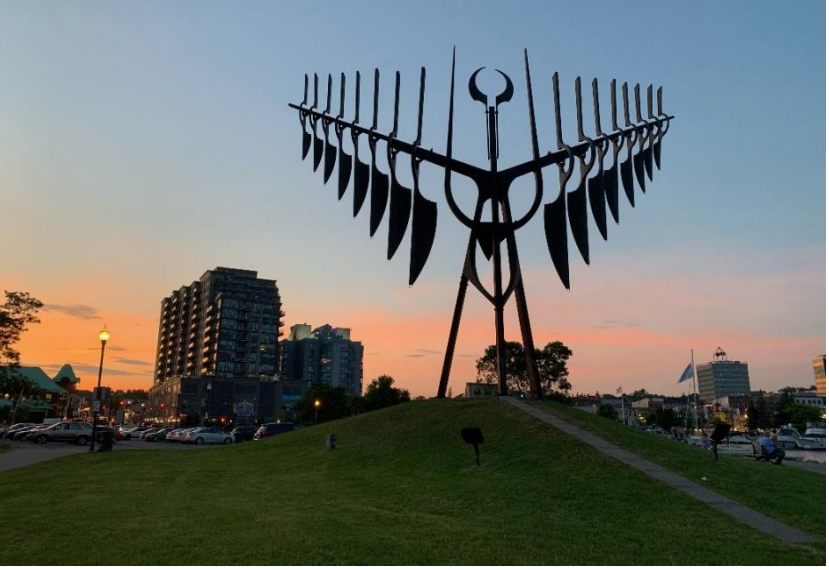

Ontario Provincial Climate Change Impact Assessment

Technical Report Appendices

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The following ministries comprised the IAIC:

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Ontario Ministry of Energy

Ontario Ministry of Environment, Conservation and Parks

Ontario Ministry of Finance

Ontario Ministry of Health

Ontario Ministry of Infrastructure

Ontario Ministry of Labour, Immigration, Training and Skills Development

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Infrastructure Ontario

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Appendix 1: Area of Focus Characterization

Food and Agriculture

Table 1.1: Food and Agriculture Level 2 Category Descriptions

Level 1 Category	Level 2 Category	Description
Field Crops	Cereals	Cereal crops are an integral part of the cropping system in Ontario, grown on approximately 25% of the arable land. Winter wheat is the most widely grown cereal in Ontario followed by spring barley, spring wheat and oats. Cereals offer many benefits to producers, from excellent profit potential to greatly improved soil structure and manure management options, as well as spreading out the workload. Cereals respond very well to management and with attention to detail, many producers find cereals to be one of their most profitable crops.
Field Crops	Forages	Forages are whole plants harvested for livestock feed. They are an important component of crop rotations on many farms. Forages provide many crop rotation and environmental benefits, including reduced soil erosion, and improved soil health and organic matter. Forages are a major Ontario crop, providing feed for Ontario's livestock industry. Hay and haylage are grown on 831,000 ha (2,000,000 acres), while there are 239,000 ha (600,000 acres) of seeded pasture and 415,000 ha (1,037,000 acres) of natural pasture. Corn silage is grown on approximately 104,000 ha (260,000 acres). The value of forage production is estimated to be about 10% of Ontario's agricultural production.
Field Crops	Soybeans	Soybeans have become the largest row crop by acreage in the province. Over 1.0 million ha (2.47 million acres) of soybeans are grown annually in Ontario. The year 2014 was the first time that acreage reached 1.21 million ha (3.0 million acres). The development of early maturing varieties, adaptability to no-till production, a wide selection of herbicides and the relative low cost of production have contributed to the widespread adoption of soybeans.
Field Crops	Corn	Corn is widely grown across southern Ontario. Over the years 2004–2015, grain corn acreage averaged 769,000 ha (1.9 million acres) with an average yield of 9.53 t/ha (152 bu/acre). An additional 118,000 ha (0.3 million acres) is grown as corn silage

Level 1 Category	Level 2 Category	Description
		for livestock feed. Grain corn produced within the province is used for both feed (55%) and industrial (45%) uses.
Field Crops	Canola	Canola is a cool-season oilseed crop well suited to the cool, temperate areas of Ontario and is grown on over 18,000 hectares (45,000 acres). Seeding and management of winter canola are similar to that of spring canola.
Livestock	Beef	The beef sector in Ontario includes cow-calf and feedlot operations engaged in breeding and handling of beef cows, steers, heifers and calves. There are 1,120,000 beef cattle managed on over 7,900 farms. Farm gate sales revenue of Ontario's beef industry is almost $1.4 billion, with processing and retail revenue of $3.5 and $9 billion, respectively.
Livestock	Sheep	The sheep sector in Ontario includes farming operations engaged in breeding and handling of sheep (ewes, rams and lambs). There are 322,000 sheep managed on 2,800 farms, representing sheep, lamb and wool industries. The largest number of sheep farms are located in Western Ontario (mostly in Grey, Bruce, Huron and Wellington counties). Farm cash receipts for Ontario's sheep sector were $73.7 million in 2016, coming from meat and wool sales.
Livestock	Swine	The swine sector in Ontario includes farming operations engaged in breeding and handling of pigs. In 2021 there were over4 million pigs managed on 2,437 farms, with the annual number of marketed pigs of over 5,400,000. Southwestern Ontario (primarily Perth, Huron and Wellington/Dufferin and Oxford counties) is the center of Ontario's swine industry, both in terms of the number of farms and the number of animals raised. Farm cash receipts for Ontario's swine sector were $1.12 billion in 2016.
Livestock	Dairy	The dairy sector in Ontario includes 3,800 farms engaged in breeding, raising and handling of dairy calves, heifers (young female cows that have not yet given birth) and cows. The total number of dairy cattle in the province is over 485,000 animals. Dairy products generate close to $2 billion in market receipts and are Ontario's top agricultural commodity.
Livestock	Poultry and Eggs	The poultry and eggs sector in Ontario includes farming operations engaged in breeding and handling of chickens, ducks,

Level 1 Category	Level 2 Category	Description
		turkeys and gamebirds. Chickens and ducks can be a source of eggs, meat or both; turkeys and gamebirds are raised for meat. In 2021 there were over 53,800,000 chickens (laying hens, pullets, broilers and roasters) and 2,453,000 turkeys managed on 8,051 and 1,816 farms, respectively. Farm cash receipts for Ontario's poultry sector (chicken, eggs and turkeys) were over $1.6 billion in 2019.
Fruits and Vegetables	Apples	Apples are produced in Ontario under diverse soil and climatic conditions. There are 15 different main varieties of apples are grown on nearly 14,000 acres in Ontario, as of 2019. The province's major apple-producing areas are along the shores of Lake Ontario, Lake Erie, Lake Huron and Georgian Bay. In recent years, the Ontario apple crop has averaged about 0.25 million metric tonnes or 13.7 million bushels. The farm gate value of the Ontario apple crop in 2019 was approximately $93 million, which includes sales to fresh and processing markets and on-farm/pick-your-own.
Fruits and Vegetables	Berries	Strawberries, raspberries and blueberries are grown across the province, mostly around major urban centres. Other types of berries grown in the province include blackberries, currants, gooseberries and cranberries. Berry crops are generally grown on the best agricultural soils, requiring excellent drainage and high organic matter for optimum production. Attention to detail is required at all stages of berry production, from planning, planting, and crop management, to managing pests, harvesting, cooling or field heat removal and marketing. In 2019 Ontario berry crops were grown on 3,400 acres of land and had annual farm gate value of over $44 million.
Fruits and Vegetables	Grapes	Grapes grown in Ontario include native labrusca types for processed juice and fresh market, French hybrid and Vitis vinifera types for wine. The Niagara Peninsula is the province's largest grape growing region, followed by Essex-Kent. Prince Edward County is an emerging area for grape production. Vitis vinifera types account for approximately 55% of Ontario's production and the trend is increasing each year. French hybrids represent 25% and labrusca 20%. Ontario produces over 85% of Canada's domestic wines on 17,500 acres of vineyard in the

Level 1 Category	Level 2 Category	Description
		Niagara Peninsula, southwestern Ontario and Prince Edward County. The gate value of grapes in 2019 was over $112 million.
Fruits and Vegetables	Tender Fruit	Tender fruit production includes peaches and nectarines, pears, sweet and sour cherries, plums and apricots. In 2019 tender fruit were grown on over 12,500 acres of land. The most important tender fruit-growing area in Ontario is the Niagara Peninsula, followed by Essex and Kent counties and Lake Huron shoreline (Huron and Lambton counties). Ontario tender fruit gate value in 2019 was almost $83 million, the largest share ($27.5 million) attributed to peaches.
Fruits and Vegetables	Field Vegetables	Field vegetables are grown on over 160,000 acres of Ontario farmland. Major field vegetables grown in Ontario include sweet corn, potatoes, green peas, tomatoes, green and wax beans, carrots, and pumpkins. Less commonly grown field vegetables are onions, cucumbers, peppers, broccoli, cabbage, and asparagus. Ontario field vegetables (excluding potatoes) gate value in 2019 was over $590 million.
Fruits and Vegetables	Greenhouse Vegetables	Greenhouse vegetables in Ontario are grown on over 3,000 acres and include tomatoes, cucumbers and peppers. 2019 gate value for greenhouse vegetables was $376 million, $339 million, and $301 million for tomatoes, cucumbers, and peppers, respectively.

Infrastructure

Table 1.2: Infrastructure Level 2 Category Descriptions

Level 1 Category	Level 2 Category	Level 2 Description
Utilities	Water Supply and Irrigation Systems	Covers potable and non-potable water supply sources and the distribution infrastructure of the water such as irrigation systems.
	Sewage Treatment Facilities	Covers sewer systems and sewage treatment facilities that collect, treat, and dispose of wastewater.
	Electrical Power Generation	Covers facilities primarily engaged in the generation of electric power, by hydraulic energy, fossil fuels, nuclear energy, or other processes (e.g., solar farms, wind turbines).
	Electrical Power Transmission, Control and Distribution	Covers the transmission, distribution and control of electric power.
	Tele communications	Includes infrastructure primarily engaged in providing telecommunications and/or video entertainment services. It includes wired and wireless telecommunications as well as satellite telecommunications.
Pipeline	Natural Gas Distribution	Covers the distribution of natural or synthetic gas to the ultimate consumers through a system of mains
	Other Pipelines	Includes integrated systems comprising various types of pipelines and ancillary facilities, such as pumping stations and incidental storage facilities
Transportation	Air Transportation	Covers airfield (runways, taxiways, apron, and de-icing), terminals and landside infrastructure (buildings, parking lot, and groundside paving), and communications equipment.

Level 1 Category	Level 2 Category	Level 2 Description
	Rail Transportation	Covers all rail lines, rail yards, as well as associated land, structures (culverts, tunnels, bridges, etc.), and buildings.
	Deep Sea, Coastal, and Great Lakes	Covers infrastructure associated with industry engaged in deep sea, coastal, and Great Lakes water transportation of freight and passengers. This includes ports, marinas and harbours, and canals and waterways
	Roads and Bridges	Covers all roads (excluding forestry roads) as well as associated earthwork, drainage, and structures (culverts, bridges, tunnels, etc.).
Buildings	Public Buildings	Buildings used by the public such as hospitals, community centres, schools.
	Housing	Government owned housing for the main purpose of a primary dwelling.
	Other Buildings	Buildings used by the government to conduct business but not open to the public such as Works garages, warehousing, storage.
Stormwater Management	Flood Mitigation Infrastructure	Covers major flood control infrastructure, including dams, spillways, berms, and dyke systems where the source of the flooding are rivers and lakes.
	Urban and Rural Stormwater Management Systems	Covers drains, pipes, ponds, low impact development, wetlands, and outfalls infrastructure that manages overland flood events.

Level 1 Category	Level 2 Category	Level 2 Description
Waste Management	Waste Management Infrastructure	There are no Level 2 Categories for this Area of Focus.

Natural Environment

Table 1.3: Natural Environment Level 2 Category Descriptions

Level 1 Category	Level 2 Category	Description
Aquatic Ecosystems	Clear Open Water	In Ontario's Land Cover Compilation, Clear Open Water refers to water bodies that have minimal evidence of turbidity or suspended sediment, and have an absence of macrophyte vegetation, tree, or shrub cover (Ontario Ministry of Natural Resources and Forestry, 2014). In contrast, Turbid Water refers to water with varying degrees of turbidity and sediment, as well as sparse floating and submerged vegetation. Clear open water habitat is distributed throughout all regions of Ontario.
Aquatic Ecosystems	Marsh	In Ontario's Land Cover Compilation, marsh refers to open, shrub, and treed communities in which the water table is seasonally or permanently at the substrate surface (Ontario Ministry of Natural Resources and Forestry, 2014). Marshes are dominated by hydrophytic macrophytes, with trees and shrubs representing less than or around 25% of the vegetation. Marshes can be marine intertidal, marine super tidal, or freshwater.
Aquatic Ecosystems	Bog	In Ontario's Land Cover Compilation, bog refers to open, shrub, or treed communities in which the water table is seasonally or permanently at the substrate surface (Ontario Ministry of Natural Resources and Forestry, 2014). They are distinguished from marshes in part by the accumulation of sphagnum peat substrate. Trees and shrubs are less than 2 metres high and tree cover is at densities of less than or around 25%.
Aquatic Ecosystems	Mudflats	In Ontario's Land Cover Compilation, Mudflat refers to the unvegetated coastal areas of the Hudson Bay-James Bay Lowlands, which are partly submerged at

Level 1 Category	Level 2 Category	Description
		high tide. Mudflats are only found in the Far North region of Ontario.
Terrestrial Ecosystems	Heath	A shrubland habitat found mainly on free-draining infertile, acidic soils and characterised by open, low-growing woody vegetation.
Terrestrial Ecosystems	Deciduous Forest	The MNRF describes the deciduous forest region of Ontario as the southernmost region in Ontario, which is dominated by agriculture and urban areas. The region is almost 3 million hectares and has largely been cleared with scattered woodlots remaining on sites which have historically been deemed too poor for agriculture. Of all the forest types in Ontario this region generally has the greatest diversity of tree species though it has the lowest proportion of forest.
Terrestrial Ecosystems	Coniferous Forest	The largest example of coniferous forest in Ontario is the boreal region. Coniferous (softwood) and mixed-wood forests dominate the Boreal region. The main conifer species are black and white spruce, jack pine, balsam fir, tamarack and eastern white cedar. The predominant deciduous (hardwood) species are poplar and white birch. A habitat dominated by vegetation composed primarily of cone-bearing needle-leaved or scale-leaved evergreen trees, found in areas that have long winters and moderate to high annual precipitation.
Terrestrial Ecosystems	Sand Barren and Dune	Sand barren and dune ecosystems consist of unconsolidated sandy sediments. These systems occur when winds act on exposed sand surfaces, for example, ancient glacial outwash plains and lake bottoms. In modern shoreline environments beaches can be examples of sand barren or dune ecosystems (Henson and Bakowsky, 2014).

Level 1 Category	Level 2 Category	Description
Terrestrial Ecosystems	Open Tallgrass Prairie	The tallgrass prairie is an ecosystem controlled by natural and anthropogenic fire. Historically, grazing by large mammals was part of periodic disturbance, which regulates tree encroachment, recycles nutrients to the soil, and catalyzes some seed dispersal and germination processes. In Ontario, the Natural Heritage Information Centre (NHIC) treats tallgrass communities with less than 10 percent tree cover as "tallgrass prairie".
Terrestrial Ecosystems	Tallgrass Savannah	Savannah can be characterized as a vegetation community consisting of a mixture of tree and grassy-herbaceous openings; the exact phylogeny can range from thickets of woods dominated by oak with grassy openings to areas of oaks that are widely spaced with an open understory (Szeicz and MacDonald, 1991).
Flora	Bryophytes - *Mielichhoferia mielichhoferiana*	*Mielichhoferia mielichhoferiana* (Alpine copper) has an Srank = S1 (critically imperiled) It is a species restricted to near-vertical rock faces with high iron levels and reduced sulphur (Brinker et al., 2018). Bryophytes have a tendency to be sensitive to changes in moisture. Amount of moisture and timing of wetness for reproduction is of particular importance for populations and *Mielichhoferia mielichhoferiana* (Alpine copper) has been noted to be low tolerant of water.
Flora	Lichens - *Arthrorhaphis Alpina*	Lewis and Brinker (2017) describe *Arthrorhaphis alpina* as a widespread, circumpolar arctic-alpine species with habitat requirements that generally entail moist soil and may grow over humus. S Rank = S1 (critically imperiled) - lack of data. Key risk factors, particularly for species of conservation concern, include specialized thermal and hydrological niches. For example, alpine dot lichen (*Arthrorhaphis alpina*) is found only in

Level 1 Category	Level 2 Category	Description
		sheltered canyons in the Ontario Great Lakes Basin, where it is disjunct from its main range to the north by over 1,500 km, and is a relic of previous colder climates.
Flora	Vascular plant - Horsetail spikerush *(Eleocharis equisetoides*)	Horsetail spikerush (*Eleocharis equisetoides*) is a perennial sedge species with restricted distribution in Ontario - it only occurs at one location in the Southwest region (Environment Canada, 2006). Although the species is globally ranked as apparently secure (G4), it is ranked at the provincial level (Srank) in Ontario as critically imperilled (S1) (Brinker et al. 2018). The species is also listed under Ontario's Endangered Species Act as endangered and under Canada's federal Species at Risk Act as endangered.
Flora	Vascular Plants - Eastern white pine (*Pinus strobus*)	Eastern white Pine *(Pinus strobus*) is a common coniferous tree that occurs throughout central and southern Ontario, and is Ontario's provincial tree. Its uses include lumber, furniture and trim; it is a soft, pale, knotty wood. White Pine represents 2.5% of Ontario's annual harvest and 4% of the province's total growing stock volume. The tree species is affected by White pine blister rust, a fungus introduced to North America from Europe, which is spread through the leaves of Gooseberries or Currants. Still, the tree species is ranked at the provincial level in Ontario (Srank) as secure (S5), meaning that it is common, widespread, and abundant in the province (NatureServe Explorer, n.d.).
Fauna	Amphibian - Spring peeper (*Pseudacris crucifer*)	*Pseudacris crucifer* (Spring peeper) is an amphibian (frog) with a wide distribution in Ontario. The species is ranked at the provincial level (Srank) as secure (S5), meaning that it is common, widespread, and abundant in the province (Brinker et al., 2018).

Level 1 Category	Level 2 Category	Description
Fauna	Northern dusky salamander (*Desmognathus fuscus*)	*Desmognathus fuscus* (Northern dusky salamander) is an amphibian (salamander) with distribution in Ontario that is restricted to a single stream site in the Niagara Gorge. Due to limitations on suitable habitat, dispersal of the species to other areas in Ontario is unlikely. In addition, the existing population could face severe consequences from a single random event (e.g., a mudslide). Other threats facing the single Ontario population are: disruption or contamination of groundwater discharge sources, habitat degradation from erosion, off-trail hiking, tree removal, and spread of the invasive Phragmites australis (European Common Reed). Although globally listed as secure (G5) by NatureServe, the species is listed at the provincial level (Srank) by NatureServe as critically imperilled (S1), meaning it is extremely rare and especially vulnerable to extirpation from the province (Brinker et al., 2018). It is also listed provincially under Ontario's Endangered Species Act as endangered and federally under the Species at Risk Act as endangered.
Fauna	Migratory Songbird - Prothonotary warbler (*Protonotoria citrea*)	*Protonotoria citrea* (prothonotary warbler) is a passerine bird species with a distribution in Ontario that is restricted to the Southwest region. Prothonotary warblers are a charismatic, migratory species that is ranked at the provincial level in Ontario (Srank) as critically imperiled (S1), meaning it is extremely rare and especially vulnerable to extirpation from the province (Brinker et al., 2018). It is also listed provincially in Ontario under the Endangered Species Act as endangered and federally under the Species at Risk Act as endangered.

