STRUCTURES FOR CANDU NUCLEAR POWER PLANTS	N287.7
8	Energy	Electricity Networks	ENVIRONMENTAL QUALIFICATION OF EQUIPMENT FOR CANDU NUCLEAR POWER PLANTS	N290.13
9	Energy	Electricity Networks	REQUIREMENTS FOR THE SUPPORT POWER SYSTEMS OF CANDU NUCLEAR POWER PLANTS	N290.5
10	Energy	Electricity Networks	REQUIREMENTS FOR MONITORING AND DISPLAY OF CANDU NUCLEAR POWER PLANT STATUS IN THE EVENT OF AN ACCIDENT	N290.6
11	Energy	Electricity Networks	FIRE PROTECTION FOR CANDU NUCLEAR POWER PLANTS	N293

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub-Category	Name of CSA Standard	CSA Standard Number
12	Institutional & Public Buildings	Low rise housing and small buildings	ASPHALT SHINGLES MADE FROM ORGANIC FELT AND SURFACED WITH MINERAL GRANULES	A123.1
13	Institutional & Public Buildings	Low rise housing and small buildings	ASPHALT COATED ROOFING SHEETS	A123.2
14	Institutional & Public Buildings	Low rise housing and small buildings	STANDARD TEST METHOD FOR THE DYNAMIC WIND UPLIFT RESISTANCE OF MECHANICALLY ATTACHED MEMBRANE ROOFING SYSTEMS	A123.21
15	Institutional & Public Buildings	Low rise housing and small buildings	ASPHALT SATURATED ORGANIC ROOFING FELT	A123.3
16	Institutional & Public Buildings	Low rise housing and small buildings	ASPHALT FOR CONSTRUCTING BUILT-UP ROOF COVERINGS AND WATERPROOFING SYSTEMS	A123.4
17	Institutional & Public Buildings	Low rise housing and small buildings	ASPHALT SHINGLES MADE FROM GLASS FELT AND SURFACED WITH MINERAL GRANULES	A123.5
18	Institutional & Public Buildings	Low rise housing and small buildings	ASPHALT SHINGLE APPLICATION ON ROOF SLOPES 1:3 AND STEEPER	A123.51
19	Institutional & Public Buildings	Low rise housing and small buildings	ASPHALT SHINGLE APPLICATION ON ROOF SLOPES 1:6 TO LESS THAN 1:3	A123.52
20	Institutional & Public Buildings	Low rise housing and small buildings	PROCEDURE FOR CERTIFICATION OF FACTORY-BUILT HOUSES	A277
21	Institutional & Public Buildings	Low rise housing and small buildings	STANDARD SPECIFICATION FOR WINDOWS, DOORS AND UNIT SKYLIGHTS	A440
22	Institutional & Public Buildings	Low rise housing and small buildings	USER SELECTION GUIDE TO CSA STANDARD A440-00, WINDOWS	A440.1
23	Institutional & Public Buildings	Energy Efficiency	ENERGY PERFORMANCE OF WINDOWS AND OTHER FENESTRATION SYSTEMS	A440.2
24	Institutional & Public Buildings		USER GUIDE TO CSA A440.2-04, ENERGY PERFORMANCE OF WINDOWS AND OTHER FENESTRATION SYSTEMS	A440.3
25	Institutional & Public Buildings	Low rise housing and small buildings	WINDOW AND DOOR INSTALLATION	A440.4

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub-Category	Name of CSA Standard	CSA Standard Number
26	Institutional & Public Buildings	Low rise housing and small buildings	STANDARD/SPECIFICATION FOR WINDOWS, DOORS AND UNIT SKYLIGHTS	A440H
27	Institutional & Public Buildings	Energy Efficiency	ENERGY PERFORMANCE EVALUATION OF SWINGING DOORS	A453
28	Institutional & Public Buildings	High-rise	CERTIFICATION OF MANUFACTURERS OF STEEL BUILDING SYSTEMS	A660
29	Institutional & Public Buildings	Low rise housing and small buildings	NATURAL AIRFLOW VENTILATORS FOR BUILDINGS	A93
30	Institutional & Public Buildings		DEFINITIONS AND GENERAL SAFETY REQUIREMENTS FOR PARK MODEL TRAILERS	Z241.0
31	Institutional & Public Buildings	Low rise housing and small buildings	CONSTRUCTION REQUIREMENTS FOR PARK MODEL TRAILERS	Z241.2
32	Water	Sanitary Sewer Systems	PLUMBING SYSTEM REQUIREMENTS FOR PARK MODEL TRAILERS	Z241.3
33	Energy	Electricity Networks	INSTALLATION REQUIREMENTS FOR PROPANE APPLIANCES AND EQUIPMENT IN PARK MODEL TRAILERS	Z241.4
34	Energy	Electricity Networks	ELECTRICAL REQUIREMENTS FOR PARK MODEL TRAILERS	Z241.5
35	Transportation Road Lighting Systems		CONCRETE POLES	A14
36	Institutional & Public Buildings	Low rise housing and small buildings	PERFORMANCE OF CONCRETE ROOF TILES	A220.0
37	Institutional & Public Buildings	Low rise housing and small buildings	INSTALLATION OF CONCRETE ROOF TILES	A220.1
38	Institutional & Public Buildings	Low rise housing and small buildings	PLANT CERTIFICATION FOR MANUFACTURERS OF CONCRETE ROOF TILES	A220.2
39	Institutional & Public Buildings	Low rise housing and small buildings	CONCRETE MATERIALS AND METHODS OF CONCRETE CONSTRUCTION	A23.1
40	Institutional & Public Buildings	Low rise housing and small buildings	METHODS OF TEST AND STANDARD PRACTICES FOR CONCRETE	A23.2