Level 1 Category	Level 2 Category	Description
Fauna	Wild turkey *(Meleagris gallopavo*)	*Meleagris gallopavo* (wild turkey) is a temperate bird species with a distribution throughout most of Ontario, excluding the Northwest and Far North regions. Wild turkeys are an important game bird throughout their range, including in Ontario where there has been a legal hunt for wild turkeys since 1987. The species is ranked at the provincial level in Ontario (Srank) as secure (S5), meaning that it is common, widespread, and abundant in the province (NatureServe Explorer, n.d.).
Fauna	Waterfowl - American coot (*Fulica americana*)	Srank = S4 (Apparently Secure). In the northern Great Plains region, populations fluctuate with precipitation levels but essentially are stable; apparently has declined in Ontario due to loss of habitat.
Fauna	Shorebird – Piping plover (*Charadrius melodus*)	Srank = S1 (Critically Imperiled). At Long Point, Ontario there were over 100 pairs in 1928. Populations in Ontario dropped to an estimated 50 birds in the early 1930s. Seven pairs were reported from Ontario in 1961 to 1965, and two pairs in 1976 to 1977. One pair of piping plovers nested along Lake Ontario in 1984. No breeding pairs seen along the Canadian shores of the Great Lakes in the 1991 and 1996 censuses. Now extirpated in Minnesota, Wisconsin and southern Ontario.
Fauna	Mammal - Moose (*Alces alces americanus*)	*Alces americanus* (moose) is a large mammal with a wide distribution in Ontario. Moose hold substantial social, economic, and ecological value to the people of Ontario. The species is ranked at the provincial level in Ontario (Srank) as secure (S5), meaning that it is common, widespread, and abundant in the province (NatureServe Explorer, n.d.).

Level 1 Category	Level 2 Category	Description
Fauna	Northern myotis *(Myotis Septentrionalis)*	Srank = S3 (Vulnerable). Approximately 40% of the global range of this species is in Canada. Particularly threatened by White-nose Syndrome. Climate change is not believed to be a significant threat alone, but may have a cumulative effect when added to other threats. Prefers cooler temperatures above freezing for hibernation (NatureServe Explorer, n.d.).
Fauna	White-tailed deer (*Odocolieus virginianus*)	*Odocolieus virginianus* (white-tailed deer) is a large herbivorous mammal with a wide distribution in Ontario. White-tailed deer are highly sought after as big game species for recreational hunters in the province (Ontario Ministry of Natural Resources and Forestry, 2017). The species is ranked at the provincial level in Ontario (Srank) as secure (S5), meaning that it is common, widespread, and abundant in the province (NatureServe Explorer, n.d.).
Fauna	Boreal Caribou (*Rangifer tarandus*)	*Rangifer tarandus* (Boreal Caribou) is a forest-dwelling caribou that has suffered range-wide declines despite conservation efforts. Srank = S4 (Apparently Secure). Over the past century, local subpopulations have been lost; range contraction has proceeded from the south by up to 50% of historical range in some areas. Despite considerable conservation efforts, range-wide declines have continued since the last assessment in 2002. For 37 of 51 subpopulations where trend data are available, 81% are in decline, as indicated by negative population growth rates. Some of the most intensively managed subpopulations may remain critically imperiled.
Fauna	Cold-water Fish - Brook Trout (*Salvelinus fontinalis*)	*Salvelinus fontinalis* (Brook Trout) is a cold-water fish species with a wide distribution in Ontario. Brook trout can be found in lakes, but are generally found in clear, cool, well-oxygenated, and shaded streams. The

Level 1 Category	Level 2 Category	Description
		species is ranked at the provincial level in Ontario (Srank) as secure (S5), meaning that it is common, widespread, and abundant in the province (NatureServe Explorer, n.d.).
Fauna	Redside dace (*Clinostomus elongatus*)	*Clinostomus elongatus* (Redside Dace) is a fish species with a distribution throughout most of Ontario, excluding the Northwest and Far North regions. Most populations in Ontario are from streams in the Greater Toronto Area, flowing into Lake Ontario (COSEWIC, 2017). Populations are also known from Lake Huron, Lake Erie, and Lake Simcoe watersheds. The species is globally ranked as vulnerable or apparently secure (G3G4) and is ranked at the provincial level (Srank) in Ontario as imperilled (S2) (Brinker et al., 2018). The species is also listed under Ontario's Endangered Species Act as endangered and under Canada's federal Species at Risk Act as endangered.
Fauna	Cool-water Fish - Walleye (*Sander vitreus*)	*Sander vitreus* (walleye) is a cool-water fish species with a wide distribution in Ontario (Dove-Thompson et al., 2011). Walleye are a preferred sport fish for anglers in Ontario and are targeted in summer, fall, and winter. The species is ranked at the provincial level in Ontario (Srank) as secure (S5), meaning that it is common, widespread, and abundant in the province (NatureServe Explorer, n.d.).
Fauna	Insect/Spider - Lake Huron grasshopper (*Trimerotropis huroniana*)	Srank = S2 (Imperiled). This globally rare grasshopper is endemic to the Great Lakes region of Ontario, Michigan, and Wisconsin where it is restricted to dunes along the shores of lakes Huron, Michigan, and Superior. In Canada, it is known from 11 dune sites: one location on the east shore of Lake Superior, and seven on Lake Huron at the south shore of Manitoulin Island and Great Duck Island. Formerly, it occurred at

Level 1 Category	Level 2 Category	Description
		three additional sites on Lake Huron but these subpopulations appear to have become extirpated in the 1990s, likely as a result of residential and commercial development combined with intensive recreational use which damaged much of the dune habitat. While recreational use by pedestrians and off-road vehicles continue to threaten some dunes, other sites have undergone recent improvements under dune stewardship programs. Additional threats to dune environments include invasive plants and changes in lake levels related to climate change, natural cycles, or lake level management (COSEWIC, 2017).
Fauna	Mollusc - Salamander mussel (*Simpsonaias ambigua*)	Srank = S1 (Critically imperiled). COSEWIC reason for designation: This freshwater mussel was reported from two rivers in southern ON in 1998. Surveys since the original COSEWIC assessment (2001) have found live individuals still along the Sydenham River. Despite extensive additional sampling, the half-shell found in 1998 is the only evidence of this species along the Thames River. Habitat quality continues to decline from intense agriculture, urban development, and pollution from point and nonpoint sources. This mussel only uses the Mudpuppy salamander as its host and threats to the salamander are also threats to the mussel.
Fauna	Reptile - Common five lined skink, Carolinian population (*Plestiodon fasciatus*)	*Plestiodon fasciatus* (Common five-lined skink) Carolinian population is a small lizard species with a restricted distribution in Ontario - it is found in one small area of southwestern Ontario (Environment Canada, 2013). The species is globally ranked as secure (G5T2) and is ranked at the provincial level (Srank) in Ontario as imperilled (S2) (Brinker et al., 2018). The species is also listed under Ontario's Endangered

Level 1 Category	Level 2 Category	Description
		Species Act as endangered and under Canada's federal Species at Risk Act as endangered.
Ecosystem Cultural Services	Recreational Fishing	Recreational fishing is fishing for sport, leisure, or competition. It is a lucrative natural environment sector supported by the provincial Ontario Federation of Anglers and Hunters (OFAH) along with other local angling clubs. Recreational fishing is regulated by the province with two categories of licensing: sportfish license and conservation licence, which determine the amount of fish an angler can fish for at a given time. Revenue from the purchase of licenses goes towards conservation programs for fish species in the province. This Level 2 category promotes tourism and fostering direct connections to the natural environment.
Ecosystem Cultural Services	Nature-Based Recreation	Natural spaces that enable active physical and experiential interactions with nature. Warm-season (hiking, camping) and winter season (skiing, snowmobiling) activities are included. Parks and protected spaces in Ontario provide ample opportunities for these types of nature-based recreation.
Ecosystem Provisioning Services	Fresh Water provision	Ontario's natural and semi-natural systems provide freshwater runoff that supports human development and wellbeing. Areas with high runoff potential (e.g., high capacity) that serve downstream areas with high demands are the most important for freshwater provision. Hotspots of freshwater provision in Ontario generally mirror population patterns and are most prevalent in the south of the province. Climate variables can affect the ability of natural systems to function properly and to provide freshwater for human use.

Level 1 Category	Level 2 Category	Description
Ecosystem Provisioning Services	Wood Supplies	Ontario's 71 million hectares of forests support the sustainable harvest of timber (and other forest products), which provides social, economic and environmental benefits to the province. In northern Ontario, the livelihoods of many communities rely on stable levels of harvesting and a healthy forest industry. Close to 90% of Ontario's forests are publicly owned and known as Crown lands, and 44% of these Crown lands are managed forests (27.7 million hectares). The amount of area available for harvest in Ontario is regulated and planned for, while the actual volume harvested varies annually and over time. Less than 0.5% of the managed Crown forest is harvested annually. Harvest levels decreased since about 2004, leveling off in 2010. Low harvest levels have negative effects on employment and local economies; environmental objectives are also affected: failing to achieve planned levels of harvest affects the ability to achieve desired forest condition (area, type and age) and related habitat diversity (1, 2).
Ecosystem Regulating Services	Carbon Storage	Carbon storage is an important aspect of climate regulation, contributing to reduced atmospheric carbon levels or limiting further accumulation. Ontario's natural ecosystems play an important role in this service, with forests, wetlands, croplands, and rangelands storing carbon in soils and vegetation. Carbon storage provision and capacity is variable across the province, but northern Ontario's boreal forests are a particular hotspot with high levels of stored carbon. Assessing the existing carbon storage regulating services provided by Ontario's ecosystems is important for current inventories as well as for identifying key locations that may have the capacity to further contribute to carbon storage, or to be

Level 1 Category	Level 2 Category	Description
		particularly sensitive to disruption by climate variables. This information can inform climate projections and management decisions.
Ecosystem Regulating Services	Water Flow Regulation	Water flow regulation provides multiple benefits, including flood prevention, drought mitigation, and flow stability. The timing and magnitude of runoff, flooding, and aquifer recharge can be strongly influenced by changes in land cover and by climate directly. Changes to water flow regulation directly affect humans (e.g., infrastructure, natural disasters) but can also impact ecosystem processes and characteristics that provide alternative services (e.g., maintenance of environmental flow needs for aquatic species).
Ecosystem Regulating Services	Pollination	Pollination is an ecosystem process by which biota are involved in the movement of floral gametes, providing the service of pollinating wild plant species and crops. Approximately 30% of the world's food is from crops that depend on pollinators.

People and Communities

Table 1.4: People and Communities Level 2 Category Descriptions

Level 1 Category	Level 2 Category	Description
Population	General Population	General Population will capture the overall climate risks and impacts that can be generalized across the residents regionally and provincially. These would include broad health-related impacts (physical and mental), as well as economic and social elements, and will include consideration of vulnerable populations, who may experience disproportionate level of impacts from climate change (e.g., children and seniors, low-income populations, people with disabilities, etc.).
Population	Unhoused	Unhoused Population will explore population impacts resulting from residential instability (including private property damage). Security of tenure is a key factor that affects how climate change is experienced by different groups.
Health care	Health care	This Level 1 category comprises establishments primarily engaged in providing health care by diagnosis and treatment and providing residential care for medical reasons. This includes ambulance services, hospital care, nursing and residential care, and in-home health care.
Social Assistance	Social Assistance	This Level 1 Category comprises establishments primarily engaged in providing social assistance and/or activities of a governmental nature. These include counselling, welfare, child protection, community housing and food services, vocational rehabilitation and childcare, legislative activities, taxation, national defense, public order and safety, immigration services, foreign affairs and international assistance, and the administration of government programs.
Indigenous Communities	Indigenous Population	Indigenous Population covers health and safety of the population and their lands as well as traditional ways of life and areas of important significance (cultural sites, historical sites).

Level 1 Category	Level 2 Category	Description
Indigenous Communities	Indigenous Health care	Indigenous Health Care includes establishments primarily engaged in providing health care by diagnosis and treatment and providing residential care for medical reasons.
Indigenous Communities	Indigenous Social Assistance	Indigenous Social Assistance includes services primarily engaged in providing social assistance, such as counselling, welfare, child protection, community housing and food services, vocational rehabilitation and childcare, to those requiring such assistance.
Indigenous Communities	Indigenous Cultural Services	Indigenous Cultural Services comprises of establishments engaged in cultural celebrations; religious worship, training, or study; administering an organized religion; or promoting cultural activities.
Indigenous Communities	Infrastructure	This Level 2 encompasses all the relevant Level 1 and Level 2 Categories that are covered under the Infrastructure Area of Focus that Indigenous Communities rely upon.
Indigenous Communities	Food & Agriculture	This Level 2 encompasses all the relevant Level 1 and Level 2 Categories that are covered under the Food and Agriculture Area of Focus that Indigenous Communities rely upon.
Indigenous Communities	Business and Economy	This Level 2 encompasses all the relevant Level 1 and Level 2 Categories that are covered under the Business and Economy Area of Focus that Indigenous Communities rely upon.
Indigenous Communities	Natural Environment	This Level 2 encompasses all the relevant Level 1 and Level 2 Categories that are covered under the Natural Environment Area of Focus that Indigenous Communities rely upon.

Business and Economy

Table 1.5: Business and Economy Level 2 Category Descriptions

Level 1 Category	Level 2 Category	Description
Accommodation and Food Services	Accommodation and Food Services	This Level 1 Category comprises establishments primarily engaged in providing short term lodging and complementary services to travelers, vacationers, and others, in facilities such as hotels, motor hotels, resorts, motels, casino hotels, bed and breakfast accommodations, housekeeping cottages and cabins, recreational vehicle parks and campgrounds, hunting and fishing camps, and various types of recreational and adventure camps. This sector also comprises establishments primarily engaged in preparing meals, snacks and beverages, to customer orders, for immediate consumption on and off the premises.
Arts, Entertainment and Recreation	Arts, Entertainment and Recreation	This Level 1 Category comprises establishments engaged in operating facilities or providing services to meet the cultural, entertainment and recreational interests of their patrons. These establishments produce, promote or participate in live performances, events or exhibits intended for public viewing; provide the artistic, creative and technical skills necessary for the production of artistic products and live performances; preserve and exhibit objects and sites of historical, cultural or educational interest; and operate facilities or provide services that enable patrons to participate in sports or recreational activities or pursue amusement, hobbies and leisure-time interests. This also includes outdoor recreational activities such as hiking, camping, recreational fishing, etc.
Construction	Construction	This category comprises of establishments primarily engaged in constructing, repairing and renovating buildings and engineering works, and in subdividing and developing land. These

Level 1 Category	Level 2 Category	Description
		establishments may operate on their own account or under contract to other establishments or property owners. They may produce complete projects or just parts of projects. Establishments often subcontract some or all of the work involved in a project or work together in joint ventures. Establishments may produce new construction or undertake repairs and renovations to existing structures.
Financial and Insurance	Monetary, Credit, Securities, Funds and other Financial Vehicles	Monetary, Credit, Securities, Funds and other Financial Vehicles covers establishments engaged in performing banking functions; and mortgage, loan and credit services.
Financial and Insurance	Insurance Carriers and Related Activities	Insurance Carriers and Related Activities covers establishments engaged in underwriting annuities, insurance polies and reinsurance, and retailing of insurance and the provision of related services to policy holders.
Forestry, Fishing and Hunting Economies	Fishing, Hunting and Trapping	This Level 1 Category consists of establishments primarily engaged in growing and harvesting timber on a long production cycle, as well as establishments that catch fish and other wild animals from their natural habitats. These establishments are dependent upon a continual supply of the natural resource.
Forestry, Fishing and Hunting Economies	Forestry and Logging	This Level 1 Category consists of establishments primarily engaged in growing and harvesting timber on a long production cycle, as well as establishments that catch fish and other wild animals from their natural habitats. These establishments are dependent upon a continual supply of the natural resource.
Information and Cultural Industries	Information and Cultural Industries	This Level 1 Category comprises establishments primarily engaged in producing and distributing (except by wholesale and retail methods) information and cultural products. Establishments providing the means to transmit or distribute

Level 1 Category	Level 2 Category	Description
		these products or providing access to equipment and expertise for processing data are also included.
Manufacturing	Manufacturing	This Level 1 Category comprises of establishments primarily engaged in the chemical, mechanical or physical transformation of materials or substances into new products. These products may be finished, in the sense that they are ready to be used or consumed, or semi-finished, in the sense of becoming a raw material for an establishment to use in further manufacturing. Related activities, such as the assembly of the component parts of manufactured goods; the blending of materials; and the finishing of manufactured products by dyeing, heat-treating, plating, and similar operations are also treated as manufacturing activities. Manufacturing establishments are known by a variety of trade designations, such as plants, factories, or mills. Manufacturing establishments may own the materials which they transform, or they may transform materials owned by other establishments. Manufacturing may take place in factories or in workers' homes, using either machinery or hand tools. Examples of manufacturing industries include food processing, wood product, chemical product, machinery, etc.
Mining, Quarrying and Oil/Gas Extraction	Mining, Quarrying and Oil/Gas Extraction	This category comprises of establishments primarily engaged in extracting naturally occurring minerals. These can be solids, such as coal and ores; liquids such as crude oil; and gases such as natural gas. Activities include quarrying, well operations, milling (for example crushing, screening, ashing or flotation) and other preparation customarily done at the mine site or as part of mining activities.

Level 1 Category	Level 2 Category	Description
Retail Trade	Retail Trade	This Level 1 Category comprises of establishments engaged in retailing merchandise, generally without transformation, and rendering services incidental to the sale of merchandise. This covers everything from motor vehicle dealerships; furniture and home furnishing stores; electronics and appliance stores; food and beverage stores; to gas stations.
Transportation Economy	Local Freight Trucking and Delivery Services	Local Freight Trucking and Delivery Services covers establishments engaged in local general freight trucking. These establishments primarily provide trucking services within a metropolitan area and its hinterland. Generally, the trips are same-day return.
Transportation Economy	Long Distance Freight Trucking	Long Distance Freight Trucking covers establishments engaged in long distance, general freight trucking. These establishments primarily provide trucking services between metropolitan areas. Generally, the trips are not same-day return.
Transportation Economy	Deep Sea, Coastal and Great Lakes	Deep Sea, Coastal and Great Lakes covers establishments primarily engaged in deep sea, coastal and Great Lakes water transportation of freight and passengers. The St. Lawrence Seaway is considered to be part of the Great Lakes system. Establishments that operate ocean-going cruise ships are included.
Transportation Economy	Rail	Rail covers establishments primarily engaged in operating railways. Establishments primarily engaged in the operation of long-haul or mainline railways, short-haul railways and passenger railways are included.
Transportation Economy	Air Transportation	Air Transportation covers establishments primarily engaged in for-hire, common carrier transportation of people and/or goods using aircraft, such as airplanes and helicopters.

Level 1 Category	Level 2 Category	Description
Utility Services	Electrical Power generation	Electrical Power Generation covers facilities primarily engaged in the generation of electric power, by hydraulic energy, fossil fuels, nuclear energy, or other processes (e.g., solar farms, wind turbines).
Utility Services	Electrical Power Transmission, Control and Distribution	Electrical power transmission, control and distribution covers the transmission, distribution, and control of electric power.
Utility Services	Natural Gas Distribution	Natural gas distribution covers the distribution of natural or synthetic gas to the ultimate consumers through a system of mains.
Utility Services	Telecommunications	Telecommunications covers the operation of wired and wireless communication services, including provision of satellite services.

Appendix 2: Summary of Criteria Used in Risk Evaluation

Table 2.1: Climate Variable Frequency Criteria

Frequency of Climate Variable Score	Category (Change in Frequency)	Definition – Amount of Change from Baseline
16	Significant Negative	+ 2.5 Standard Deviations from the mean
8	Slight Negative	+ 1.5 Standard Deviations from the mean
4	Baseline/No Change	Baseline condition
2	Slight Positive	- 2.5 Standard Deviations from the mean
1	Significant Positive	- 1.5 Standard Deviations from the mean

Table 2.2: Human Health and Safety Consequence Criteria

Consequence Score	Category	Criteria	Definition – Portion of Population that is Adversely Impacted
16	Very High	>80% to 100%	Proportion of the population that experiences an adverse effect. The higher the percentage, the higher the consequence.
8	High	>60% to 80%	
4	Medium	>40% to 60%	
2	Low	>20% to 40%	
1	Very Low	0% to 20%	

Table 2.3: Disruption to Services Consequence Criteria

Consequence Score	Category	Criteria	Definition – Inability of Asset to Function Properly due to Impact by Climate Variable
16	Very High	>80% to 100% (Total loss of function of an asset; shut down)	Percent loss of function (e.g., downtime) of the asset that is impacted by the climate variable Higher the percentage, the higher the score.
8	High	>60% to 80%	
4	Medium	>40% to 60%	
2	Low	>20% to 40%	
1	Very Low	5% to 20% (Below 5%, assumed limited to no loss of function; continues to function after exposure to a variable)	

Table 2.4: Environmental Damage and Natural Asset Services Consequence Criteria

Consequence Score	Category	Ability to Recover from Impact by Climate Variable	Ability of Natural Asset to Deliver Services Due to Climate Variable Impact
16	Very High	Very serious, widespread, and potentially permanent/irreversible damage or loss to populations demographics and/or habitats (e.g., local extinctions) occurring due to deterioration in habitat conditions, reduced food availability, and/or other factors.	Catastrophic disruptions affecting the entire province or beyond and leading to permanent changes in systems
8	High	Serious impacts on populations and/or habitats from large changes in habitat quality and/or population demographics (e.g., serious decline in reproduction limiting population increase) due to deterioration in habitat conditions, reduced food availability, and/or other factors that will be very difficult (but not impossible) to reverse/mitigate, with a long period likely needed to restore to an acceptable level	Widespread and long-term disruptions in flows of services, impacting large numbers of people.
4	Medium	Wider and longer-term impacts on populations and/or habitats from changes in habitat quality and/or population demographics due to deterioration in habitat conditions, reduced food availability, and/or other factors that will be difficult to reverse/mitigate	Frequent and numerous disruptions within the capacity of the system to recuperate and recover over the medium to short term.
2	Low	Minimal impacts on population and/or habitats from small, generally reversible/mitigatable changes	Many localized disruptions that are easily accommodated by normal system protocols for repair and maintenance, or changes in people's attitudes or behaviour.

Consequence Score	Category	Ability to Recover from Impact by Climate Variable	Ability of Natural Asset to Deliver Services Due to Climate Variable Impact
1	Very Low	Short term impact. Recovery immediately after the event.	Very few localized disruptions that are easily accommodated by normal system protocols for repair and maintenance, or changes in people's attitudes or behaviour.

Table 2.5: Financial Loss Consequence Criteria

Consequence Score	Category	Amount of Business Revenue Loss due to Impact by Climate Variable. Measured as a % of annual revenue (Business and Economy)	Yield Loss (Food and Agriculture)	Cost of Asset Damage or Replacement due to Impact by Climate Variable (Infrastructure)
16	Very High	>50% of annual revenue	>50%	>60% (Full failure/damage to infrastructure)
8	High	25% to 49% of annual revenue	>30 – 50%	40 – 60% (Earlier end of life)
4	Medium	10% to 24% of annual revenue	>10 – 30%	20 – 40%
2	Low	6% to 9% of annual revenue	>5 – 10%	>10 – 20% (Increased maintenance)
1	Very Low	0% to 5% of annual revenue	<5%	<10% (Status quo)

Table 2.6: Likelihood of Impact Consequence

Likelihood Score	Category	Definition – Annual Probability
16	Frequent	>80% to 100%
8	Probable	>60% to 80%
4	Occasional	>40% to 60%
2	Remote	>20% to 40%
1	Improbable	0% to 20%

Appendix 3: PCCIA Engagement

Engagement is a fluid and dynamic part of any technical process and critical for any climate change impact and risk assessment. A climate change impact assessment requires holistic knowledge of risk perceptions and risk tolerances from key stakeholders and impacted communities to determine the scope and assessment of action. Engaging with external participants in the PCCIA allowed for additional resources and information to be identified and incorporated into the assessment process.

The objectives of the PCCIA engagement process were to facilitate meaningful interactions with a targeted group of participants, using clearly defined methods and communications materials, that aimed to:

- Inform a targeted group of invited participants about the process to develop a climate change impact assessment for the Province of Ontario.
- Seek feedback and input from participants on the risks and vulnerabilities for current and future climatic conditions and evaluate potential changes for each of five areas of focus and six geographic regions.
- Strengthen the focus and audiences for the resultant decision-making supports.

The engagement tactics undertaken as part of the PCCIA were originally planned to be in person. At the outset of the project, discussions with the Ontario Ministry of the Environment, Conservation and Parks and the Impact Assessment Inter-Ministry Committee (IAIC), led to the development of a fulsome Engagement Plan which outlined the necessary virtual re-alignment due to the pandemic. The greatest change to the process was to necessarily shift away from generation of risk perceptions and consequence scores to a validation process. The benefit of virtual engagement was that more people could participate in the process, and it also led to more discrete pieces of information review and contribution instead of larger amounts in workshops. This made it more manageable for participants.

To the extent possible the objectives, outcomes, and outputs of the engagement process were constant with original plans. The engagement process aligned with the methods set out for the PCCIA and was fully supportive of a top-down climate change assessment like the PCCIA.

The main audiences for PCCIA engagement included the IAIC, Indigenous organizations and other external participants (e.g. subject-matter experts). These audiences each have differing perspectives on areas of impact, risk perceptions and tolerances and understanding of impact assessment processes. With this in mind, virtual engagement tactics, including detailed background documents, were developed to build knowledge of the process, inform participants of progress to date and present and validate various aspects of impact assessment results.

Impact Assessment Engagement Participants

Impact Assessment Inter-Ministerial Committee (IAIC) – The IAIC comprised of a range of internal government representatives from multiple ministries and/or agencies. The IAIC provided governmental perspectives on aspects of the PCCIA, including the methodological framework; the literature and data sources; climate analytic and socioeconomic projections; primary climate variables and evaluation criteria; current climate risk and vulnerabilities; future climate risk and vulnerabilities; adaptation and resilience best current practices; cross-sectoral impacts, and insight about the eventual utility of diverse types of decision-making supports.

The composition of the IAIC was determined and coordinated by the Ministry. Engagement with the IAIC was also coordinated by MECP. The Consulting Team reviewed and answered feedback from the IAIC. MECP also provided the consulting team with validated and consolidated feedback from the IAIC. The survey, workshops and meetings allowed IAIC members to provide direct input to the process.

Indigenous Participants – Ontario's Indigenous (First Nations, Métis and Inuit) communities are the original inhabitants of Ontario. For thousands of years, they have developed distinct languages, cultures and ways of life, and rich laws and traditions. The Truth and Reconciliation Commission aptly state the imperative for enhanced relationships with Indigenous people based on reconciliation and mutual respect. While Indigenous communities in Ontario contribute least to climate change, the effects of it are being felt disproportionately by them. Warming winters are impacting the construction and maintenance of winter roads which connect many remote First Nation communities to critical services; warm spells can lead to rapid snow melt and flooding; and changes to, or loss of, important species that are culturally significant will be amplified from climate change.

The PCCIA sought to engage meaningfully with Indigenous people to gain a strong understanding of the experiences associated with climate change. Indigenous communities were one of five Level 1 categories under the People and Communities Area of Focus. In order to maintain consistency in the use of information to support quantitative risk scoring in the P&C Area of Focus, the initial approach to engagement of Indigenous communities was separate, but consistent with the broader engagement activities of the PCCIA.

The large number of Indigenous communities in Ontario required an approach to obtain input at higher levels. Thus like the approach used to develop the lists of external organizations, a list of provincial- or regional-level organizations was developed that represented membership for all communities and included Tribal Councils, Political Territorial Organizations (PTOs), and sector-based organizations. In the Far North region, Tribal Councils and other PTOs were chosen to provide information and perspectives given their close working relationships with

northern First Nations. In a similar fashion, other Political Territorial Organizations (Nishnawbe Aski Nation, Grand Council Treaty #3, Anishnabek Nation, and the Association of Iroquois and Allied Indians) were chosen because of their broad membership of First Nation communities. The Métis Nation of Ontario was selected to represent Métis communities in Ontario. Other Indigenous organizations that represented communities or who had Indigenous communities as members were also included on the list. And finally, sector-based organizations such as Miisun Integrated Resource Management (forestry), Ontario First Nations Technical Services Corporation (engineering and environmental consulting), Indigenous Tourism Ontario (tourism), First Nation Tax Commission (business) and Indian Agriculture Program of Ontario (agriculture).

External Participants – External participants consisted of non-government organizations, industry and trade associations, and other Area of Focus -specific organizations. A participant list was drafted with input from the consulting team, MECP, and IAIC.

Each invited organization was asked to nominate a representative with "technical subject matter expertise related to climate change impacts and adaptation in Ontario." The list of external participants evolved over the course of the process and was updated as organizations (and associated participants) were selected throughout the project. Over the course of the project, a few organizations declined to participate given their internal capacity and/or subject matter expertise. Occasionally other organizations requested to be added to the participant list in which case additions were confirmed with the MECP based on the selection criteria (listed above). In total, more than 200 organizations across Ontario were invited to nominate one representative and provide input to the PCCIA.

Engagement Elements and Process

The specific elements or tactics of engagement were chosen and designed to capture meaningful information that would support the PCCIA in the most efficient manner. The engagement tactics varied depending on the purpose and intent and each was deemed to be the most effective given the need to maintain an all-virtual delivery. The tactics that were employed include:

- Webinars - The webinars are an opportunity to share information at the start and end of the process, in a presentation-style, with all participants ("information out").
- Survey - The survey was an opportunity for all participants to share information (responses and documentation) to inform the PCCIA process ("information in").
- Virtual Workshops - The two virtual workshops were an opportunity for a smaller group of external participants to meet, by Area of Focus, to discuss the findings from the survey and provide additional, detailed information to the consulting team.
- Virtual Meetings - The two virtual meetings were just for IAIC/MECP staff and were an opportunity to provide feedback directly to the consulting team, in a group setting, and

were facilitated by the consulting team. A change to the method of engagement of Indigenous organizations occurred part way through the engagement process and resulted in virtual meetings where an interview was conducted.

- Ongoing Communication - Email was used as the primary method of communication with external participants. Phone calls and one-on-one meetings were used to supplement email, where and as needed.

Engagement Events

Engagement events were designed to obtain feedback and input at critical junctures of the PCCIA. Each event was supported by a background document listing objectives and information, and participants were primed with specific session questions. The shift to virtual engagement meant that virtual tools such as Survey Monkey (for survey questions), Menti (for polling), and Mural (for participant input) were obtained and utilized. Zoom was used as the main virtual communication platform.

The four key points of engagement and objectives for the PCCIA process were as follows:

- Engagement Session #1: To review the methodological framework
- Engagement Session #2: To validate current risks and vulnerabilities, and gather insights on the decision support systems
- Engagement Session #3: To validate future risks and vulnerabilities
- Engagement Session #4: To review cross-sectoral impacts

Table 3.1 summarizes the completed engagement events associated with the PCCIA.

Table 3.1: Details of Engagement Events

Engagement Event	Date	Audience	Format	Tools	Objectives

Meeting #1	November 19, 2020	IAIC	1 virtual workshop
			2.5 hours long
				Hosted on Zoom
				Discussion in breakout rooms
				Used MURAL to capture ideas
					- Provide a project update
					- Share information on the methodological framework
					- Seek IAIC input on framing questions related to:
					  - Climate variables
					  - Areas of focus
					  - Risk measurement perspectives
					  - Adaptive Capacity

Webinar #1	August 4, 2021	External, IAIC and Indigenous participants	1 virtual webinar 1 hour long	Hosted in Zoom Webinar mode	- Introduce the Provincial Climate Change Impact Assessment (PCCIA) - Share an overview of the methodology - Create a common understanding of the engagement process - Explain the important role of participants - Share the planned outcomes for the PCCIA
Survey #1	August 2021	External, IAIC and Indigenous participants	5 surveys, by Area of Focus	SurveyMonkey was used as the data collection tool	- Participants were asked to review preliminary results of the PCCIA assessment for the current timeframe based on recent historical and current

Engagement Event	Date	Audience	Format	Tools	Objectives
				A fillable Word version was provided upon request	climate conditions from 1980 to 2010, including: - The interactions between climate variables and Level 1/Level 2 categories - The preliminary impact assessment results by Level 1/Level 2 Category, and by geographic region
Workshop #1	September 21 to 24, 2021	External and IAIC	5 virtual workshops, by Area of Focus 2.5 hours long	Hosted on Zoom Discussion in breakout rooms Used MURAL to capture ideas Used Mentimeter for the anonymous evaluation	Building on feedback received to date: - Recap the purpose of the PCCIA - Recap the methodology and information used in developing the PCCIA Using the feedback received from Survey 1: - Gather feedback on key climate interactions - Gather feedback on preliminary results, and capture regional considerations
Workshop #2	January 26 to 31, 2022	External and IAIC	5 virtual workshops, by Area of Focus 3 hours long	Hosted on Zoom Discussion in breakout rooms Used Mentimeter to capture ideas about risk profiles	Building on workshop #1: - Recap the purpose of the PCCIA - Recap the feedback received to date, and how it has been used Gather feedback on: - Risk profiles (changing risk over time)

Engagement Event	Date	Audience	Format	Tools	Objectives
				and for the anonymous evaluation Used Google Sheets to capture ideas about Adaptive Capacity	- Adaptive Capacity for each Level 1 category - Adaptation Best Practices
Workshop #3	April 7, 2022	IAIC	1 virtual workshop 2.5 hours long	Hosted on Zoom Discussion in breakout rooms Used MURAL to capture ideas Used Mentimeter for the anonymous evaluation	Gather feedback on: - Cross-sectoral impacts and considerations - Framing and characterization of cross-sectoral themes Discuss: - Opportunities for improving Adaptive Capacity and adaptation interventions in response to cross-sectoral impacts - Utility of cross-sectoral information for policy and program areas

Input from engagement sessions was used to inform several components of the PCCIA. Following the completion of Survey #1 and Workshop #1, feedback from participants was reviewed and categorized associated with each Area of Focus, and by the type of topic it referred to. Comments were identified by types such as "suggested new climate interactions", "new resource", "indirect or cross-sectoral impacts to take note of," or "regional considerations". Each of these types of comments were then used to update content as part of the current and future risk assessment:

- Suggested new climate interactions were used develop additional interactions and risk scores associated with particular Areas of Focus, Level 1 and Level 2 categories
- New resources were reviewed and where relevant added to the PCCIA Risk Scenarios
- Indirect or cross-sectoral impacts were carried forward
- Regional considerations were carried forward and used to inform characterization and discussions contained throughout this report, and in particular Appendix 11

Following the completion of Workshop #2, feedback was used to update and confirm climate risk scoring and to inform Adaptive Capacity characterizations across Level 1 categories. Comments were also received regarding adaptation best practices associated with policy and regulation, project or programs, research and development, and investment and incentives. Results from this section were used as follows:

- To review and revise interactions and risk scenarios, where sufficient evidence and data allowed).
- To add and update Adaptive Capacity characterizations, including scores assigned.
- To identify adaptation best practices and inform research and development of the draft PCCIA Adaptation Best Practices Report, which is available as a separate document.

Ultimately, results from engagement sessions were used to refine, re-frame, validate, and inform PCCIA products such that they are more valuable and conveyed in a manner that is appropriate and intuitive.

Engagement Participation Rates

The total number of invited external organizations (not including Indigenous organizations and IAIC) was 200. Area of Focus -specific attendance numbers for events varied from less than 50% (Workshop #2) to more than 60% (Workshop #1). Participation rates were highest among the Agriculture and Business and Economy Areas of Focus while lowest turnout was for People and Communities and Natural Environment, specifically for Workshop #2. We do not assume any Area of Focus-specific reasons for varied turnout, rather simply the circumstances (ability and desire) in order to participate. A tally of attendance rates for external and IAIC participants in each of the engagement events is included in Table 3.2 and 3.3 below.

Summary of Engagement among External Participants and IAIC Members

Table 3.2: Summary of External Organization Engagement

EXTERNAL ORGANIZATIONS													
Engagement Opportunity	**Date**	**Total[1]**		**Business & Economy**		**Food & Agriculture**		**Infrastructure**		**Natural Environment**		**People & Communities**	
		Invited	**Participated**	**Invited**	**Participated**	**Invited**	**Participated**	**Invited**	**Participated**	**Invited**	**Participated**	**Invited**	**Participated**
PCCIA Webinar (all Areas of Focus)	Wednesday, August 04, 2021	200	**93**	-	-	-	-	-	-	-	-	-	-
Area of Focus Surveys	August, 2021	-	**95**	60	**20**	48	**29**	32	**20**	33	**20**	33	**16**
Area of Focus Workshop 1	September 21 – 24, 2021	-	**83**	57	**19**	47	**20**	32	**18**	34	**15**	33	**15**
Area of Focus Workshop 2	January 26 – 31, 2022	-	**72**	55	**20**	48	**20**	36	**19**	35	**14**	31	**14**

Table 3.3: Summary of IAIC Engagement

IAIC (Ministries and Government Entities)									
Engagement Opportunity	**Date**	**Total**		**Business & Economy**	**Food & Agriculture**	**Infrastructure**	**Natural Environment**	**People & Communities**	
		Invited	**Participated**	**Participated**	**Participated**	**Participated**	**Participated**	**Participated**	
Webinar	Wednesday, August 04, 2021	**16**	**9**	-	-	-	-	-	
Survey	August, 2021	-	**11**	**6**	**1**	**7**	**2**	**4**	
Workshop 1	September 21 – 24, 2021	-	**11**	**6**	**3**	**7**	**3**	**5**	
Workshop 2	January 26 – 31, 2022	-	**11**	**8**	**3**	**7**	**4**	**5**	
Workshop 3	April 7, 2022	**16**	**12**	-	-	-	-	-	

[1] Several external participants belong to more than one Area of Focus. The total number of participants for a given event will therefore be less than the combined number of participants for all Areas of Focus.