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub- Category	Name of CSA Standard	CSA Standard Number
41	Institutional & Public Buildings & Transportation		DESIGN OF CONCRETE STRUCTURES	A23.3
42	Institutional & Public Buildings & Transportation		PRECAST CONCRETE - MATERIALS AND CONSTRUCTION	A23.4
43	Transportation		PRECAST CONCRETE PAVING SLABS	A231.1
44	Transportation		PRECAST CONCRETE PAVERS	A231.2
45	Institutional & Public Buildings & Transportation		QUALIFICATION CODE FOR ARCHITECTURAL AND STRUCTURAL PRECAST CONCRETE PRODUCTS	A251
46	Water		METHODS FOR DETERMINING PHYSICAL PROPERTIES OF CIRCULAR CONCRETE PIPE, MANHOLE SECTIONS, CATCH BASINS AND FITTINGS	A257.0
47	Water		NON-REINFORCED CIRCULAR CONCRETE CULVERT, STORM DRAIN, SEWER PIPE, AND FITTINGS	A257.1
48	Water		REINFORCED CIRCULAR CONCRETE CULVERT, STORM DRAIN, SEWER PIPE, AND FITTINGS	A257.2
49	Water		JOINTS FOR CIRCULAR CONCRETE SEWER AND CULVERT PIPE, MANHOLE SECTIONS, AND FITTINGS USING RUBBER GASKETS	A257.3
50	Water		PRECAST REINFORCED CIRCULAR CONCRETE MANHOLE SECTIONS, CATCH BASINS, AND FITTINGS	A257.4
51	Institutional & Public Buildings & Transportation		QUALIFICATION CODE FOR CONCRETE TESTING LABORATORIES	A283
55	Institutional & Public Buildings & Transportation		CEMENTITIOUS MATERIALS FOR USE IN CONCRETE	A3001
53	Institutional & Public Buildings & Transportation		MASONRY AND MORTAR CEMENT	A3002
54	Institutional & Public Buildings & Transportation		CHEMICAL TEST METHODS FOR CEMENTITIOUS MATERIALS FOR USE IN CONCRETE AND MASONRY	A3003
55	Institutional & Public Buildings & Transportation		PHYSICAL TEST METHODS FOR CEMENTITIOUS MATERIALS FOR USE IN CONCRETE AND MASONRY	A3004

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub-Category	Name of CSA Standard	CSA Standard Number
56	Institutional & Public Buildings & Transportation		TEST EQUIPMENT AND MATERIALS FOR CEMENTITIOUS MATERIALS FOR USE IN CONCRETE AND MASONRY	A3005
57	Institutional & Public Buildings & Transportation		CONCRETE CONSTRUCTION FOR HOUSING AND SMALL BUILDINGS	A438
58	Institutional & Public Buildings		ENGINEERING DESIGN IN WOOD	O86
59	Institutional & Public Buildings		STRENGTH DESIGN IN ALUMINUM	S157
60	Institutional & Public Buildings & Transportation		LIMIT STATES DESIGN OF STEEL STRUCTURES	S16
61	Institutional & Public Buildings & Transportation		FALSEWORK FOR CONSTRUCTION PURPOSES	S269.1
62	Institutional & Public Buildings & Transportation		ACCESS SCAFFOLDING FOR CONSTRUCTION PURPOSES	S269.2
63	Institutional & Public Buildings & Transportation		CONCRETE FORMWORK	S269.3
64	Institutional & Public Buildings & Transportation		DESIGN OF MASONRY STRUCTURES	S304.1
65	Institutional & Public Buildings	Low rise housing and small buildings	LOAD TEST PROCEDURE FOR WOOD ROOF TRUSSES FOR HOUSES AND SMALL BUILDINGS	S307
66	Institutional & Public Buildings	Low rise housing and small buildings	METHOD OF TEST FOR EVALUATION OF TRUSS PLATES USED IN LUMBER JOINTS	S347
67	Institutional & Public Buildings & Transportation		CODE OF PRACTICE FOR SAFETY IN DEMOLITION OF STRUCTURES	S350
68	Institutional & Public Buildings		AIR-SUPPORTED STRUCTURES	S367
69	Communications		ANTENNAS, TOWERS, AND ANTENNA-SUPPORTING STRUCTURES	S37
70	Institutional & Public Buildings	Low rise housing and small buildings	CONSTRUCTION OF PRESERVED WOOD FOUNDATIONS	S406