Indigenous Engagement

Engagement of Indigenous organizations was deemed an important component to the PCCIA and methods to engage were sensitive to the constraints faced by Indigenous organizations. Through non-PCCIA related interactions with some First Nations communities and organizations it was reported that the pandemic was stretching the limits of their capacity and that low response could be in part attributed to the pandemic. This was observed firsthand early in the PCCIA engagement process.

Feedback was first sought through introduction to the PCCIA and invitation to the introductory webinar and to solicit input to the initial survey. Initial contact was through email and a second email invitation was issued a week later, then a follow up phone call was placed to 22 organizations selected for the engagement. The Project Team experienced challenges reaching the identified contacts resulting in a low response rate from organizations. This low response rate created concern that the subsequent planned unique workshop with Indigenous organizations would not be well attended and so Indigenous engagement activities took a new approach. A background document was developed and contained information about the broader PCCIA, a summary of the methods used to score climate change risk, a breakdown of the Areas of Focus including the Level 1 category for Indigenous peoples, climate change parameters used in the assessment and the analysis of climate variable-impact interactions. With this, the approach shifted to one-on-one conversations (interviews) with each organization which allowed for both a more intimate, private, and open conversation, but also to open up significantly more flexibility with respect to timing and time availability. Survey questions were included in the background document and stood as a guide for the discussion.

The knowledge that was shared through interviews pointed primarily to the impacts that communities are facing from climate change and what they are, and are not, able to do in response to those impacts. Despite being keenly aware of climate change and its impacts, the scarcity of resources and overall low Adaptive Capacity in the Far North region severely constrains adaptation. Adaptive Capacity issues in general transcend to First Nations in the south, but affordable options for food, more reliable power supply, more robust transportation networks and closer proximity to health care and other essential services enable adaptation.

Touch points with the 22 Indigenous organizations lent opportunity for participation in the PCCIA. In most cases, the lack of response or invitation declines, combined with the approach to solicit engagement at the organizational level (as opposed to the community level) meant that knowledge and information from engagement was limited. In order to support the information feeding into the People and Communities portion of the PCCIA, supplemental research was conducted to enhance the literature base for climate change impacts, risks and Adaptive Capacity.

Climate change knowledge and adaptation activity within Indigenous communities, associations and organizations is apparent and should be emphasized in future outcomes of this project and subsequent iterations of climate change assessment at a provincial scale.

Engagement Process Observations and Lessons Learned

The engagement process was scaled to match the size of the PCCIA and also reflected its stature in the context of the overall PCCIA process. The radical shift to an all-virtual engagement process also meant additional details for preparation and management of many more virtual sessions. In large, the engagement was deemed to be a moderate success when considering factors such as overall attendee preparation, attendee understanding of the topic, turn out and effectiveness of contributions.

As with any climate change assessment, engagement is a crucial component of the process and helps reveal data and information, but also people's perceptions of risks, risk tolerances and perspectives on priority areas of impact. The engagement process for the PCCIA yielded some important observations and lessons that can be noted for subsequent iterations of an Ontario-wide climate change assessment. Table 3.4 below summarizes those observations and lessons and is divided into main themes or topics.

Table 3.4: Observations and Lessons from Engagement in the PCCIA

Topic	Observations and Lessons Learned
Participant Communication and Engagement	The consulting team tried, as much as possible, to clearly communicate the intent of the PCCIA and the benefit for external participants to contribute. Overall, the participation rates seemed high. Participants who were unable to attend the virtual workshops and meetings were able to submit written commentary in response to the discussion questions for up to a week after the sessions. All references and written feedback provided by external participants were provided to the technical consulting team. As a value-add, the consulting team developed text for an engagement launch email and two-page backgrounder for external participants. This email served to introduce the process, invite recipients to participate, and share opportunities for engagement. A similar notice at the end of the process, with links to the results, could also help to enhance communication.

Topic	Observations and Lessons Learned
	The one-channel email approach, using info@pccia.ca served the project well; there is a single record of communication and it provided clarity to participants.
Participant Tracking	Email was the primary mode of communication with external participants. Tracking down current and correct contacts was an important yet labour-intensive part of the process. While emails reached the majority of participants, personalized reminder phone calls in advance of the webinar and workshops served to increase participation rates.
Varied Participant Experience	Participants were drawn from dozens of organizations across Ontario and brought various levels of technical climate change adaptation experience to the engagement process. Some participants used the workshops as capacity building exercises (seeking definitions and clarity at every step of the way) and others were keen to delve deeper into the methodology. Participants also had varying levels of time to devote to the process and in some cases that created a lack of continuity of input. Participating in the PCCIA process was a voluntary, additional effort for all invited organizations and required staff time and resources.
Differing Expectations	Over the course of the project, some external participants wanted to play a different role in the process than the engagement work plan allowed. Some participants requested more openness and transparency in the sources and data and others asked for the Province to move forward on mitigation and adaptation action, in tandem. It was important to strike the balance of open, inclusive engagement and respect and reiterate the top-down, reference-based, consulting-team led process.
Disruptions	Overall, there was no organized effort by any external participants to disrupt the engagement process. There were a few participants that expressed concerns and/or had questions about the methodology, expertise of the consulting team, and/or opportunities for feedback and input. In these cases, a one-on-one (or small) virtual meeting was the preferred way to understand participants' concerns, assure they were being listened to, and provide them with direct access to the consulting team and MECP.

Topic	Observations and Lessons Learned
Access to Information	At the MECP's request, there was no website or central, accessible repository of information for participants. This meant that registration, participant updates, questions and answers, and data sharing, all transpired over email. The development of a "single window location" for PCCIA-based information, FAQs, recordings, information packages, etc. would have made the coordination of the project less onerous and could have created a more open and transparent process for external participants.
Language	The entire engagement process was conducted in English. There were no requests for other languages.
Learning While Doing	The PCCIA workshops included anonymous evaluation forms. The consulting team reviewed the feedback and incorporated it into subsequent workshops. One notable change was during Workshop #1, the breakout room format was changed to allow participants to share ideas based on their interests versus being assigned to groups. Participation rates for the evaluations, overall, were quite low under 10% of attendees provided feedback).
Advance Planning	The consulting team found that full-team and facilitation-team rehearsals were helpful for the entire workshop team to prepare for the meetings and workshops. The consulting team provided a dedicated technical producer for all workshops whose role was to manage the PowerPoint, virtual tools, chat, waiting room, and helped to navigate any access or technical challenges. This is a critical role in virtual engagement. Circulating material in advance of the meetings and workshops (including the agenda, background information and discussion questions) provided participants with an opportunity to review and digest the content. As with all workshops, some participants took the time to review the material and came prepared while others did not.
Timing	The window for external engagement noted in the PCCIA work plan was quite narrow. This resulted in two rounds of five Area of Focus workshops held over four days each. For future engagements, we would recommend these be spread out over a few more working days to allow for incorporation of participant's evaluation feedback and allow downtime for the core engagement team.

Topic	Observations and Lessons Learned
Deviations from the Engagement Plan	The engagement process deviated from the Engagement Plan in the following ways: Workshops #1 and #2 were originally planned strictly for external participants. IAIC workshops were going to be facilitated by MECP using the material from the external workshops. IAIC members ended up joining the external workshops as participants. The engagement process was revised slightly, mid-project, to remove Survey #2. This was because the feedback received during Survey #1 was not as useful as anticipated (and not as useful as the workshop-based commentary). Removal of the second survey provided the team with additional time for project planning in advance of Workshop #2.
Technology	Due to physical gathering restrictions in Ontario related to COVID-19, the entire engagement process was virtual. There were no in-person or hybrid meetings or workshops. Lack of access to reliable Internet service was not reported as a barrier to participation. The consulting team chose virtual engagement tools that were simple, user-friendly and easy for the consulting team to extract information from for future technical analysis.
Timing	The engagement process sustained the timeline noted in the project work plan and was completed in full.

Peer Review Panel

As part of the engagement process, a Peer Review Panel (PRP) was planned, assembled in late 2021, and began its work in early 2022. Throughout the reporting and synthesis stage of the PCCIA, the PRP reviewed draft PCCIA products and provide commentary on the utility of PCCIA products for decision-making support and communication among their stakeholder/membership base. The PRP did not provide technical peer review, rather their feedback was used to improve a) clarity, and b) the ability of draft products to meet the needs of Ontario stakeholders and Indigenous peoples such as communicating relevant risks or adaptation actions for implementation.

It is important to distinguish between the PRP and other External and Indigenous participants who were engaged as part of PCCIA process. While there was some overlap between participants and PRP members, these groups serve different functions. The PRP was comprised of 10 members, whose expertise, diverse perspectives and organizational mandates align with

the diversity of draft PCCIA deliverables and their application for different user groups. The following criteria were considered in developing the PRP membership:

- Appropriate level of expertise or experience to inform the review of draft deliverables and communicating results
- Experience related to climate change, impacts and risk assessment
- Relevance, experience, and presence throughout Ontario or in a particular geographic region (e.g., the Far North)
- Diversity of coverage of PRP members across all PCCIA areas of focus to ensure cross-cutting representation of the PRP
- Diversity of PRP members such that they represent different users of PCCIA information (e.g., policymaker or technical user)

The following table (Table 3.5) summarizes confirmed PRP members involved in PCCIA draft product review, in consideration with the criteria above.

Table 3.5: PCCIA Peer Review Panel Members

No.	Organization	Individual
1	Cambium Indigenous Professional Services (CIPS)	Kerry Ann Charles, Environment Partnership Co-ordinator
2	Association of Municipalities of Ontario (AMO)	Amber Crawford, Senior Policy Advisor
3	Council of the Great Lakes Region (CGLR)	Mark Fisher, Chief Executive Officer
4	Intact Centre on Climate Adaptation	Kathryn Bakos, Director Climate Finance and Science Program
5	Conservation Ontario (CO)	Jo-Anne Rzadki, Manager, Business Development and Partnerships
6	Ontario Association for Impact Assessment (OAIA)	Cheryl Chetkiewicz, President
7	Real Property Association of Canada (REALPAC)	Michael Brooks, CEO
8	Institute for Catastrophic Loss Reduction (ICLR)	Gordon McBean, Research Chair and Professor Emeritus, Western University
9	Ontario Federation of Agriculture (OFA)	Drew Spoelstra, Vice President
10	Ontario Soil and Crop Improvement Association (OSCIA)	Andrew Graham, Executive Director

At the onset of the PRP recruitment process, a Terms of Reference (ToR) was developed which described the activities, timelines, time commitment and compensation. The PRP were asked to keep the draft products in confidence and review from the perspective of the people/organizations they represent. Four meetings with the PRP were hosted over the duration of the PCCIA, the first to convene the panel and provide an overview of the overall process, and the remaining three to discuss each draft product and offer an opportunity to provide feedback verbally. PRP review processes involved targeted review periods, each consisting of two weeks to provide input. Feedback was provided in writing based upon review templates with targeted review questions aligned with the terms of the PRP and/or verbally over one of the regular meetings.

The PRP was involved in reviewing three PCCIA products, including:

- Draft Adaptation Best Practices Report (May 2022)
- Draft Decision-Making Supports (July 2022)
- Draft Summary Reports (January 2023)

Feedback received from the PRP was reviewed and used to revise drafts. These edits were made prior to draft products being submitted to Ministry staff for their review periods as per the work plan. As it relates to this Technical Report – the Regional and Area of Focus Summary Reports are based upon the content in this report and represent concise results targeting each Area of Focus and Region.

Appendix 4: Climate Projections Methodology

Historical and projected future climate data are required to generate and validate climate risks within the PCCIA. Consultation with MECP staff was undertaken to confirm the procedures and methodology followed. This represented a balance between efficiency of computations which covered the entire province at a 10 km x 10 km resolution, and a selection of climate variables which were optimized for their utility across all Areas of Focus. Ultimately 15 climate variables were selected for the PCCIA.

Current climate impacts were assessed using Environment and Climate Change Canada's latest official Climate Normals released for the period of 1981 to 2010 (Environment and Climate Change Canada, 2022). Then, using climate projections the same impacts were assessed in the future time horizons of the 2050s (representing the period from 2041 to 2070) and the 2080s (representing the period from 2071 to 2100). The changes from current conditions inform the quantified degree of expected future climate conditions.

Historical Data

High-resolution (10 km by 10 km) temperature and precipitation observations from a peer-reviewed and vetted gridded dataset were used to calculate the historical period (baseline) climate indices for the PCCIA. Every grid cell value was calculated, then all grid cells falling within each of the PCCIA regions were averaged to get the regional averages. No additional corrections or interpolations were necessary with this dataset as it provides daily data at a 10 km resolution and amounts to slightly over 18,000 data points across Ontario.

A high resolution (10 km by 10 km) dataset of temperature and precipitation observations covering the entire province was used for the assessment (Environment and Climate Change Canada, 2016; Natural Resources Canada, 2020) and has been used widely within Canada for other climate research (e.g. for developing wildfire indices by the Canadian Forestry Service) (McKenney et al., 2011; Hopkinson and McKenney, 2011; Hutchinson et al., 2009). This dataset is referred to as the CANGRD-McKenney dataset (Environment and Climate Change Canada, 2016; Natural Resources Canada, 2020). In general, this baseline dataset represents climate conditions very well, but because it is based upon observational data there is a larger potential error in data-sparse parts of Canada's North. This spatially continuous daily dataset is obtained through interpolation of Environment Canada observation station data from 1951 to 2010, but only the most recent 1981 to 2010 period was included in the PCCIA.

Daily observed minimum and maximum temperatures and precipitation (including rain and snow) were used used for the development of the gridded historical dataset (Mckenney et al., 2011). As outlined, interpolation of station data uses a smoothing-spline technique to interpolate data between stations to produce a continuous climate surface. Stations with data records of more than five years were included. In general, the baseline data represent climate

conditions in Ontario very well, with error and uncertainty being greater in data-sparse northern regions than in other parts of the province. Importantly, the data may be the only acceptable observation-based data source available for remote regions. For the mapping purposes of this study, this gridded dataset is superior to a simple interpolation between stations of varying periods from the Environment and Climate Change Canada archive.

From the basic variables of temperature and precipitation, further complex climate parameters can be calculated. For the PCCIA, 15 variables were ultimately selected based on the scope of the assessment and based those that could be applicable across multiple Areas of Focus (see Table 4.1).

Table 4.1: PCCIA Climate Variables

Climate Grouping	Climate Variable	Brief Description
High and Extreme Temperature	Extreme Hot Days (> 30°C)	A count of the average number of days per year where the maximum temperature exceeds 30°C.
	Cooling Degree Days (18°C)	The annual accumulation of mean temperature over 18°C as an indication of cooling demand.
Low Temperature	Degree Days < 0°C	The annual accumulation of cold conditions in a year where the daily mean temperature is less than zero.
	Cold Days < -25°C.	A count of the average number of days per year where the minimum temperature is less than -25°C.
Temperature	Growing degree Days (5°C)	The seasonal accumulation of heat where the mean temperature is greater than 5°C.
	Growing Season Length	The length of the growing season in days is determined by spring temperature and autumn temperature thresholds.
Precipitation	Spring Precipitation	Total spring precipitation (rain and snow).
	Summer Precipitation	Total summer precipitation (rain and snow).
	Autumn Precipitation	Total autumn precipitation (rain and snow).

Climate Grouping	Climate Variable	Brief Description
Winter Precipitation	Winter Rain Percentage (Rain:Snow ratio)	The proportion of winter precipitation falling as snow using a daily mean temperature threshold of less than 0°C.
	Winter Precipitation	Total winter precipitation (rain and snow).
Extreme Precipitation Events	Extreme Precipitation (Short-Duration)	The average annual maximum one day precipitation amount. Projections for this variable were not directly obtained from model output and will be described in more detail in the projections section.
	Extreme Precipitation (Long Duration)	The average annual maximum three-day accumulated precipitation amount.
Drought	Moisture Deficit	The difference between annual precipitation and annual evapotranspiration.
Wildfire	Wildfire Index	The average return period of wildfire in years determined by climate and burnable material. Wildfire return period is the average time between fire events. The values for this variable and its methodology were obtained directly from the Canadian Forestry Service (CFS) and provided with permission from CFS.

All variables were derived from the daily historical dataset and computed using an analytical system by the Consulting Team, except for variables 13 and 15, maximum 1-day precipitation, and wildfire return period, respectively. These two are described below.

The consulting team acknowledges that the approach used to downscale Global Climate Model projections to develop regional scale projections is only reasonable for a provincial scale assessment of this nature. This approach and resulting climate projections would not be technically reasonable for local scale risk assessments as more sophisticated approaches are current available, such as the use of Regional Climate Models, that better account for Ontario's unique geophysical features (e.g., Great Lakes, Niagara Escarpment, Hudson Bay) and their influence on local climate and weather, and in particular extreme weather events. These

downscaling approaches and associated climate projection data (e.g. Zhu et al., 2020, York University's Ontario Climate Data Portal) should be used for local scale assessments.

Maximum 1-Day Precipitation

Special treatment was applied for the calculation of maximum one-day precipitation amount. This is because the use of a gridded precipitation dataset representing a 10 km x 10 km area would always tend to reduce the maximum observed amount due to the associated scale of such events, which can be far less than 10 km wide. Simply put, this means that the 10 km x 10 km maximum daily precipitation amount for the 1981 to 2010 period was adjusted up for each grid cell to better correspond to actual observation station maximum amounts.

For this procedure, representative stations with sufficiently long periods of record within 1981 to 2010 were obtained. Across Ontario, over 70 stations were selected, and the maximum daily observed precipitation amount was obtained for the station in this baseline period. The difference between the two maximum values was then considered to 'adjust' upwards of the maximum one day amounts.

Due to the sparsity of stations in some regions, the number of stations under consideration varied. In the Southwest Region: 28 stations, Central Region: nine stations, East Region: 11 stations, Northeast Region: nine stations, Northwest Region: 10 stations, and Far North Region: two stations.

The percent difference between the station and gridded maximum value was obtained for all stations, and then for each region, the median value of the considered stations was calculated. The median value was used to obtain the regional correction adjustment percentage because the distribution of adjustments was not normally distributed, so the median better considers extremes within the station data differences. For the Far North Region, there are only two stations and so no median value is possible.

The outlier station is representative of an extreme storm occurring in 2004, where the observed station measurement was nearly three times greater than the gridded value at this location. Most differences at the 70 stations considered were within 50% of the gridded value (the blue bar).

To assess if there were significant regional differences in adjustment factors, each region was considered separately, and the results of the regional median adjustment factors are shown in Table 4.2.

The median adjustment for all regions (except the Far North where no median could be obtained (due to existing data gaps) were all quite similar, implying that the maximum daily

gridded precipitation amount should be augmented to match station observed maximums by 38.5% for all regions. As a result, this adjustment factor was applied to all grid points equally.

New Baseline grid cell 1-day maximum (mm) = CANGRD-McKenney 1-day maximum x 1.385

This approach better represents the true potential maximum of a single location within each grid cell which has been actually observed and measured. This corrected value was then used as the baseline 1-day maximum for each grid cell rather than the direct CANGRD-McKenney value.

Table 4.2: Median Adjustments by PCCIA Region

PCCIA Region	Daily Maximum Precipitation Grid Adjustment (%)
Southwest	38.8
Central	38.4
Central	37.8
Northeast	39.4
Northwest	37.9
Far North	-
All Regions	**38.5**

For the projection of 1-day maximum precipitation amounts, recent research has indicated that the default procedure should be the use of the Clausius-Clapeyron (C-C) temperature methodology (Environment and Climate Change Canada, 2020; CSA, 2019). It is recommended that the relative change in precipitation extremes scales directly with temperature at a rate approximating the C-C relation of 7% increase per degree C increase. Given temperature changes are considered more reliable than direct precipitation projections, it is therefore recommended that this temperature scaling technique be employed and 'should remain the "default null hypothesis" for future projections. This was the technique applied for the PCCIA. The AR5 model average temperature change between the baseline and future periods for each grid cell was multiplied by 7% to obtain the future 1-day maximum precipitation amount. This 7% per degree C change was then added to the adjusted baseline grid values obtained.

Fire Index (Fire Return Period)

Special treatment was also applied for variable 15, the wildfire return period variable which was provided directly by the Canadian Forestry Service (CFS) in gridded format. The CFS methodology also employs CANGRD-McKenney climate data in their index formulation (Natural Resources Canada, 2020). This is important for consistency across all variables in the establishment of a common baseline condition. Data from their calculations was initially

supplied at very high resolution of 250 x 250 meters which far exceeds the resolution necessary for an Ontario-wide assessment such as this, and so this data was linearly interpolated by averaging all data points to obtain an equivalent grid point location of 10 x 10 km used for all other variables (the fire index value of a given 10 km by 10 km grid cell is the average of all the 250 m by 250 m datapoints within the 10 km by 10 km grid cell).

The procedures for the CFS fire return period are described below, as received by CFS. The only modifications to the CFS data were:

1. Averaging of the 3 considered GCMs provided by CFS (Canadian CanESM2, UK HadGEM3, and the Japanese MIROC-ESM) for all 250 m x 250 m grid points, and
2. Subsequent averaging of the resulting high-resolution grid to the same CANGRD-McKenney 10 x 10 km grid used for all other variables.

The three models selected by CFS represent a small subset of models used within the GCM ensemble for other variables that were calculated.

For the CFS gridded data, the values represent the burn probabilities and were obtained by combining information about vegetation properties and regional-scale projections of fire regime. They represent the probability that pixels belonging to a given vegetation type might burn each year (CFS, pers. Comm). Burn probabilities are influenced by bottom-up and top-down factors, both of which are acting at different spatial scales. Bottom-up represent the surface conditions such as vegetation type and age, whereas top-down represent climate conditions such as temperature, wind, precipitation, soil moisture and humidity. Warm and dry conditions are of course most favorable for wildfire.

As with the other variables considered within the PCCIA, historical conditions were first calculated and then, using climate projections, the fire return periods are re-assessed for the future periods. Vegetation types, ages and burn probabilities were considered and modelled using the CFS system as outlined in Boulanger et al. (2014) and Beaudoin et al. (2014) using the national forest inventory database. For the future condition, vegetation types are held constant and only the top-down conditions (climate) are altered to obtain the future fire return periods. The calculation of the index is identical otherwise between the historical and future periods, just as in the other variables considered.

The methodology of scoring this fire index by using the standard deviation (SD) of the historical range of frequencies results in a time range which is much larger than other variables since it can span between a few to thousands of years (see more on the methodology below). For this reason, it did not properly reflect the potential wildland fire occurrence expected in Ontario and therefore the variable has not been included in this report.

Future Projections

Climate change projections look ahead for multiple decades into the future using climate change models. Climate scientists develop their projections of future climate using selected results from different climate change models that are generated by the most recent Intergovernmental Panel on Climate Change (IPCC) Assessment. The IPCC assessments rely on data and studies produced from a suite of global climate model (GCM) projections from various peer-reviewed international research centres. These projections are created through a standard set of experiments run on supercomputers with mathematical models that simulate a coupled atmosphere-ice-ocean-land system.

Representative Concentration Pathways (RCPs) refer to a set of emission standards used primarily by climate modellers to explore plausible future emission options and their implications for the globe's climate responses. Expressed as watts per square meter, they refer to consistent prescribed pathways by 2100 for greenhouse gas (GHG) and aerosol concentrations, together with land use change. There are four RCPs used for the latest IPCC Assessment Report 5 (AR5) from 2013, ranging from ambitious GHG reductions in the near and ongoing future (RCP2.6) through to a future with little curbing of emissions (RCP8.5). RCP8.5 is used in this assessment as a reasonable "worst case" and refers to "business as usual" global emissions into the future. Current global emissions are trending more in line with the RCP8.5 scenario than other scenarios.

In this assessment, 32 GCMs were used in the RCP4.5 ensemble, while 33 models were used in the RCP8.5 ensemble to calculate projections of future conditions Maximum, minimum and mean temperature are standard output variables from these GCMs, as is precipitation. The suite of models used in AR5 is from the Fifth Coupled Model Intercomparison Project (CMIP5), coordinated by the World Climate Research Program (IPCC, 2013). Since this PCCIA was started and climate projections were completed, new climate change projections have become available with the IPCC Sixth Assessment report (AR6). These new projections do not negate the utility of the currently assessed AR5 projections.

The use of multiple models to generate a best estimate of climate change is preferred over a single model outcome. Research has indicated that the use of multi-model ensembles is preferable to the selection of a single or few individual models since each model can contain inherent biases and weaknesses (IPCC-TGICA, 2007; Tebaldi and Knutti, 2007). For the PCCIA, an ensemble of GCM projections was utilized for future projected climate conditions based on two future greenhouse gas emission pathways: RCP4.5 (low emission pathway) and RCP8.5 (high emission pathway). There is considerable uncertainty associated with future GHG emissions as international agreements are required for various GHG targets. Nevertheless, past GHG emissions due to their persistence in the atmosphere will continue to influence our climate

even if GHG emissions were to drastically be reduced immediately due to international cooperation.

Methodology

In this study, the approach used to derive downscaled climate change projections is the Delta Approach, which is one of several methods for obtaining downscaled and bias-corrected projections of future climate. This approach is perhaps the simplest, the easiest to understand, and has been widely used for impacts and adaptation studies. It has also been shown to compare well with other more complicated downscaling approaches. When this method is coupled with the use of many models to generate projections, it generally provides more useful information than when a single or small set of models are used, regardless of their spatial or temporal resolution.

Interpolated projections developed for this study are provided at the 10 km x 10 km baseline period resolution, which matches the historical CANGRD-McKenney dataset. The following 5 steps summarize in a general sense how the Delta Approach is used to accomplish this:

1. Obtain for each climate parameter, a baseline climate condition (or 'average' climate) for the specified grid cell of the 10 km x 10 km dataset over the baseline period.
2. Using the ensemble of all available CMIP5 models (CMIP5 ensemble), obtain the model average climate for the same historical period. For many of the GCMs included, outputs are considered for multiple model runs when they were available. For our ensemble procedure, we first average all runs per model to obtain a model average value, then the individual model values are averaged to obtain the CMIP5 ensemble average. Before obtaining the average of all models, however, the model outputs are re-gridded according to a common resolution, since different modeling centres use different grid alignments and dimensions. This re-gridding uses a scale representative of the resolution of the GCMs, in this case approximately 150 by 150 km, matching the grid dimensions of the popular NCAR reanalysis, NCEP1. This is done using a process of linear interpolation to obtain the re-gridded datasets. This regrid size is intermediate of all the model resolutions, so minimal interpolation is required.
3. The CMIP5 ensemble future climate is obtained for each of the required future periods. The model averaging procedure to obtain the ensemble average follows the same procedure as outlined in item (2) above. In this case, for the 2050s and 2080s future periods.
4. The difference (or 'delta') between the CMIP5 baseline period and CMIP5 future periods is then obtained, representing the change in the specified climate condition (the 'climate change signal'). A climate delta is produced for each modelled variable, between the baseline (1981-2010) and the future time periods. This is equally applied using both the RCP4.5 (low GHG) and RCP 8.5 (business as usual or high GHG) scenarios.

The final step is to apply this delta value to the observed CANGRD-McKenney 10 km x 10 km baseline period value. This has the effect of correcting for any difference (or bias) between the true measured baseline climate and the CMIP5 model baseline climate. By applying the delta to the baseline data, a new downscaled climate average for each of the future periods and variables is obtained for each of the over 18,000 grid points across Ontario. Note that only datapoints falling within Ontario borders are considered for this analysis.

This procedure was used for all variables including the Canadian Forestry Service, variable 15, however, for their CMIP5 ensemble, fewer models (3) were employed and then averaged together to produce the delta or climate change signal.

For the PCCIA, the Ontario-wide grid point dataset was further aggregated into the six requested administrative regions. For this output, all grid centre-points falling within each region were averaged to provide the regional value for each of the 15 variables.

Localized conditions within Ontario are captured by the high-resolution baseline climate and the broad-scale climate change signal is overlain from the model ensemble which is suitable for the PCCIA scale of assessment. Specific detailed investigations of individual locations could additionally incorporate higher resolution regional climate models (RCMs), but this was not considered for this report due to:

- The limited number of RCMs compared to GCMs
- The scale of the PCCIA both in terms of area, temporal requirements of the variables
- The number of variables to be computed at each gridpoint which would be much more computationally intensive

The ultimate objective of the projection effort was to utilize the widest array of model outputs in the ensemble, versus a reduced ensemble of higher resolution regional climate models. Furthermore, all RCMs are ultimately using GCM model output as their initialization anyway, and are strongly influenced by the GCM projection itself. Ideally, RCMs would be initialized by all available GCMs to provide a higher resolution output, but this has not yet been completed by developers of RCMs due to computational limitations.

Climate Risk Evaluation Using the Normalized Z-Scores

To enable a multi-variable risk scoring approach in assessing climate risk, one of the methodologies which can be applied is the calculation of a ‘Normalized Z-Score’. The result of this indicator is unitless and so has some value when combining variables which are different (e.g., temperature, precipitation, winds, for example). Normalized Z-scores are taken from the statistical literature and represent the deviation of a population of observed (climate or other

variable) from its historical condition. This score is useful since it is a metric of the difference of a variable from its observed normal 'range'. The value of such a normalized score then is a clear, quantifiable, meaningful and unitless measure of a climatic (or other) variable from its standard condition. Larger scores imply greater change and therefore greater potential risk going forward. Because each climate variable is normalized by its own standard deviation, the scores from disparate variables can be directly combined into a single score. A high score (either negative or positive) indicates values which are increasingly less common than historically seen or conversely more extreme.

The historical population is considered normally distributed and so follows the typical 'bell curve' shape, with the peak of the bell being the most frequently observed condition over an historical period. For example, there is an historical average and a historical variance around this average. As the tails of the bell curve slope downward to the left (lower values than normal) or downward to the right (higher values than normal), their standard deviations from the mean increase as shown below for a normalized distribution of occurrence.

From the peak (or most often occurring value) the likelihood of occurrences becomes less and less, so according to the normal distribution, less than 5% of the values would be expected to be outside of the 2 standard deviation range shown in red (exactly 95.4% would be expected to be within +/- 2 standard deviations).

The 'Normalized Z-score' is then simply calculated as this (Pauline et al. 2021):

$$z = \frac{\text{Value} - \text{Mean}}{\text{Standard Deviation}} = \frac{x - \mu}{\sigma}.$$

Where each value in a population has the mean of the population subtracted from it, and is then 'normalized' by dividing this value by the standard deviation of the entire population. This results in a unitless normalized Z-score. This can be calculated from any variable and the result is a Z-score, which is zero if the value is exactly the mean of the population, but increases both positively or negatively as the individual value grows further than the mean. A way of measuring how 'different' this value is from the population is how far this value exceeds the standard deviation of the population. Each variable can (and will) have a different mean and standard deviation associated with it and the unitless Z-scores from each can be easily combined into a single composite indicator as desired by the user. This can be done simply by adding all component variable Z-scores together equally, or if desired weighting each variable first by a factor and then combining them.

To incorporate climate change, the historical distribution of the mean and standard deviation are used but in the equation above the 'values' represent the future projected values of the variable. So first a Z-score of the historical data is computed, and then by calculating a future projected population of values (such as the 2050s projected maximum temperature), these become the new 'value' in the equation. The greater the change between the future value and the historical mean, the larger the numerator of the equation becomes, and this is then divided by the historical observed distribution to obtain the normalized score. For some climate observations such as precipitation, which are highly variable historically, the standard deviation can be large and so even projected large differences in the numerator can still result in relatively small Z-scores.

In the literature, resulting Z-scores have no 'official' categorization of what is considered 'normal' or 'extreme'. As a result, the assignment of the Z-score can vary. For example, in Pauline et al. (2021), the interpretation of the Z-score is summarized in Table 4.3.

Table 4.3: Interpretation of Z Values in Support of Identifying Climate Variable Frequency Scores for the PCCIA

Absolute Value	Interpretation
0 – 2.0	Normal
2.01 – 3.0	Unusual
>3.0	Extreme

Where a score between +/- 2 is considered normal – and occurs about 95% of the time in the population. Between +/- 2 and +/-3 would be considered extreme. This could just as easily have used the thresholds of 2.5 and 3.5, or 2.5 and 3.0 for the definitions of normal, unusual, or extreme. The important part in the consideration of a multi-variable risk score is they are combinable, and it is preferable to apply equal categorization to all variables. Meaning a score of 2.5 for any variable would be considered 'unusual' since each variable is normalized by its own standard deviation.

For the PCCIA, the threshold Z-score values of 1.5 and 2.5 were used, meaning a Z-score within +/- 1.5 was considered 'normal'. Values beyond +/- 1.5 to +/- 2.5 were considered moderate change and those scores beyond +/- 2.5 were considered significant change. Within the PCCIA the Z-score results of each grid cell then resulted in numerical categorization value according to the following list

1- (large negative change from current climate)
2- (moderate negative change from current climate)
4- (similar to current climate)
8- (moderate positive change from current climate)

16- (large positive change from current climate)

The current climate (1981 to 2010) conditions of all variables were set at 4 to represent a baseline in current conditions under which future frequency scores are then able to indicate increases or decreases in frequency associated with the climate variable (e.g., extreme cold and extreme heat frequency in 2050s receive frequency scores lower and higher than 4, respectively, due to their differing trends). The future climate variable categorization then depended upon the future departures of the climate variable from the historical condition according to the Z-score. In the normalized Z-score equation above, the 'value' was then the projected value of the climate indicator. The mean and standard deviation remained the historical computed values for 1981 to 2010.

The historical mean and standard deviations used in the computation were not the entire provincial aggregated values. Because Ontario is a large area, differences between northern and southern regions are significant and if a provincial average of all 18,000 plus points were used, localized effects within regions would be lost. Furthermore, the Ontario historical values would be totally overwhelmed by the Far North region which comprises most of the Ontario grid points. To better represent within-region changes, the mean value and standard deviation value of each of the six regions was first computed for all variables and then the average of the six regions was used to determine the mean and standard deviation within the equation. This allowed for each region to be given equal weighting in the scoring and the entire provincial historical condition was not overwhelmed by the Far North region grid points. A Z-score was computed for each of the individual 18,000 plus grid points within Ontario and then for reporting purposes all the points were then assigned a corresponding numerical categorization value ranging between 1 and 16 as outlined above. Then for each of the six administrative regions, the scores were averaged to provide a regional categorization value.

Large changes in the Z-score (either positive or negative) then resulted if the climate condition produced a large change from the current historical average. All 15 variables were computed equally and used the same threshold Z-score categorization of +/- 1.5 and +/- 2.5. This was done for consistency between all variables considered and therefore all 15 variables were considered equal. Additionally, a sensitivity analysis of the use of various Z-score categorization thresholds was also undertaken to determine sensitivity of the selected 1.5 and 2.5 thresholds. There is a delicate balance to select ranges which do not result in all values falling within one category and are able to capture the changes with enough granularity to provide informative guidance. The analysis determined that altering the threshold values to 2 and 3 did not significantly alter the resulting six administrative zone categorizations from their original values. Across Ontario there are 15 variables, 6 regions, and 4 potential future scenarios (2050s RCP4.5 and RCP8.5, and 2080s RCP4.5 and RCP8.5). This results in a total number of 15 x 6 x 4 = 360 values to be considered. By altering the threshold values from 1.5 to 2.0 and the second

threshold from 2.5 to 3.0, only 43 of 360 cells were shifted into a different category, representing just 12% of the cells. This indicates that there is not a high sensitivity of the Z-score categorization thresholds assigned for this study and provides confirmation that the categories selected are meaningful both meteorologically (it represents the variability of the climate parameter) and for guidance purposes (identifies those with the greatest change and therefore higher potential impact for prioritization).

With the development of future values of climate variables from climate models, it can be expected that the distributions will shift and the potential for future Z-scores well beyond historical Z-scores will result. The future projections can therefore assume various greenhouse gas concentrations assumptions (low or high going forward) which can then produce their own related Z-score distributions which can be compared against another directly. The computed Z-score can therefore quantitatively identify variables with very large deviations from their historical observed range which can clearly inform stakeholders, practitioners and policy-makers of conditions of greatest priority. Through the use of a combined Z-score for all variables, it can be used to identify locations of highest priority where coincidental high scores from individual components result in a large total score. It is this climate score which is ultimately multiplied by the sector impact score to obtain the final risk score.