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub- Category	Name of CSA Standard	CSA Standard Number
71	Institutional & Public Buildings & Transportation		GUIDELINES FOR THE DEVELOPMENT OF LIMIT STATES DESIGN	S408
72	Transportation		PARKING STRUCTURES	S413
73	Institutional & Public Buildings & Transportation		GUIDELINE ON DURABILITY OF BUILDINGS	S478
74	Transportation		CANADIAN HIGHWAY BRIDGE DESIGN CODE	S6
75	Transportation		COMMENTARY ON CAN/CSA-S6-00, CANADIAN HIGHWAY BRIDGE DESIGN CODE	S6.1
76	Institutional & Public Buildings		DESIGN AND CONSTRUCTION OF BUILDING COMPONENTS WITH FIBRE-REINFORCED POLYMERS	S806
77	Institutional & Public Buildings		GUIDELINE FOR SEISMIC RISK REDUCTION OF OPERATIONAL AND FUNCTIONAL COMPONENTS (OFCS) OF BUILDINGS	S832
78	Institutional & Public Buildings	HVAC Systems	INSTALLATION CODE FOR OIL- BURNING EQUIPMENT	B139
79	Institutional & Public Buildings	HVAC Systems	OIL BURNING EQUIPMENT: GENERAL REQUIREMENTS	B140.0
80	Institutional & Public Buildings	HVAC Systems	VAPOURIZING-TYPE OIL BURNERS	B140.1
81	Institutional & Public Buildings	HVAC Systems	AUTOMATIC FLUE-PIPE DAMPERS FOR USE WITH OIL-FIRED APPLIANCES	B140.14
82	Institutional & Public Buildings	HVAC Systems	PRESSURE ATOMIZING OIL BURNER NOZZLES	B140.2.2
83	Institutional & Public Buildings	HVAC Systems	OIL BURNING STOVES AND WATER HEATERS	B140.3
84	Institutional & Public Buildings	HVAC Systems	OIL-FIRED WARM AIR FURNACES	B140.4
85	Institutional & Public Buildings	HVAC Systems	OIL-FIRED STEAM AND HOT- WATER BOILERS FOR RESIDENTIAL USE	B140.7.1
86	Institutional & Public Buildings	HVAC Systems	OIL-FIRED STEAM AND HOT- WATER BOILERS FOR COMMERCIAL AND INDUSTRIAL USE	B140.7.2
87	Institutional & Public Buildings	HVAC Systems	PORTABLE INDUSTRIAL OIL-FIRED HEATERS	B140.8
88	Institutional & Public Buildings	HVAC Systems	PORTABLE LIQUID FUELLED CATALYTIC APPLIANCES	B140.9.1

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub- Category	Name of CSA Standard	CSA Standard Number
89	Institutional & Public Buildings	Energy Efficiency	ENERGY UTILIZATION EFFICIENCIES OF OIL-FIRED FURNACES AND BOILERS	B212
90	Institutional & Public Buildings	HVAC Systems	MECHANICAL FLUE-GAS EXHAUSTERS	B255
91	Institutional & Public Buildings	HVAC Systems	POWER-OPERATED DISPENSING DEVICES FOR FLAMMABLE LIQUIDS	B346
92	Institutional & Public Buildings	HVAC Systems	INSTALLATION CODE FOR SOLID- FUEL-BURNING APPLIANCES AND EQUIPMENT	B365
93	Institutional & Public Buildings	HVAC Systems	SOLID-FUEL-FIRED CENTRAL HEATING APPLIANCES	B366.1
94	Institutional & Public Buildings	HVAC Systems	PORTABLE CONTAINERS FOR GASOLINE AND OTHER PETROLEUM FUELS	B376
95	Transportation	Aerodromes	STORAGE, HANDLING, AND DISPENSING OF AVIATION FUELS AT AERODROMES	B836
96	Energy	Electrical Network	EMERGENCY ELECTRICAL POWER SUPPLY FOR BUILDINGS	C282
97	Energy	Electrical Network	INSTALLATION AND MAINTENANCE OF FARM STANDBY ELECTRIC POWER	C679
98	Water	Potable Water	PLUMBING FITTINGS	B125
99	Water	Wastewater	ASBESTOS CEMENT DRAIN, WASTE, AND VENT PIPE AND PIPE FITTINGS	B127.1
100	Water	Potable Water	POLYETHYLENE PIPE, TUBING, AND FITTINGS FOR COLD-WATER PRESSURE SERVICES	B137.1
101	Water	Potable Water	CROSSLINKED POLYETHYLENE/ALUMINUM/CROS SLINKED POLYETHYLENE COMPOSITE PRESSURE-PIPE SYSTEMS	B137.10
102	Water	Potable Water	POLYPROPYLENE (PP-R) PIPE AND FITTINGS FOR PRESSURE APPLICATIONS	B137.11
103	Energy	Gas Distribution	POLYAMIDE PIPING SYSTEMS FOR GAS SERVICES	B137.12
104	Water	Potable Water	PVC INJECTION-MOULDED GASKETED FITTINGS FOR PRESSURE APPLICATIONS	
105	Water	Potable Water	RIGID POLYVINYL CHLORIDE (PVC) PIPE FOR PRESSURE APPLICATIONS	B137.3