Appendix 5: Summary of Climate Information and Frequency Scores

Table 5.1: Climate Information and Frequency Scores

Climate Variable	Region	Historic Condition	Units	Trend	Normalized Z-Scores (Unitless, used to determine frequency scores based on +/- 1.5 standard deviations and +/- 2.5 standard deviations)				Variable Frequency Scores			
					2050s RCP4.5	2080s RCP4.5	2050s RCP8.5	2080s RCP8.5	2050s RCP4.5	2080s RCP4.5	2050s RCP8.5	2080s RCP8.5
High and Extreme Temperatures												
Extreme hot days >30°C	Central Region	9.1	days/yr	Increasing	7.2	9.9	11.7	24.3	16	16	16	16
Extreme hot days >30°C	Eastern Region	8.6	days/yr	Increasing	7.1	9.5	11.5	23.8	16	16	16	16
Extreme hot days >30°C	Far North Region	2.4	days/yr	Increasing	2.2	3.1	3.8	9.7	8	16	16	16
Extreme hot days >30°C	Northeast Region	4.1	days/yr	Increasing	3.7	5.1	6.3	15.0	16	16	16	16
Extreme hot days >30°C	Northwest Region	3.8	days/yr	Increasing	3.4	4.9	5.9	14.2	16	16	16	16
Extreme hot days >30°C	Southwest Region	8.8	days/yr	Increasing	7.5	10.3	12.2	25.4	16	16	16	16
Cooling Degree Days	Central Region	225	degrees/-yr	Increasing	4.9	6.4	7.4	14.2	16	16	16	16
Cooling Degree Days	Eastern Region	192	degrees/yr	Increasing	4.5	5.9	6.8	13.4	16	16	16	16
Cooling Degree Days	Far North Region	57	degrees/yr	Increasing	1.8	2.5	2.9	6.6	8	16	16	16
Cooling Degree Days	Northeast Region	90	degrees/yr	Increasing	2.8	3.7	4.4	9.3	16	16	16	16
Cooling Degree Days	Northwest Region	87	degrees/yr	Increasing	2.7	3.7	4.3	9.1	16	16	16	16
Cooling Degree Days	Southwest Region	251	degrees/yr	Increasing	5.1	6.6	7.6	14.5	16	16	16	16
Low Temperatures												
Extreme cold days < -25°C	Central Region	2.2	days/yr	Decreasing	-0.3	-0.3	-0.3	-0.4	4	4	4	4
Extreme cold days < -25°C	Eastern Region	8.3	days/yr	Decreasing	-0.9	-1.0	-1.1	-1.4	4	4	4	4
Extreme cold days < -25°C	Far North Region	55.4	days/yr	Decreasing	-3.7	-4.6	-5.1	-8.1	1	1	1	1
Extreme cold days < -25°C	Northeast Region	27.2	days/yr	Decreasing	-2.1	-2.5	-2.7	-3.9	2	1	1	1
Extreme cold days < -25°C	Northwest Region	33.5	days/yr	Decreasing	-2.4	-2.9	-3.1	-4.7	2	1	1	1
Extreme cold days < -25°C	Southwest Region	0.7	days/yr	Decreasing	-0.1	-0.1	-0.1	-0.1	4	4	4	4
Degree Days <0C	Central Region	407	degrees/yr	Decreasing	-1.4	-1.7	-1.8	-2.5	4	2	2	1
Degree Days <0C	Eastern Region	614	degrees/yr	Decreasing	-1.6	-2.0	-2.1	-3.1	2	2	2	1
Degree Days <0C	Far North Region	1925	degrees/yr	Decreasing	-3.2	-3.9	-4.3	-6.9	1	1	1	1
Degree Days <0C	Northeast Region	1153	degrees/yr	Decreasing	-2.3	-2.8	-3.0	-4.7	2	1	1	1
Degree Days <0C	Northwest Region	1357	degrees/yr	Decreasing	-2.5	-3.0	-3.2	-5.0	2	1	1	1
Degree Days <0C	Southwest Region	334	degrees/yr	Decreasing	-1.3	-1.5	-1.6	-2.2	4	2	2	2
Temperature												

Climate Variable	Region	Historic Condition	Units	Trend	Normalized Z-Scores (Unitless, used to determine frequency scores based on +/- 1.5 standard deviations and +/- 2.5 standard deviations)				Variable Frequency Scores			
					2050s RCP4.5	2080s RCP4.5	2050s RCP8.5	2080s RCP8.5	2050s RCP4.5	2080s RCP4.5	2050s RCP8.5	2080s RCP8.5
Growing Degree Days	Central Region	2108	degrees/yr	Increasing	3.1	4.0	4.4	7.8	16	16	16	16
Growing Degree Days	Eastern Region	1988	degrees/yr	Increasing	3.0	3.8	4.2	7.6	16	16	16	16
Growing Degree Days	Far North Region	1162	degrees/yr	Increasing	2.1	2.8	3.1	5.8	8	16	16	16
Growing Degree Days	Northeast Region	1508	degrees/yr	Increasing	2.5	3.2	3.7	6.7	16	16	16	16
Growing Degree Days	Northwest Region	1461	degrees/yr	Increasing	2.4	3.2	3.5	6.4	8	16	16	16
Growing Degree Days	Southwest Region	2191	degrees/yr	Increasing	3.1	4.0	4.5	7.8	16	16	16	16
Growing Season Length	Central Region	197.8	days/yr	Increasing	2.7	3.3	3.6	5.2	16	16	16	16
Growing Season Length	Eastern Region	180.8	days/yr	Increasing	2.6	3.3	3.7	5.6	16	16	16	16
Growing Season Length	Far North Region	142.8	days/yr	Increasing	2.2	2.9	3.2	5.4	8	16	16	16
Growing Season Length	Northeast Region	157.8	days/yr	Increasing	2.6	3.5	3.8	6.0	16	16	16	16
Growing Season Length	Northwest Region	154.5	days/yr	Increasing	2.5	3.3	3.7	6.2	8	16	16	16
Growing Season Length	Southwest Region	206.3	days/yr	Increasing	2.6	3.1	3.4	4.8	16	16	16	16
Precipitation												
Mean Spring Precipitation	Central Region	195.1	mm	Increasing	1.4	1.6	2.0	3.3	4	8	8	16
Mean Spring Precipitation	Eastern Region	203.7	mm	Increasing	1.4	1.6	2.0	3.2	4	8	8	16
Mean Spring Precipitation	Far North Region	73.5	mm	Increasing	0.6	0.8	0.9	1.5	4	4	4	4
Mean Spring Precipitation	Northeast Region	158.7	mm	Increasing	1.2	1.6	1.9	3.0	4	8	8	16
Mean Spring Precipitation	Northwest Region	120.7	mm	Increasing	0.8	1.1	1.5	2.3	4	4	4	8
Mean Spring Precipitation	Southwest Region	207.5	mm	Increasing	1.6	1.7	2.1	3.2	8	8	8	16
Mean Summer Precipitation	Central Region	206.9	mm	Flat	0.2	0.3	0.1	-0.2	4	4	4	4
Mean Summer Precipitation	Eastern Region	213.3	mm	Flat	0.2	0.3	0.1	-0.2	4	4	4	4
Mean Summer Precipitation	Far North Region	164	mm	Flat	0.3	0.3	0.3	0.2	4	4	4	4
Mean Summer Precipitation	Northeast Region	208	mm	Flat	0.2	0.3	0.1	-0.1	4	4	4	4
Mean Summer Precipitation	Northwest Region	222.5	mm	Flat	0.1	0.2	0.0	-0.1	4	4	4	4
Mean Summer Precipitation	Southwest Region	207.8	mm	Flat	0.2	0.3	0.0	-0.2	4	4	4	4
Mean Autumn Precipitation	Central Region	231.8	mm	Increasing	0.8	0.5	0.6	0.8	4	4	4	4
Mean Autumn Precipitation	Eastern Region	252	mm	Increasing	0.9	0.7	0.8	1.0	4	4	4	4
Mean Autumn Precipitation	Far North Region	141.5	mm	Increasing	0.6	0.8	0.8	1.2	4	4	4	4
Mean Autumn Precipitation	Northeast Region	236.6	mm	Increasing	1.0	1.0	1.0	1.5	4	4	4	4
Mean Autumn Precipitation	Northwest Region	180.5	mm	Increasing	0.7	0.8	0.7	1.1	4	4	4	4
Mean Autumn Precipitation	Southwest Region	250.3	mm	Increasing	0.7	0.4	0.5	0.7	4	4	4	4

Climate Variable	Region	Historic Condition	Units	Trend	Normalized Z-Scores (Unitless, used to determine frequency scores based on +/- 1.5 standard deviations and +/- 2.5 standard deviations)				Variable Frequency Scores			
					2050s RCP4.5	2080s RCP4.5	2050s RCP8.5	2080s RCP8.5	2050s RCP4.5	2080s RCP4.5	2050s RCP8.5	2080s RCP8.5
Winter Precipitation												
Mean Winter Precipitation	Central Region	183.4	mm	Increasing	0.9	1.2	1.4	2.2	4	4	4	8
Mean Winter Precipitation	Eastern Region	193.2	mm	Increasing	1.1	1.4	1.6	2.5	4	4	8	8
Mean Winter Precipitation	Far North Region	60.9	mm	Increasing	0.5	0.6	0.6	1.1	4	4	4	4
Mean Winter Precipitation	Northeast Region	153.5	mm	Increasing	0.9	1.1	1.3	2.1	4	4	4	8
Mean Winter Precipitation	Northwest Region	81.4	mm	Increasing	0.5	0.6	0.6	1.1	4	4	4	4
Mean Winter Precipitation	Southwest Region	207.8	mm	Increasing	1	1.3	1.6	2.4	4	4	8	8
Rain:Snow Ratio	Central Region	34.3	% rain in winter	Increasing	3.1	3.7	3.9	5.9	16	16	16	16
Rain:Snow Ratio	Eastern Region	26.3	% rain in winter	Increasing	2.9	3.6	3.8	5.9	16	16	16	16
Rain:Snow Ratio	Far North Region	1.3	% rain in winter	Increasing	0.8	1.1	1.3	2.8	4	4	4	16
Rain:Snow Ratio	Northeast Region	8.4	% rain in winter	Increasing	1.9	2.4	2.6	4.5	8	8	16	16
Rain:Snow Ratio	Northwest Region	3.1	% rain in winter	Increasing	1.4	1.8	2.0	3.7	4	8	8	16
Rain:Snow Ratio	Southwest Region	39.4	% rain in winter	Increasing	2.8	3.3	3.5	5.4	16	16	16	16
Extreme Precipitation												
Extreme Precipitation (3-day)	Central Region	85.5	mm	Flat	0.2	0.0	0.1	0.1	4	4	4	4
Extreme Precipitation (3-day)	Eastern Region	93.7	mm	Flat	0.1	0.0	0.0	0.0	4	4	4	4
Extreme Precipitation (3-day)	Far North Region	56.5	mm	Flat	0.2	0.2	0.2	0.3	4	4	4	4
Extreme Precipitation (3-day)	Northeast Region	81.4	mm	Flat	0.3	0.3	0.3	0.5	4	4	4	4
Extreme Precipitation (3-day)	Northwest Region	94.7	mm	Flat	0.3	0.4	0.4	0.6	4	4	4	4
Extreme Precipitation (3-day)	Southwest Region	104.5	mm	Flat	0.2	0.0	0.1	0.1	4	4	4	4
Extreme Precipitation (1-day)	Central Region	85.5	mm	Increasing	0.9	1.1	1.2	2.0	4	4	4	8
Extreme Precipitation (1-day)	Eastern Region	91.3	mm	Increasing	1.0	1.2	1.3	2.2	4	4	4	8
Extreme Precipitation (1-day)	Far North Region	52.2	mm	Increasing	0.6	0.8	0.8	1.4	4	4	4	4
Extreme Precipitation (1-day)	Northeast Region	79.3	mm	Increasing	0.8	1.1	1.2	2.0	4	4	4	8
Extreme Precipitation (1-day)	Northwest Region	81.1	mm	Increasing	0.9	1.1	1.2	2.0	4	4	4	8
Extreme Precipitation (1-day)	Southwest Region	102.1	mm	Increasing	1.0	1.3	1.4	2.3	4	4	4	8

Climate Variable	Region	Historic Condition	Units	Trend	Normalized Z-Scores (Unitless, used to determine frequency scores based on +/- 1.5 standard deviations and +/- 2.5 standard deviations)				Variable Frequency Scores			
					2050s RCP4.5	2080s RCP4.5	2050s RCP8.5	2080s RCP8.5	2050s RCP4.5	2080s RCP4.5	2050s RCP8.5	2080s RCP8.5
Drought												
Drought	Central Region	261.2	mm	Flat	-0.1	-0.3	-0.4	-1.1	4	4	4	4
Drought	Eastern Region	321.9	mm	Flat	0.0	-0.2	-0.2	-0.9	4	4	4	4
Drought	Far North Region	13.5	mm	Flat	-0.2	-0.3	-0.4	-1.0	4	4	4	4
Drought	Northeast Region	281.2	mm	Flat	0.1	0.0	-0.1	-0.5	4	4	4	4
Drought	Northwest Region	134.8	mm	Flat	-0.3	-0.4	-0.5	-1.1	4	4	4	4
Drought	Southwest Region	308	mm	Flat	-0.1	-0.4	-0.4	-1.1	4	4	4	4
Wildfire[2]												

[2] The scoring methods for the wildfire index by using the standard deviation (SD) of the historical range of frequencies results in a time range which is much larger than other variables since it can span between a few to thousands of years. For this reason, it did not properly reflect the potential wildland fire occurrence expected in Ontario, and therefore the variable has not been included in this table.

Appendix 6: Socio-Economic Projections Methodology

Introduction

Socio-economic development will drive Ontario's new infrastructure, industrial development, and land-use, as well as influence demographics such as migration and population structure. As part of the Provincial Climate Change Impact Assessment (PCCIA) a socio-economic projection was prepared to help in evaluating how populations and assets at risk to climate change may be impacted in Ontario until the end of the century.

Projections of long-run population and economic growth have a very wide range of uncertainty related to many factors including development of new technologies, investment in infrastructure, reforms to law and institutions, environmental and resource constraints, population pressures and the growth of intellectual capital. However, it is not necessary to make a perfect prediction of all the shifts and changes in economic structure and demographics that are possible to be able to reasonably assess climate impacts. The future predicted by the projection is not being evaluated, the projection is being used to provide a plausible and consistent reference case from which to assess different climate scenarios and consider the relative scale and importance of anticipated impacts.

This means that only a single socio-economic projection is developed. Typically, national climate impact assessments single out one Shared Socio-economic Pathway (SSP) for all Representative Concentration Pathways (e.g. RCP4.5 and RCP8.5) so that the projection can isolate differences in climate change impacts between the two RCPs (e.g., results are not influenced by differing pathways of socioeconomic change). For Ontario's climate assessment the single socio-economic projection for Ontario was based on IPCC's SSP2 scenario (Riahi et al., 2016), representing a "middle of the road" scenario that balances socio-economic challenges for adaptation and mitigation.

The SSP2 scenario includes published country level population and economic growth projections for Canada. These country level results out to the year 2100 are downscaled to Ontario to provide the general overall demographic and economic trends and include global damage functions of climate change. While the global damage functions and climate sensitivity of the SSP2 scenario may not necessarily align specifically to Ontario's circumstances, the adoption of the SSP2 scenario is advantageous as the scenario is parametrized within a long-term globally consistent frame in which national policies will develop.

Ontario regional forecasts and historical data are used to fit the overall SSP2 Canada population and economic projection to the circumstances in Ontario. Socio-economic parameters are provided on an annual basis from 2020 to 2100 at the census division level that includes 49 different census divisions in Ontario. This data, at the census division level, can be mapped directly to the six regions in Ontario that are the focus of the climate assessment.

Table 6.1 summarizes the twelve socio-economic metrics and indicators that are provided in the projection.

Table 6.1: Socio-Economic Metrics and Indicators Included in Socio-Economic Projections

Category	Metric or Indicator	Dimensions of Data in Addition to Census Division and Year
Demographics	Population	19 Age groups (5-year age groups)
	Population Density	N/A
	Households	N/A
	Household Size	N/A
Housing	Housing Stock	5 Housing Types
Economics	Gross Domestic Product	20 Industry Categories (2 Digit level NAICS)
	Industry Output	20 Industry Categories (2 Digit level NAICS)
	Employment	20 Industry Categories (2 Digit level NAICS)
	Employment Rate	N/A
	Wages	20 Industry Categories (2 Digit level NAICS)
	Low Income Measure After Tax (LIM -AT)	3 age groups
	Investment in Construction Capital Formation	17 Building and Engineering Structure Types

Methodology

The Ontario PCCIA scope and methodological framework provide several challenges to developing socio-economic projections. First, it is a comprehensive assessment and not an isolated impact assessment or a sector level study, where cumulative damage functions related to all of the climate impacts being assessed are being modelled. Second, it involves sub-regional scale modelling, introducing additional complexity and greater levels of uncertainty related to climate and socio-economic scenarios.

National climate impact assessment modelling generally starts with developing reference socio-economic projections that are consistent with global integrated socio-economic and climate scenarios. The IPCC has made significant progress in integrating socio-economic and climate scenarios and changing impact assessment from a sequential approach - emission scenarios driving climate models and sequential afterwards driving climate impacts – to a more

integrated and parallel approach, in which socio-economic development is not just steering emission pathways but also climate impacts.

The IPPC has developed five possible Socioeconomic Pathways (SSPs) for world development in the twenty-first century (Fricko et al., 2017) (see Figure 6.1). These SSPs have been implemented in different global integrated assessment models and are applied to be consistent with different Representative Concentration Pathways (e.g., RCP4.5 and RCP8.5) (Riahi et al., 2016).

Figure 6.1: Shared Socioeconomic Pathways (SSPs) developed by the IPCC

While separate SSPs could be chosen for individual RCP scenarios, in national climate impact assessments, this is not desirable as it becomes difficult to measure whether impacts are related to differing pathways of socio-economic change (e.g., the SSP) or whether they are related to the change in climate variables identified by the RCP scenario. Typically, national climate impact assessments single out one SSP for all RCPs so that the projection isolates the differences in climate change impacts between the two RCP trajectories (results are not influenced by differing pathways of socioeconomic change). For example, the US national climate assessment singles out the SSP2 scenario.

For Ontario's PCCIA we elect also to take this approach and base the socio-economic projection for Ontario on SSP2 – the middle of the road. The SSP scenario lies broadly in the middle between RCP4.5 and RCP8.5 and this single scenario means that we can identify changes that are related only to climate impacts and not differing pathways of socio-economic change.

The SSP2 scenario includes published country level population and economic growth projections. These country level results are then downscaled to Ontario to provide the general demographic trends (population, age structure) and economic trends (consumption levels and patterns, size of labour force) required for socio-economic projections that include global damage functions of climate change. While the global damage functions and climate sensitivity of the SSP2 scenario don't align specifically to Ontario's circumstances, the projection is parameterized within a long-term globally consistent frame in which national policies will develop.

Socio-economic projections needed to be developed for the six geographic regions of Ontario, but optimally for risk assessment of different populations and assets, further subdivisions are useful and for reporting socio-economic impact indicators more detailed resolution is also helpful. For these reasons, the socio-economic projections are developed at the census-division level. The projection includes a set of demographic and economic metrics and indicators as well as one housing stock physical indicator for every year between 2020 and 2100 and for all 49 census divisions in Ontario. These socio-economic metrics and indicators and a brief description of how they were developed are described in Table 6.2.

It should be noted that since this analysis took place, updated demographic trends have been released. The Ministry of Finance population projections used for modelling in the PCCIA were released in 2020 and do not reflect the Ministry's current projections (Ontario Ministry of Finance, 2022) for the latest demographic trends and increased federal immigration targets.