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub- Category	Name of CSA Standard	CSA Standard Number
106	Energy	Gas Distribution	POLYETHYLENE PIPING SYSTEMS FOR GAS SERVICES	B137.4
107	Energy	Gas Distribution	ELECTROFUSION-TYPE POLYETHYLENE FITTINGS FOR GAS SERVICES	B137.4.1
108	Water	Potable Water	CROSSLINKED POLYETHYLENE (PEX) TUBING SYSTEMS FOR PRESSURE APPLICATIONS	B137.5
109	Water	Potable Water	CPVC PIPE, TUBING AND FITTINGS FOR HOT- AND COLD-WATER DISTRIBUTION SYSTEMS	B137.6
110	Water	Potable Water	POLYBUTYLENE (PB) PIPING FOR PRESSURE APPLICATIONS	B137.8
111	Water	Potable Water	POLYETHYLENE/ALUMINIUM/POLY ETHYLENE COMPOSITE PRESSURE-PIPE SYSTEMS	B137.9
112	Water	Sanitary Sewer Systems	ABS DRAIN, WASTE, AND VENT PIPE AND PIPE FITTINGS	B181.1
113	Water	Sanitary Sewer Systems	PVC DRAIN, WASTE, AND VENT PIPE AND PIPE FITTINGS	B181.2
114	Water	Sanitary Sewer Systems	POLYOLEFIN LABORATORY DRAINAGE SYSTEMS	B181.3
115	Water	Sanitary Sewer Systems	COEXTRUDED ABS/PVC DRAIN, WASTE AND VENT PIPE	B181.5
116	Communications		PVC UNDERGROUND TELECOMMUNICATION CABLE DUCTING AND FITTINGS	B196.3
117	Water	Sanitary Sewer Systems	GROOVE AND SHOULDER TYPE MECHANICAL PIPE COUPLINGS	B242
118	Water	Potable Water	WATER PRESSURE REDUCING VALVES FOR DOMESTIC WATER SUPPLY SYSTEMS	B356
119	Water	Potable Water	GENERAL REQUIREMENTS FOR PLUMBING FIXTURES	B45.0
120	Water	Potable Water	CERAMIC PLUMBING FIXTURES	B45.1
121	Water	Sanitary Sewer Systems	GLASS LAVATORIES	B45.11
122	Water	Potable Water	ENAMELLED CAST-IRON PLUMBING FIXTURES	B45.2
123	Water	Potable Water	PORCELAIN-ENAMELLED STEEL PLUMBING FIXTURES	B45.3
124	Water	Potable Water	STAINLESS STEEL PLUMBING FIXTURES	B45.4

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub- Category	Name of CSA Standard	CSA Standard Number
125	Water	Potable Water	PLASTIC PLUMBING FIXTURES	B45.5
126	Water	Sanitary Sewer Systems	TERRAZZO PLUMBING FIXTURES	B45.8
127	Water	Sanitary Sewer Systems	MACERATING SYSTEMS AND RELATED COMPONENTS	B45.9
128	Water	Sanitary Sewer Systems	MECHANICAL COUPLINGS FOR DRAIN, WASTE, AND VENT PIPE AND SEWER PIPE	B602
129	Water	Potable water	DEFINITIONS, GENERAL REQUIREMENTS, AND TEST METHODS FOR VACUUM BREAKERS AND BACKFLOW PREVENTERS	B64.0
130	Water	Potable water	VACUUM BREAKERS, ATMOSPHERIC TYPE (AVB)	B64.1.1
131	Water	Potable water	VACUUM BREAKERS, PRESSURE TYPE (PVB)	B64.1.2
132	Water	Potable water	VACUUM BREAKERS, SPILL- RESISTANT PRESSURE TYPE (SRPVB)	B64.1.3
133	Water	Potable water	MANUAL FOR THE SELECTION AND INSTALLATION OF BACKFLOW PREVENTION DEVICES	B64.10
134	Water	Potable water	MANUAL FOR THE MAINTENANCE AND FIELD TESTING OF BACKFLOW PREVENTION DEVICES	B64.10.1
135	Water	Potable water	VACUUM BREAKERS, HOSE CONNECTION TYPE (HCVB)	B64.2
136	Water	Potable water	VACUUM BREAKERS, HOSE CONNECTION TYPE (HCVB) WITH MANUAL DRAINING FEATURE	B64.2.1
137	Water	Potable water	VACUUM BREAKERS, HOSE CONNECTION DUAL CHECK TYPE (HCDVB)	B64.2.1.1
138	Water	Potable water	VACUUM BREAKERS, HOSE CONNECTION TYPE (HCVB) WITH AUTOMATIC DRAINING FEATURE	B64.2.2
139	Water	Potable water	BACKFLOW PREVENTERS, DUAL CHECK VALVE TYPE WITH ATMOSPHERIC PORT (DCAP)	B64.3

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub- Category	Name of CSA Standard	CSA Standard Number
140	Water	Potable water	BACKFLOW PREVENTERS, DUAL CHECK VALVE TYPE WITH ATMOSPHERIC PORT FOR CARBONATORS (DCAPC)	B64.3.1
141	Water	Potable water	BACKFLOW PREVENTERS, REDUCED PRESSURE PRINCIPLE TYPE (RP)	B64.4
142	Water	Fire Protection	BACKFLOW PREVENTERS, REDUCED PRESSURE PRINCIPLE TYPE FOR FIRE SYSTEMS (RPF)	B64.4.1
143	Water	Fire Protection	BACKFLOW PREVENTERS, DOUBLE CHECK VALVE TYPE (DCVA)	B64.5
144	Water	Fire Protection	BACKFLOW PREVENTERS, DOUBLE CHECK VALVE TYPE FOR FIRE SYSTEMS (DCVAF)	B64.5.1
145	Water	Fire Protection	BACKFLOW PREVENTERS, DUAL CHECK VALVE TYPE (DUC)	B64.6
146	Water	Potable water	BACKFLOW PREVENTERS, DUAL CHECK VALVE TYPE FOR FIRE SYSTEMS (DUCF)	B64.6.1
147	Water	Potable water	VACUUM BREAKERS, LABORATORY FAUCET TYPE (LFVB)	B64.7
148	Water	Potable water	BACKFLOW PREVENTERS, DUAL CHECK VALVE TYPE WITH INTERMEDIATE VENT (DUCV)	B64.8
149	Water	Fire Protection	BACKFLOW PREVENTERS, SINGLE CHECK VALVE TYPE FOR FIRE SYSTEMS (SCVAF)	B64.9
150	Water	Sanitary Sewer Systems	PREFABRICATED SEPTIC TANKS AND SEWAGE HOLDING TANKS	B66
151	Water		CAST IRON SOIL PIPE, FITTINGS, AND MEANS OF JOINING	B70
152	Water	Wastewater	FRAMES AND COVERS FOR MAINTENANCE HOLES AND CATCHBASINS	B70.1
153	Water	Wastewater	FLOOR, AREA, AND SHOWER DRAINS, AND CLEANOUTS FOR RESIDENTIAL CONSTRUCTION	B79
154	Energy	Electrical Component	BALLASTS FOR DISCHARGE LAMPS (EXCLUDING TUBULAR FLUORESCENT LAMPS) - GENERAL SAFETY REQUIREMENTS	E922

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub- Category	Name of CSA Standard	CSA Standard Number
155	Energy	Electrical Component	AUXILIARIES FOR LAMPS - A.C. SUPPLIED ELECTRONIC BALLASTS FOR TUBULAR FLUORESCENT LAMPS - GENERAL AND SAFETY REQUIREMENTS	E928
156	Energy	Electricity Networks	OVERHEAD SYSTEMS	C22.3 NO. 1
157	Energy	Electricity Networks	ELECTRICAL COORDINATION	C22.3 NO. 3
158	Energy	Electricity Networks	RECOMMENDED PRACTICES FOR ELECTRICAL PROTECTION-- ELECTRICAL CONTACT BETWEEN OVERHEAD SUPPLY AND COMMUNICATIONS LINES	C22.3 NO. 5.1
159	Energy	Electricity Networks	PRINCIPLES AND PRACTICES OF ELECTRICAL COORDINATION BETWEEN PIPELINES AND ELECTRIC SUPPLY LINES	C22.3 NO. 6
160	Energy	Electricity Networks	UNDERGROUND SYSTEMS	C22.3 NO. 7
161	Energy	Electricity Networks	RAILWAY ELECTRIFICATION GUIDELINES	C22.3 NO. 8
162	Energy	HVAC Systems	WATER-SOURCE HEAT PUMPS - TESTING AND RATING FOR PERFORMANCE - PART 1: WATER- TO-AIR AND BRINE-TO-AIR HEAT PUMPS	C13256-1
163	Energy	HVAC Systems	WATER-SOURCE HEAT PUMPS - TESTING AND RATING FOR PERFORMANCE - PART 2: WATER- TO-WATER AND BRINE-TO-WATER HEAT PUMPS	C13256-2
164	Energy	Electricity Networks	PERFORMANCE STANDARD FOR DUSK-TO-DAWN LUMINAIRES	C239
165	Institutional & Public Buildings	HVAC Systems	RATING THE PERFORMANCE OF RESIDENTIAL MECHANICAL VENTILATING EQUIPMENT	C260
166	Energy	HVAC Systems	PERFORMANCE STANDARD FOR SPLIT-SYSTEM CENTRAL AIR- CONDITIONERS AND HEAT PUMPS	C273.3
167	Institutional & Public Buildings	HVAC Systems	INSTALLATION REQUIREMENTS FOR AIR-TO-AIR HEAT PUMPS	C273.5