Table 6.2: Socio-Economic Metrics and Indicators Included in Socio-Economic Projections

Category	Metric/Indicator	Description of Method to Develop Projection
Demographics	Population	Projection of Population for 49 Census by 5-year age group (52 Regions including three sub-regions in Far-North). Model is based on Ontario Ministry of Finance Projections by Census Division to 2046 and Statistics Canada forecasts of population to 2068 and fit to SSP2 global scenario model projections to 2100 considering relative age structure, fertility, death rates and net migration of Ontario. The projection is found to lie roughly halfway between Ontario's Reference population projection to 2046 and Ontario's Low population projection to 2046.
	Population Density	Calculated from census division areas from 2016 Statistics Canada Census Data and Population (Statistics Canada, 2020a).
	Households	Projection of housing types in each Census Division for five housing types (Single-detached house, Attached or Semi-detached dwelling, Apartment in a building that has fewer than five storeys, Apartment in a building that has five or more storeys and population without housing). Projections of housing stock are based on the historical relationship between households and housing types from Statistics Canada 2016 Census and population density at the census division level, as well as the estimated renovation rate of existing stock (Statistics Canada, 2020a; 2020c).
	Household Size	Calculated from average household size and Population.
Housing	Housing Stock	Projection of housing types in each Census Division for five housing types (Single-detached house, Attached or Semi-detached dwelling, Apartment in a building that has fewer than five storeys, Apartment in a building that has five or more storeys and population without housing). Projections of housing stock are based on the historical relationship between households and housing types from Statistics Canada 2016 Census and population density at the census division level, as well as the estimated renovation rate of existing stock (Statistics Canada, 2020a; 2020c).
Economics	Gross Domestic Product	Projection of GDP for 49 Census and 20 industry classifications identified at the 20 digit NAICS level, including; 11 Agriculture, forestry, fishing and hunting, 21 Mining, quarrying, and oil and gas extraction, 22 Utilities, 23 Construction, 31-33 Manufacturing, 41 Wholesale trade, 44-45 Retail trade, 48-49 Transportation and warehousing, 51 Information and cultural industries, 52 Finance

		and insurance, 53 Real estate and rental and leasing, 54 Professional, scientific and technical services, 55 Management of companies and enterprises, 56 Administrative and support, waste management and remediation services, 61 Educational services, 62 Health care and social assistance, 71 Arts, entertainment and recreation, 72 Accommodation and food services, 81 Other services (except public administration), and 91 Public administration. Projection is based on overall GDP levels projected in SSP2 global scenario model projections to 2100 for Canada. The share of GDP by sector is downscaled to Ontario for 2020 and then to Census division, based on historical rates of GDP from Statistics Canada for Ontario and then downscaled to census divisions by considering the historical employment in each of the industrial categories by census division identified in Statistics Canada 2016 Census (Statistics Canada 2021a). The projection is then based on maintaining the share of relative employment in each industry category within each census division while responding to the change in population and overall employment.
	Industry Output	Projection of industry output for 49 Census and 20 industry classifications is identified at the two-digit NAICS level. The projection is based on the historical relationship between GDP and industry output for the sector. The historical relationship is based on direct input-output multipliers for Ontario (2017) and Canada (2020) at the detailed (229 Industries) level from Statistics Canada. The results are then aggregated for the 20-industry classification.
	Employment	Projection of full time equivalent (FTE) employment for 49 census divisions and 20 industry classifications at the 2-digit NAICS level. The projection is based on the distribution of historical employment indicated by census sub-division in Statistics Canada 2016 Census (Statistics Canada 2020a). Employment in the future is solved to balance overall GDP projections by industry sector and consider labour force changes. An overall labour productivity rate of 1% per year is considered in the projection.
	Employment Rate	Calculated from Employment and Population
	Wages	Projection of wages for 49 Census and 20 industry classifications is identified at the 2-digit NAICS level. The projection is based on the historical relationship between wages and salaries and industry output for the sector from the direct input-output multipliers for Ontario (2017) and

		Canada (2020) at the detailed (229 Industries) level from Statistics Canada (2020a;2021b). An overall labour productivity rate of one percent per year is considered in the projection.

Results

In the projection, overall Gross Domestic Product (GDP) and economic growth, as well as population growth and age structure are downscaled from the Canada level SSP2 results to Ontario. A population model that includes key dynamics such as birthrates, deaths and net migration by census sub-division in Ontario is built starting with 2020 population statistics. A comparison to the Ontario Ministry of Ontario Finance Projections (2019 to 2046) reveals that the SSP2 roughly falls in the middle between their reference and low population projection.

Figure 6.2 below broadly compare the overall and relative growth rate of a few key metrics to illustrate the overall projection.

Figure 6.2: Index of Major Socio-Economic Indicators for Ontario (2020 to 2100)

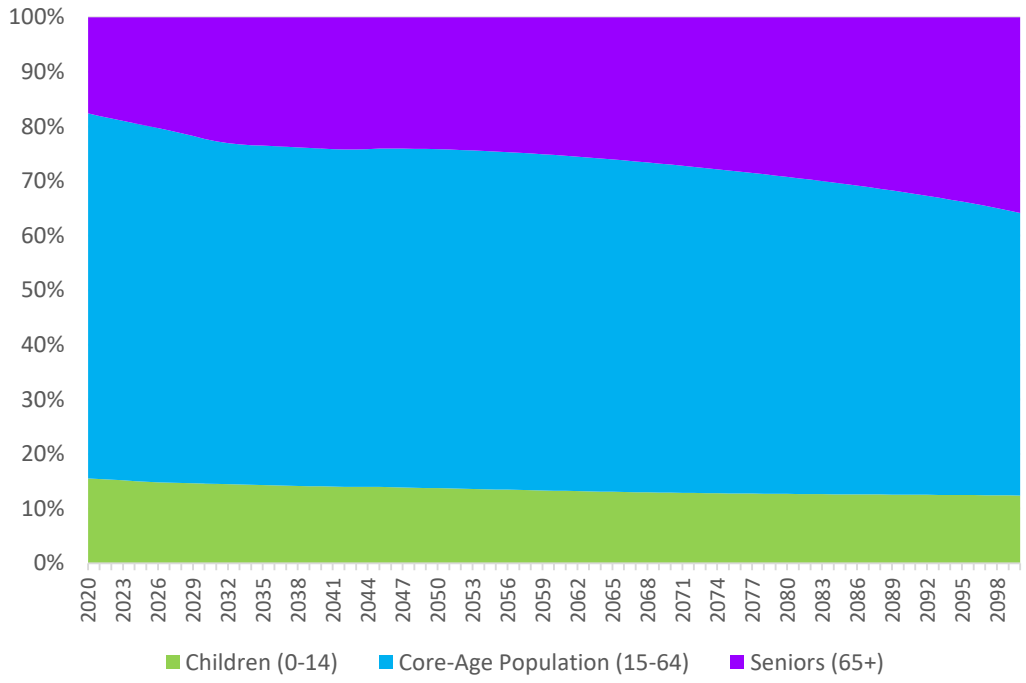
In the subsections below, specific metrics and indicators that were developed for the socio-economic projections are highlighted to provide a sense of the socio-economic data that is available.

Demographics

Population growth in the socio-economic projection declines significantly from 2020 all the way through to 2100 where annual overall population growth for the province is less than 0.1%. The major contributing factor to the decline in population growth is the significant relative increase of the population over 65 that contributes to a lower birth rate. Note that the federal government has been periodically raising immigration targets and the current federal target is just over 1.1% of the population. Despite this policy, long-term population projections used in this report from Statistics Canada to 2068 and the SSP2 scenario forecast to 2100 indicate declining population growth rates in Canada and globally out past 2050.

As a general comparison the number of individuals over 65 years of age grows from an estimated population today of 2.6 million to over 7.5 million by the year 2100 (Figure 6.3). Nearly a threefold increase while the total population increases less than 1.5 times. Average household sizes decline in the socio-economic projection as there are proportionately fewer families and more persons over the age of 65.

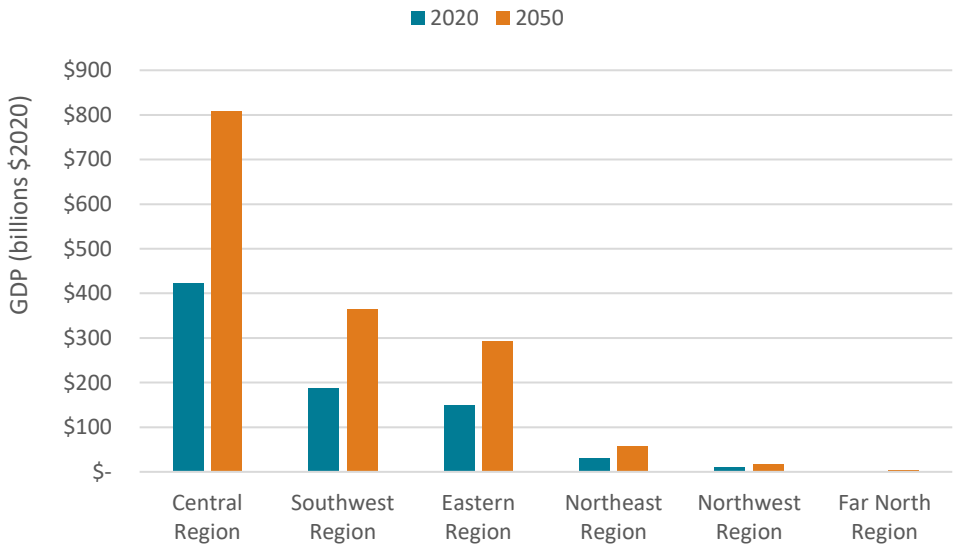
Figure 6.3: Population Age Structure



Economics

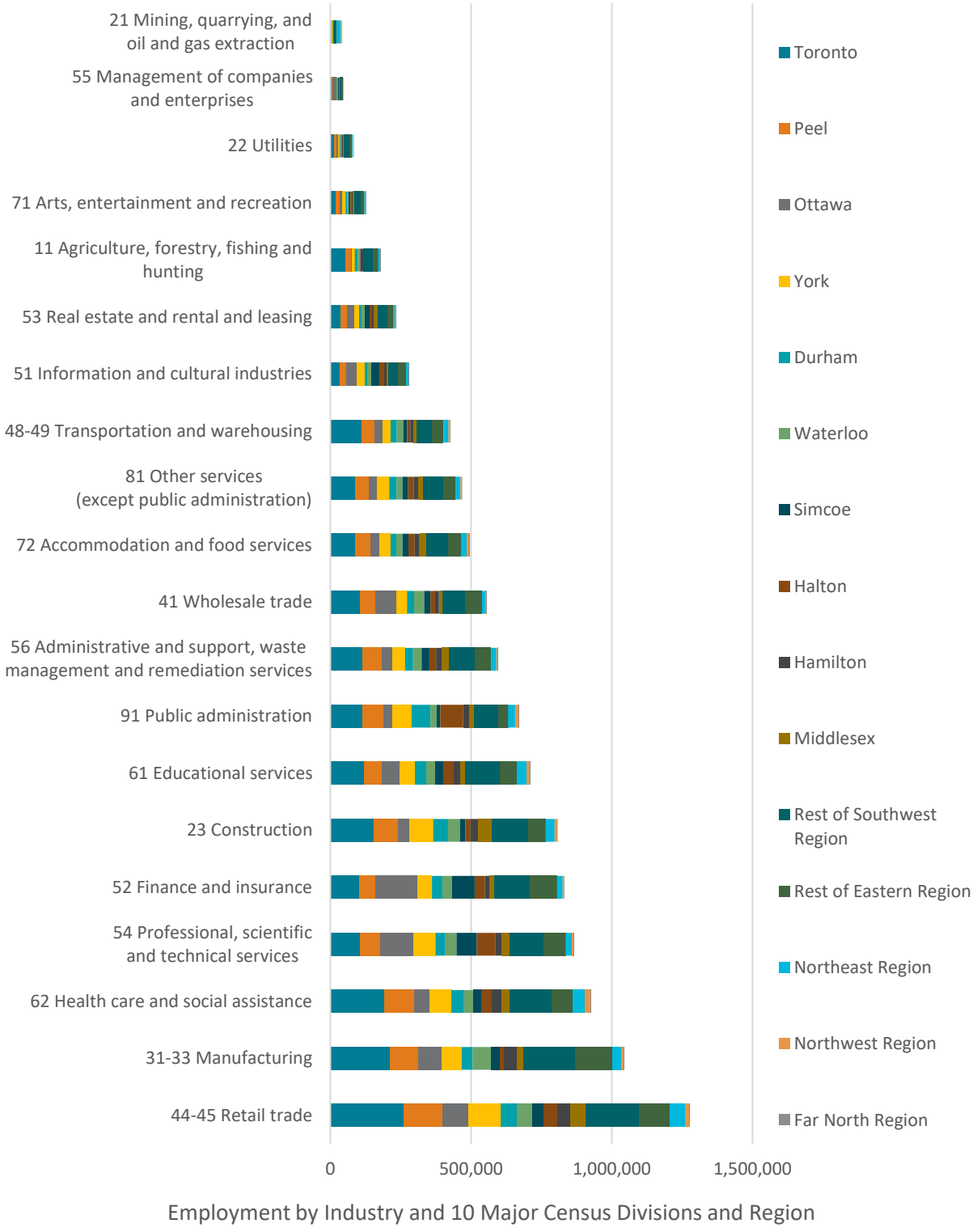
The socio-economic projection shows relatively even growth of GDP between the six regions, with the Central Region contributing 52 to 53% of Ontario's GDP in both 2020 and 2050 (Figure 6.4).

Figure 6.4: GDP by PCCIA Region for 2020 and 2050



When we extract the annual investment in construction expected in the socio-economic projection in Thunder Bay census division in 2050. This investment represents the overall construction costs of the building or engineering structures but excludes real estate brokerage, legal services, architectural engineering, and taxes. Projections indicates that $771 million or 41% of the annual investment in construction in the Thunder Bay Census division in 2050 is associated with residential buildings (Figure 6.5).

Figure 6.5: Employment by Industry and Census Division in 2050



Appendix 7: Summary of Climate Risk Scores for all Regions and Areas of Focus

How to Read Risk Profiles				
Rating	**Low**	**Medium**	**High**	**Very High**
Score	2	4	8	16

Food and Agriculture

Table 7.1: Climate Risk Scores for Level 1 and Level 2 categories across all PCCIA Regions and for Food and Agriculture

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Food & Agriculture	Field Crops	Canola	Central Region	4	8	8	8	8
Food & Agriculture	Field Crops	Canola	Northeast Region	4	8	8	8	8
Food & Agriculture	Field Crops	Canola	Southwest Region	4	8	8	8	8
Food & Agriculture	Field Crops	Cereals	Central Region	4	8	8	16	16
Food & Agriculture	Field Crops	Cereals	Eastern Region	4	8	8	16	16
Food & Agriculture	Field Crops	Cereals	Northeast Region	4	8	8	8	8
Food & Agriculture	Field Crops	Cereals	Northwest Region	4	8	8	8	8
Food & Agriculture	Field Crops	Cereals	Southwest Region	4	8	8	16	16
Food & Agriculture	Field Crops	Corn	Central Region	8	8	8	8	16
Food & Agriculture	Field Crops	Corn	Eastern Region	8	8	8	8	16
Food & Agriculture	Field Crops	Corn	Northeast Region	8	8	8	8	8
Food & Agriculture	Field Crops	Corn	Southwest Region	8	8	8	16	16
Food & Agriculture	Field Crops	Forages	Central Region	4	8	8	16	16
Food & Agriculture	Field Crops	Forages	Eastern Region	4	8	8	16	16
Food & Agriculture	Field Crops	Forages	Northeast Region	4	8	8	8	8
Food & Agriculture	Field Crops	Forages	Northwest Region	4	8	8	8	8
Food & Agriculture	Field Crops	Forages	Southwest Region	4	8	8	8	16
Food & Agriculture	Field Crops	Soybeans	Central Region	8	8	8	8	16
Food & Agriculture	Field Crops	Soybeans	Eastern Region	8	8	8	8	16
Food & Agriculture	Field Crops	Soybeans	Northeast Region	8	8	8	8	8
Food & Agriculture	Field Crops	Soybeans	Southwest Region	8	8	8	8	16
Food & Agriculture	Fruits and Vegetables	Apples	Central Region	8	16	16	16	16
Food & Agriculture	Fruits and Vegetables	Apples	Eastern Region	8	16	16	16	16

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Food & Agriculture	Fruits and Vegetables	Apples	Southwest Region	8	16	16	16	16
Food & Agriculture	Fruits and Vegetables	Berries	Central Region	8	8	8	16	16
Food & Agriculture	Fruits and Vegetables	Berries	Eastern Region	8	8	8	8	8
Food & Agriculture	Fruits and Vegetables	Berries	Northeast Region	8	8	8	8	8
Food & Agriculture	Fruits and Vegetables	Berries	Northwest Region	8	8	8	8	8
Food & Agriculture	Fruits and Vegetables	Berries	Southwest Region	8	8	8	8	8
Food & Agriculture	Fruits and Vegetables	Field Vegetables	Central Region	8	8	8	8	16
Food & Agriculture	Fruits and Vegetables	Field Vegetables	Eastern Region	8	8	8	8	16
Food & Agriculture	Fruits and Vegetables	Field Vegetables	Southwest Region	8	8	8	8	16
Food & Agriculture	Fruits and Vegetables	Grapes	Eastern Region	4	8	8	8	16
Food & Agriculture	Fruits and Vegetables	Grapes	Southwest Region	4	8	8	8	16
Food & Agriculture	Fruits and Vegetables	Greenhouse Vegetables	Central Region	4	8	8	8	8
Food & Agriculture	Fruits and Vegetables	Greenhouse Vegetables	Eastern Region	4	8	8	8	8
Food & Agriculture	Fruits and Vegetables	Greenhouse Vegetables	Southwest Region	4	8	8	8	8
Food & Agriculture	Fruits and Vegetables	Tender Fruit	Central Region	8	8	8	8	8
Food & Agriculture	Fruits and Vegetables	Tender Fruit	Eastern Region	8	8	8	8	8
Food & Agriculture	Fruits and Vegetables	Tender Fruit	Southwest Region	8	8	8	8	8
Food & Agriculture	Livestock	Beef	Central Region	4	8	8	8	8
Food & Agriculture	Livestock	Beef	Eastern Region	4	8	8	8	8
Food & Agriculture	Livestock	Beef	Northeast Region	4	4	4	4	4
Food & Agriculture	Livestock	Beef	Northwest Region	4	4	4	4	4
Food & Agriculture	Livestock	Beef	Southwest Region	4	8	8	8	8
Food & Agriculture	Livestock	Dairy	Central Region	4	8	8	8	8
Food & Agriculture	Livestock	Dairy	Eastern Region	4	8	8	8	8
Food & Agriculture	Livestock	Dairy	Northeast Region	4	4	4	4	8
Food & Agriculture	Livestock	Dairy	Northwest Region	4	4	4	4	8
Food & Agriculture	Livestock	Dairy	Southwest Region	4	8	8	8	8
Food & Agriculture	Livestock	Poultry and eggs	Central Region	4	8	8	8	8
Food & Agriculture	Livestock	Poultry and eggs	Eastern Region	4	8	8	8	8
Food & Agriculture	Livestock	Poultry and eggs	Northeast Region	4	4	4	4	8
Food & Agriculture	Livestock	Poultry and eggs	Northwest Region	4	4	4	4	8
Food & Agriculture	Livestock	Poultry and eggs	Southwest Region	4	8	8	8	8

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Food & Agriculture	Livestock	Sheep	Central Region	4	4	4	4	4
Food & Agriculture	Livestock	Sheep	Eastern Region	4	4	4	4	4
Food & Agriculture	Livestock	Sheep	Northeast Region	4	4	4	4	4
Food & Agriculture	Livestock	Sheep	Northwest Region	4	4	4	4	4
Food & Agriculture	Livestock	Sheep	Southwest Region	4	4	4	4	4
Food & Agriculture	Livestock	Swine	Central Region	4	8	8	8	8
Food & Agriculture	Livestock	Swine	Eastern Region	4	8	8	8	8
Food & Agriculture	Livestock	Swine	Northeast Region	4	4	4	4	8
Food & Agriculture	Livestock	Swine	Northwest Region	4	4	4	4	8
Food & Agriculture	Livestock	Swine	Southwest Region	4	8	8	8	8