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub-Category	Name of CSA Standard	CSA Standard Number
168	Institutional & Public Buildings	Energy Efficiency	ENERGY PERFORMANCE, WATER CONSUMPTION, AND CAPACITY OF AUTOMATIC HOUSEHOLD CLOTHES WASHERS	C360
169	Institutional & Public Buildings	HVAC Systems	STANDARD LABORATORY METHODS OF TEST FOR RATING THE PERFORMANCE OF HEAT/ENERGY-RECOVERY VENTILATORS	C439
170	Institutional & Public Buildings	HVAC Systems	DESIGN AND INSTALLATION OF EARTH ENERGY SYSTEMS FOR COMMERCIAL AND INSTITUTIONAL BUILDINGS	C448.1
171	Institutional & Public Buildings	HVAC Systems	DESIGN AND INSTALLATION OF EARTH ENERGY SYSTEMS FOR RESIDENTIAL AND OTHER SMALL BUILDINGS	C448.2
172	Institutional & Public Buildings	HVAC Systems	DESIGN AND INSTALLATION OF UNDERGROUND THERMAL ENERGY STORAGE SYSTEMS FOR COMMERCIAL AND INSTITUTIONAL BUILDINGS	C448.3
173	Institutional & Public Buildings	HVAC Systems	INSTALLATION OF ELECTRIC STORAGE TANK AND HEAT PUMP WATER HEATERS FOR RESIDENTIAL USE	C652
174	Transportation	Roadway lighting	PERFORMANCE STANDARD FOR ROADWAY LIGHTING LUMINAIRES	C653
175	Institutional & Public Buildings	HVAC Systems	PERFORMANCE STANDARD FOR SINGLE PACKAGE CENTRAL AIR-CONDITIONERS AND HEAT PUMPS	C656
176	Institutional & Public Buildings	HVAC Systems	ENERGY PERFORMANCE STANDARD FOR REFRIGERATED DISPLAY CABINETS (MERCHANTISERS)	C657
177	Institutional & Public Buildings	Energy Efficiency	PERFORMANCE OF AUTOMATIC ICE-MAKERS AND ICE STORAGE BINS	C742
178	Institutional & Public Buildings	HVAC Systems	PERFORMANCE STANDARD FOR RATING PACKAGED WATER CHILLERS	C743
179	Institutional & Public Buildings	Energy Efficiency	STANDARD FOR PACKAGED TERMINAL AIR-CONDITIONERS AND HEAT PUMPS	C744

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub-Category	Name of CSA Standard	CSA Standard Number
180	Institutional & Public Buildings	Energy Efficiency	ENERGY EFFICIENCY OF ELECTRIC STORAGE TANK WATER HEATERS AND HEAT PUMP WATER HEATERS	C745
181	Institutional & Public Buildings	Energy Efficiency	PERFORMANCE STANDARD FOR RATING LARGE AIR CONDITIONERS AND HEAT PUMPS	C746
182	Institutional & Public Buildings	Energy Efficiency	PERFORMANCE OF DEHUMIDIFIERS	C749
183	Energy	Energy Efficiency	MINIMUM EFFICIENCY VALUES FOR DRY-TYPE TRANSFORMERS	C802.2
184	Energy	Energy Efficiency	MAXIMUM LOSSES FOR POWER TRANSFORMERS	C802.3
185	Transportation	Energy Efficiency	PERFORMANCE OF HIGHMAST LUMINAIRES FOR ROADWAY LIGHTING	C811
186	Institutional & Public Buildings	Energy Efficiency	PERFORMANCE TEST METHOD FOR UNINTERRUPTIBLE POWER SUPPLIES	C813.1
187	Institutional & Public Buildings	Energy Efficiency	ENERGY PERFORMANCE OF CEILING FANS	C814
188	Institutional & Public Buildings	Energy Efficiency	ENERGY PERFORMANCE OF DRINKING-WATER COOLERS	C815
189	Institutional & Public Buildings	Energy Efficiency	PERFORMANCE OF GENERAL SERVICE FLUORESCENT LAMPS	C819
190	Institutional & Public Buildings	Energy Efficiency	ENERGY EFFICIENCY TEST METHODS FOR SMALL PUMPS	C820
191	Institutional & Public Buildings	Energy Efficiency	ENERGY PERFORMANCE STANDARD FOR FOOD SERVICE REFRIGERATORS AND FREEZERS	C827
192	Institutional & Public Buildings	Energy Efficiency	PERFORMANCE OF INTERNALLY LIGHTED EXIT SIGNS	C860
193	Institutional & Public Buildings	Energy Efficiency	PERFORMANCE OF COMPACT FLUORESCENT LAMPS AND BALLASTED ADAPTERS	C861
194	Institutional & Public Buildings	Energy Efficiency	PERFORMANCE OF INCANDESCENT REFLECTOR LAMPS	C862

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub-Category	Name of CSA Standard	CSA Standard Number
195	Transportation	Roadway Lighting	ENERGY EFFICIENCY OF HIGH-INTENSITY DISCHARGE (HID) AND LOW-PRESSURE SODIUM (LPS) LAMP BALLASTS	C863
196	Institutional & Public Buildings	HVAC System	RESIDENTIAL MECHANICAL VENTILATION SYSTEMS	F326
197	Transportation	Stormwater	CORRUGATED STEEL PIPE PRODUCTS	G401
198	Institutional & Public Buildings	Occupational health and safety	SAFETY IN WELDING, CUTTING AND ALLIED PROCESSES	W117.2
199	Institutional & Public Buildings	Occupational health and safety	CERTIFICATION OF WELDING INSPECTION ORGANIZATIONS	W178.1
200	Institutional & Public Buildings	Occupational health and safety	CERTIFICATION OF WELDING INSPECTORS	W178.2
201	Transportation		WELDING OF REINFORCING BARS IN REINFORCED CONCRETE CONSTRUCTION	W186
202	Transportation		CERTIFICATION OF COMPANIES FOR FUSION WELDING OF STEEL	W47.1
203	Transportations		WELDED STEEL CONSTRUCTION (METAL ARC WELDING)	W59
204	Energy	Gas Systems	STEEL PIPE	Z245.1
205	Energy	Gas systems	STEEL FITTINGS	Z245.11
206	Energy	Gas systems	STEEL FLANGES	Z245.12
207	Energy	Gas systems	STEEL VALVES	Z245.15
208	Energy	Gas systems	COILED ALUMINUM LINE PIPE AND ACCESSORIES	Z245.6
209	Energy	Gas systems	STORAGE OF HYDROCARBONS IN UNDERGROUND FORMATIONS - RESERVOIR STORAGE	Z341.1
210	Energy	Gas systems	STORAGE OF HYDROCARBONS IN UNDERGROUND FORMATIONS - SALT CAVERN STORAGE	Z341.2
211	Energy	Gas systems	STORAGE OF HYDROCARBONS IN UNDERGROUND FORMATIONS - MINED CAVERN STORAGE	Z341.3
212	Institutional & Public Buildings	Fire Protection	TEST METHODS FOR IN-LINE AND FIREBOX FLAME ARRESTERS	Z343
213	Energy	Oil & Gas Systems	OIL AND GAS PIPELINE SYSTEMS	Z662

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub- Category	Name of CSA Standard	CSA Standard Number
214	Institutional & Public Buildings	HVAC Systems	GAS-FIRED APPLIANCES FOR OUTDOOR INSTALLATION	CAN1-2.21
215	Institutional & Public Buildings	HVAC Systems	LEVER OPERATED PRESSURE LUBRICATED PLUG TYPE GAS SHUT-OFF VALVES	CGA 3.11
216	Institutional & Public Buildings	HVAC Systems	LEVER OPERATED NON-LUBRICATED GAS-SHUT-OFF VALVES	CGA 3.16
217	Institutional & Public Buildings	HVAC Systems	ELASTOMERIC COMPOSITE HOSE AND HOSE COUPLINGS FOR CONDUCTING PROPANE AND NATURAL GAS	CGA 8.1
218	Institutional & Public Buildings	HVAC Systems	VENTED GAS FIREPLACES	CSA 2.22
219	Institutional & Public Buildings	HVAC Systems	DECORATIVE GAS APPLIANCES FOR INSTALLATION IN SOLID-FUEL BURNING FIREPLACES	CSA 2.26
220	Institutional & Public Buildings	HVAC Systems	GAS-FIRED CENTRAL FURNACES	CSA 2.3
221	Institutional & Public Buildings	HVAC Systems	GAS UNIT HEATERS AND GAS-FIRED DUCT FURNACES	CSA 2.6
222	Institutional & Public Buildings	HVAC Systems	GAS WATER HEATERS, VOLUME 1, STORAGE WATER HEATERS WITH INPUT RATINGS OF 75,000 BTU PER HOUR OR LESS	CSA 4.1
223	Institutional & Public Buildings	HVAC Systems	GAS WATER HEATERS - VOLUME III, STORAGE WATER HEATERS WITH INPUT RATINGS ABOVE 75,000 BTU PER HOUR, CIRCULATING AND INSTANTANEOUS	CSA 4.3
224	Institutional & Public Buildings	HVAC Systems	RELIEF VALVES FOR HOT WATER SUPPLY SYSTEMS	CSA 4.4
225	Institutional & Public Buildings	HVAC Systems	GAS-FIRED POOL HEATERS	CSA 4.7
226	Institutional & Public Buildings	HVAC Systems	GAS-FIRED LOW-PRESSURE STEAM AND HOT WATER BOILERS	CSA 4.9
227	Institutional & Public Buildings	HVAC Systems	CONNECTORS FOR GAS APPLIANCES	CSA 6.10
228	Institutional & Public Buildings	HVAC Systems	CONNECTORS FOR MOVABLE GAS APPLIANCES	CSA 6.16
229	Institutional & Public Buildings	HVAC Systems	SERVICE REGULATORS FOR NATURAL GAS	CSA 6.18
230	Institutional & Public Buildings	HVAC Systems	RESIDENTIAL CARBON MONOXIDE ALARMING DEVICES	CSA 6.19

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub- Category	Name of CSA Standard	CSA Standard Number
231	Institutional & Public Buildings	HVAC Systems	LINE PRESSURE REGULATORS	CSA 6.22
232	Institutional & Public Buildings	HVAC Systems	GAS CONVENIENCE OUTLETS AND OPTIONAL ENCLOSURES	CSA 6.24
233	Institutional & Public Buildings	HVAC Systems	CYLINDER CONNECTION DEVICES	CSA 6.25
234	Institutional & Public Buildings	HVAC Systems	FUEL GAS PIPING SYSTEMS USING CORRUGATED STAINLESS STEEL TUBING (CSST)	CSA 6.26
235	Institutional & Public Buildings	HVAC Systems	CONNECTORS FOR OUTDOOR GAS APPLIANCES AND MANUFACTURED HOMES	CSA 6.27
236	Institutional & Public Buildings	HVAC Systems	AUTOMATIC VALVES FOR GAS APPLIANCES	CSA 6.5
237	Institutional & Public Buildings	HVAC Systems	QUICK DISCONNECT DEVICES FOR USE WITH GAS FUEL APPLIANCES	CSA 6.9
238	Institutional & Public Buildings	Energy Efficiency	TESTING METHOD FOR MEASURING ENERGY CONSUMPTION AND DETERMINING EFFICIENCIES OF GAS-FIRED STORAGE WATER HEATERS	P.3
239	Institutional & Public Buildings	Energy Efficiency	TESTING METHOD FOR MEASURING ANNUAL FIREPLACE EFFICIENCY	P.4.1
240	Energy	Energy Efficiency	TESTING METHOD FOR MEASURING ENERGY LOSS OF GAS-FIRED INSTANTANEOUS WATER HEATERS	P.7
241	Energy	Oil & Gas Systems	CODE FOR DIGESTER GAS AND LANDFILL GAS INSTALLATIONS	B105
242	Energy	Oil & Gas System	NATURAL GAS FUELLING STATIONS INSTALLATION CODE	B108
243	Institutional & Public Buildings	Oil & Gas System	NATURAL GAS AND PROPANE INSTALLATION CODE	B149.1
244	Institutional & Public Buildings	Oil & Gas System	B149.1 POCKET REFERENCE 2005	B149.1PR
245	Institutional & Public Buildings	Gas Distribution	PROPANE STORAGE AND HANDLING CODE	B149.2
246	Institutional & Public Buildings	Gas Distribution	CODE FOR THE FIELD APPROVAL OF FUEL-RELATED COMPONENTS ON APPLIANCES AND EQUIPMENT	B149.3
247	Institutional & Public Buildings	Gas Distribution	NATURAL GAS AND PROPANE INSTALLATION CODE HANDBOOK	B149HB

No.	Infrastructure Category as per proposed Definition of Infrastructure	Infrastructure Sub- Category	Name of CSA Standard	CSA Standard Number
248	Institutional & Public Buildings	Gas Distribution	QUEBEC SUPPLEMENT - 2003 FOR USE WITH CSA B149.1-00 NATURAL GAS AND PROPANE INSTALLATION CODE AND CSA B149.2-00 PROPANE STORAGE AND HANDLING CODE	B149S1
249	Transportation		CARRIER SAFETY MANAGEMENT SYSTEM ESSENTIALS: GUIDELINES TO ASSIST IN THE IMPLEMENTATION OF A CARRIER SAFETY MANAGEMENT SYSTEM AND IN UNDERSTANDING CSA STANDARD B619-00	PLUS 1161
250	Culture, Recreation and Tourism Facilities		WHAT'S NEW IN CAN/CSA-Z614	PLUS 614
251	Culture, Recreation and Tourism Facilities		CHILDREN'S PLAYSPACES AND EQUIPMENT	Z614
252	All		EMERGENCY PREPAREDNESS AND RESPONSE	Z731
253	All	Stakeholder engagement	A GUIDE TO PUBLIC INVOLVEMENT	Z764
254	Institutional & Public Buildings/Transportation	High rise commercial and industrial buildings/Railways/Seaports, harbours, dry docks, Marina	SAFETY STANDARD FOR MAINTENANCE AND INSPECTION OF OVERHEAD CRANES, GANTRY CRANES, MONORAILS, HOISTS, AND TROLLEYS	B167
255	Institutional & Public Buildings	HVAC Systems	GUIDELINE FOR MANAGING INDOOR AIR QUALITY IN OFFICE BUILDINGS	Z204
256	Institutional & Public Buildings		SIGNS AND SYMBOLS FOR THE WORKPLACE	Z321
257	Institutional & Public Buildings		SAFEGUARDING OF MACHINERY	Z432
258	Institutional & Public Buildings		HEALTH AND SAFETY CODE FOR SUSPENDED EQUIPMENT OPERATIONS	Z91