Infrastructure

Table 7.2: Climate Risk Scores for Level 1 and Level 2 categories across all PCCIA Regions and for Infrastructure

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Infrastructure	Buildings	Housing	Central Region	4	4	4	8	8
Infrastructure	Buildings	Housing	Eastern Region	4	4	4	8	8
Infrastructure	Buildings	Housing	Far North Region	4	4	8	8	8
Infrastructure	Buildings	Housing	Northeast Region	4	4	4	4	8
Infrastructure	Buildings	Housing	Northwest Region	4	4	4	4	4
Infrastructure	Buildings	Housing	Southwest Region	4	8	8	8	8
Infrastructure	Buildings	Other Buildings	Central Region	4	4	4	8	8
Infrastructure	Buildings	Other Buildings	Eastern Region	4	4	4	8	8
Infrastructure	Buildings	Other Buildings	Far North Region	4	4	8	8	8
Infrastructure	Buildings	Other Buildings	Northeast Region	4	4	4	4	4
Infrastructure	Buildings	Other Buildings	Northwest Region	4	4	4	4	4
Infrastructure	Buildings	Other Buildings	Southwest Region	4	4	4	8	8
Infrastructure	Buildings	Public Buildings	Central Region	4	4	4	8	8
Infrastructure	Buildings	Public Buildings	Eastern Region	4	4	4	8	8
Infrastructure	Buildings	Public Buildings	Far North Region	4	4	8	8	8
Infrastructure	Buildings	Public Buildings	Northeast Region	4	4	4	4	4
Infrastructure	Buildings	Public Buildings	Northwest Region	4	4	4	4	4
Infrastructure	Buildings	Public Buildings	Southwest Region	4	4	4	8	8
Infrastructure	Pipeline Transportation	Natural Gas Distribution	Central Region	4	4	4	4	4
Infrastructure	Pipeline Transportation	Natural Gas Distribution	Eastern Region	4	4	4	4	4
Infrastructure	Pipeline Transportation	Natural Gas Distribution	Far North Region	4	4	4	4	4
Infrastructure	Pipeline Transportation	Natural Gas Distribution	Northeast Region	4	4	4	4	4
Infrastructure	Pipeline Transportation	Natural Gas Distribution	Northwest Region	4	4	4	4	4
Infrastructure	Pipeline Transportation	Natural Gas Distribution	Southwest Region	4	4	4	4	4
Infrastructure	Pipeline Transportation	Pipelines	Central Region	4	4	4	4	4
Infrastructure	Pipeline Transportation	Pipelines	Eastern Region	4	4	4	4	4
Infrastructure	Pipeline Transportation	Pipelines	Far North Region	4	4	4	4	4
Infrastructure	Pipeline Transportation	Pipelines	Northeast Region	4	4	4	4	4
Infrastructure	Pipeline Transportation	Pipelines	Northwest Region	4	4	4	4	4
Infrastructure	Pipeline Transportation	Pipelines	Southwest Region	4	4	4	4	4

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Infrastructure	Stormwater Management	Flood Mitigation Infrastructure	Central Region	8	8	8	8	8
Infrastructure	Stormwater Management	Flood Mitigation Infrastructure	Eastern Region	8	8	8	8	8
Infrastructure	Stormwater Management	Flood Mitigation Infrastructure	Far North Region	8	8	8	8	8
Infrastructure	Stormwater Management	Flood Mitigation Infrastructure	Northeast Region	8	8	8	8	8
Infrastructure	Stormwater Management	Flood Mitigation Infrastructure	Northwest Region	8	8	8	8	8
Infrastructure	Stormwater Management	Flood Mitigation Infrastructure	Southwest Region	8	8	8	8	8
Infrastructure	Stormwater Management	Urban and Rural Stormwater Management Systems	Central Region	8	8	8	8	8
Infrastructure	Stormwater Management	Urban and Rural Stormwater Management Systems	Eastern Region	8	8	8	8	8
Infrastructure	Stormwater Management	Urban and Rural Stormwater Management Systems	Far North Region	8	8	8	8	8
Infrastructure	Stormwater Management	Urban and Rural Stormwater Management Systems	Northeast Region	8	8	8	8	8
Infrastructure	Stormwater Management	Urban and Rural Stormwater Management Systems	Northwest Region	8	8	8	8	8
Infrastructure	Stormwater Management	Urban and Rural Stormwater Management Systems	Southwest Region	8	8	8	8	8
Infrastructure	Transportation	Air Transportation	Central Region	4	8	8	8	8
Infrastructure	Transportation	Air Transportation	Eastern Region	4	8	8	8	8
Infrastructure	Transportation	Air Transportation	Far North Region	4	4	4	4	4
Infrastructure	Transportation	Air Transportation	Northeast Region	4	8	8	8	8
Infrastructure	Transportation	Air Transportation	Northwest Region	4	8	8	8	8
Infrastructure	Transportation	Air Transportation	Southwest Region	4	8	8	8	8
Infrastructure	Transportation	Deep Sea, Coastal and Great Lakes	Central Region	4	4	4	4	4
Infrastructure	Transportation	Deep Sea, Coastal and Great Lakes	Eastern Region	4	4	4	4	4
Infrastructure	Transportation	Deep Sea, Coastal and Great Lakes	Far North Region	4	4	4	4	4
Infrastructure	Transportation	Deep Sea, Coastal and Great Lakes	Northeast Region	4	4	4	4	4
Infrastructure	Transportation	Deep Sea, Coastal and Great Lakes	Northwest Region	4	4	4	4	4
Infrastructure	Transportation	Deep Sea, Coastal and Great Lakes	Southwest Region	4	4	4	4	4
Infrastructure	Transportation	Rail	Central Region	4	8	8	8	8
Infrastructure	Transportation	Rail	Eastern Region	4	8	8	8	8
Infrastructure	Transportation	Rail	Far North Region	4	4	8	8	8
Infrastructure	Transportation	Rail	Northeast Region	4	8	8	8	8
Infrastructure	Transportation	Rail	Northwest Region	4	8	8	8	8
Infrastructure	Transportation	Rail	Southwest Region	4	8	8	8	8
Infrastructure	Transportation	Roads and Bridges	Central Region	4	4	4	4	8

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Infrastructure	Transportation	Roads and Bridges	Eastern Region	4	4	4	4	8
Infrastructure	Transportation	Roads and Bridges	Far North Region	4	4	4	4	4
Infrastructure	Transportation	Roads and Bridges	Northeast Region	4	4	4	4	4
Infrastructure	Transportation	Roads and Bridges	Northwest Region	4	4	4	4	4
Infrastructure	Transportation	Roads and Bridges	Southwest Region	4	4	4	4	4
Infrastructure	Utilities	Electrical Power Generation	Central Region	8	8	8	8	8
Infrastructure	Utilities	Electrical Power Generation	Eastern Region	8	8	8	8	8
Infrastructure	Utilities	Electrical Power Generation	Far North Region	8	8	8	8	8
Infrastructure	Utilities	Electrical Power Generation	Northeast Region	8	8	8	8	8
Infrastructure	Utilities	Electrical Power Generation	Northwest Region	8	8	8	8	8
Infrastructure	Utilities	Electrical Power Generation	Southwest Region	8	8	8	8	8
Infrastructure	Utilities	Electrical Power Transmission, Control and Distribution	Central Region	4	8	8	8	8
Infrastructure	Utilities	Electrical Power Transmission, Control and Distribution	Eastern Region	4	8	8	8	8
Infrastructure	Utilities	Electrical Power Transmission, Control and Distribution	Far North Region	4	8	8	8	8
Infrastructure	Utilities	Electrical Power Transmission, Control and Distribution	Northeast Region	4	8	8	8	8
Infrastructure	Utilities	Electrical Power Transmission, Control and Distribution	Northwest Region	4	8	8	8	8
Infrastructure	Utilities	Electrical Power Transmission, Control and Distribution	Southwest Region	4	8	8	8	8
Infrastructure	Utilities	Sewage Treatment Facilities	Central Region	4	4	4	8	8
Infrastructure	Utilities	Sewage Treatment Facilities	Eastern Region	4	4	4	8	8
Infrastructure	Utilities	Sewage Treatment Facilities	Far North Region	4	4	4	4	4
Infrastructure	Utilities	Sewage Treatment Facilities	Northeast Region	4	4	4	4	4
Infrastructure	Utilities	Sewage Treatment Facilities	Northwest Region	4	4	4	4	4
Infrastructure	Utilities	Sewage Treatment Facilities	Southwest Region	4	4	4	8	8
Infrastructure	Utilities	Telecommunications	Central Region	4	4	4	4	4
Infrastructure	Utilities	Telecommunications	Eastern Region	4	4	4	4	8

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Infrastructure	Utilities	Telecommunications	Far North Region	4	4	4	4	4
Infrastructure	Utilities	Telecommunications	Northeast Region	4	4	4	4	4
Infrastructure	Utilities	Telecommunications	Northwest Region	4	4	4	4	4
Infrastructure	Utilities	Telecommunications	Southwest Region	4	4	4	4	4
Infrastructure	Utilities	Water Supply and Irrigation Systems	Central Region	4	4	4	4	4
Infrastructure	Utilities	Water Supply and Irrigation Systems	Eastern Region	4	4	4	4	4
Infrastructure	Utilities	Water Supply and Irrigation Systems	Far North Region	4	4	4	4	4
Infrastructure	Utilities	Water Supply and Irrigation Systems	Northeast Region	4	4	4	4	4
Infrastructure	Utilities	Water Supply and Irrigation Systems	Northwest Region	4	4	4	4	4
Infrastructure	Utilities	Water Supply and Irrigation Systems	Southwest Region	4	4	4	4	4
Infrastructure	Waste Management	Waste Management	Central Region	4	4	4	8	8
Infrastructure	Waste Management	Waste Management	Eastern Region	4	4	4	8	8
Infrastructure	Waste Management	Waste Management	Far North Region	4	4	4	4	4
Infrastructure	Waste Management	Waste Management	Northeast Region	4	4	4	4	8
Infrastructure	Waste Management	Waste Management	Northwest Region	4	4	4	4	8
Infrastructure	Waste Management	Waste Management	Southwest Region	4	4	4	8	8

Natural Environment

Table 7.3: Climate Risk Scores for Level 1 and Level 2 categories across all PCCIA Regions and for Natural Environment

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Natural Environment	Aquatic Ecosystems	Bog	Central Region	4	8	8	8	8
Natural Environment	Aquatic Ecosystems	Bog	Eastern Region	4	8	8	8	8
Natural Environment	Aquatic Ecosystems	Bog	Far North Region	8	8	16	16	16
Natural Environment	Aquatic Ecosystems	Bog	Northeast Region	8	8	8	16	16
Natural Environment	Aquatic Ecosystems	Bog	Northwest Region	8	8	8	16	16
Natural Environment	Aquatic Ecosystems	Bog	Southwest Region	4	8	8	8	8
Natural Environment	Aquatic Ecosystems	Clear Open Water	Central Region	4	8	8	8	8
Natural Environment	Aquatic Ecosystems	Clear Open Water	Eastern Region	4	8	8	8	8
Natural Environment	Aquatic Ecosystems	Clear Open Water	Far North Region	4	4	4	8	8
Natural Environment	Aquatic Ecosystems	Clear Open Water	Northeast Region	4	4	4	8	8
Natural Environment	Aquatic Ecosystems	Clear Open Water	Northwest Region	4	4	4	8	8
Natural Environment	Aquatic Ecosystems	Clear Open Water	Southwest Region	4	8	8	8	8
Natural Environment	Aquatic Ecosystems	Marsh	Central Region	4	8	8	16	16
Natural Environment	Aquatic Ecosystems	Marsh	Eastern Region	4	8	8	8	8
Natural Environment	Aquatic Ecosystems	Marsh	Far North Region	4	4	8	8	8
Natural Environment	Aquatic Ecosystems	Marsh	Northeast Region	4	4	8	8	8
Natural Environment	Aquatic Ecosystems	Marsh	Northwest Region	4	4	4	8	8
Natural Environment	Aquatic Ecosystems	Marsh	Southwest Region	4	8	8	8	8
Natural Environment	Aquatic Ecosystems	Mudflats	Far North Region	8	8	8	16	16
Natural Environment	Ecosystem Cultural Services	Nature based recreation	Central Region	4	8	8	8	8
Natural Environment	Ecosystem Cultural Services	Nature based recreation	Eastern Region	4	8	8	8	8
Natural Environment	Ecosystem Cultural Services	Nature based recreation	Northeast Region	4	8	8	8	16
Natural Environment	Ecosystem Cultural Services	Nature based recreation	Northwest Region	4	8	8	16	16
Natural Environment	Ecosystem Cultural Services	Nature based recreation	Southwest Region	4	8	8	8	8
Natural Environment	Ecosystem Cultural Services	Recreational Fishing (Angling)	Central Region	4	8	8	8	8
Natural Environment	Ecosystem Cultural Services	Recreational Fishing (Angling)	Eastern Region	4	8	8	8	8
Natural Environment	Ecosystem Cultural Services	Recreational Fishing (Angling)	Far North Region	4	4	8	8	8
Natural Environment	Ecosystem Cultural Services	Recreational Fishing (Angling)	Northeast Region	4	8	8	8	8
Natural Environment	Ecosystem Cultural Services	Recreational Fishing (Angling)	Northwest Region	4	8	8	8	8
Natural Environment	Ecosystem Cultural Services	Recreational Fishing (Angling)	Southwest Region	4	8	8	8	8

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Natural Environment	Fauna	Amphibian	Central Region	4	8	8	8	8
Natural Environment	Fauna	Amphibian	Eastern Region	4	8	8	8	8
Natural Environment	Fauna	Amphibian	Far North Region	4	4	4	8	8
Natural Environment	Fauna	Amphibian	Northeast Region	4	4	4	8	8
Natural Environment	Fauna	Amphibian	Northwest Region	4	4	4	8	8
Natural Environment	Fauna	Amphibian	Southwest Region	8	8	8	8	8
Natural Environment	Fauna	Bird	Central Region	4	8	8	8	8
Natural Environment	Fauna	Bird	Eastern Region	4	8	8	8	8
Natural Environment	Fauna	Bird	Northeast Region	4	8	8	8	8
Natural Environment	Fauna	Bird	Northwest Region	4	4	8	8	8
Natural Environment	Fauna	Bird	Southwest Region	4	8	8	8	8
Natural Environment	Fauna	Cold-water fish	Central Region	8	16	16	16	16
Natural Environment	Fauna	Cold-water fish	Eastern Region	4	8	8	8	8
Natural Environment	Fauna	Cold-water fish	Far North Region	4	4	8	8	8
Natural Environment	Fauna	Cold-water fish	Northeast Region	4	8	8	8	8
Natural Environment	Fauna	Cold-water fish	Northwest Region	4	4	8	8	8
Natural Environment	Fauna	Cold-water fish	Southwest Region	8	16	16	16	16
Natural Environment	Fauna	Cool-water fish	Central Region	4	8	8	16	16
Natural Environment	Fauna	Cool-water fish	Eastern Region	4	8	8	16	16
Natural Environment	Fauna	Cool-water fish	Far North Region	8	8	8	16	16
Natural Environment	Fauna	Cool-water fish	Northeast Region	4	8	8	8	8
Natural Environment	Fauna	Cool-water fish	Northwest Region	4	8	8	8	8
Natural Environment	Fauna	Cool-water fish	Southwest Region	4	8	8	8	8
Natural Environment	Fauna	Fish	Central Region	8	16	16	16	16
Natural Environment	Fauna	Fish	Eastern Region	8	16	16	16	16
Natural Environment	Fauna	Fish	Far North Region	4	4	8	8	8
Natural Environment	Fauna	Fish	Northeast Region	4	8	8	8	8
Natural Environment	Fauna	Fish	Northwest Region	4	4	8	8	8
Natural Environment	Fauna	Fish	Southwest Region	8	16	16	16	16
Natural Environment	Fauna	Insect/Spider	Central Region	4	8	8	16	16
Natural Environment	Fauna	Insect/Spider	Eastern Region	4	4	4	8	8
Natural Environment	Fauna	Insect/Spider	Far North Region	4	4	4	4	4

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Natural Environment	Fauna	Insect/Spider	Northeast Region	4	8	8	8	8
Natural Environment	Fauna	Insect/Spider	Northwest Region	4	4	4	4	4
Natural Environment	Fauna	Insect/Spider	Southwest Region	4	8	8	16	16
Natural Environment	Fauna	Mammal	Central Region	4	8	8	16	16
Natural Environment	Fauna	Mammal	Eastern Region	4	8	8	16	16
Natural Environment	Fauna	Mammal	Far North Region	4	8	8	8	8
Natural Environment	Fauna	Mammal	Northeast Region	4	8	8	8	8
Natural Environment	Fauna	Mammal	Northwest Region	4	8	8	8	8
Natural Environment	Fauna	Mammal	Southwest Region	4	8	8	16	16
Natural Environment	Fauna	Migratory songbirds	Central Region	4	8	8	8	8
Natural Environment	Fauna	Migratory songbirds	Eastern Region	4	8	8	8	8
Natural Environment	Fauna	Migratory songbirds	Far North Region	4	4	8	8	8
Natural Environment	Fauna	Migratory songbirds	Northeast Region	4	8	8	8	8
Natural Environment	Fauna	Migratory songbirds	Northwest Region	4	4	8	8	8
Natural Environment	Fauna	Migratory songbirds	Southwest Region	4	8	8	8	8
Natural Environment	Fauna	Mollusc	Southwest Region	8	16	16	16	16
Natural Environment	Fauna	Reptile	Central Region	4	4	4	4	4
Natural Environment	Fauna	Reptile	Eastern Region	4	8	8	4	4
Natural Environment	Fauna	Reptile	Northeast Region	4	8	8	4	4
Natural Environment	Fauna	Reptile	Southwest Region	4	4	4	4	4
Natural Environment	Fauna	Warm-water fish	Central Region	4	8	8	4	4
Natural Environment	Fauna	Warm-water fish	Eastern Region	4	8	8	8	8
Natural Environment	Fauna	Warm-water fish	Far North Region	8	8	8	8	8
Natural Environment	Fauna	Warm-water fish	Northeast Region	4	8	8	8	8
Natural Environment	Fauna	Warm-water fish	Northwest Region	4	8	8	8	8
Natural Environment	Fauna	Warm-water fish	Southwest Region	4	8	8	8	8
Natural Environment	Fauna	Waterfowl	Central Region	8	16	16	16	16
Natural Environment	Fauna	Waterfowl	Eastern Region	4	8	8	8	8
Natural Environment	Fauna	Waterfowl	Far North Region	4	8	8	8	8
Natural Environment	Fauna	Waterfowl	Northeast Region	4	8	8	8	8
Natural Environment	Fauna	Waterfowl	Northwest Region	4	8	8	8	8
Natural Environment	Fauna	Waterfowl	Southwest Region	8	16	16	16	16

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Natural Environment	Flora	Bryophyte	Northwest Region	4	4	4	8	8
Natural Environment	Flora	Lichen	Northwest Region	4	8	8	8	8
Natural Environment	Flora	Lichen	Southwest Region	4	8	8	16	16
Natural Environment	Flora	Vascular plant	Central Region	4	8	8	8	8
Natural Environment	Flora	Vascular plant	Eastern Region	4	8	8	8	8
Natural Environment	Flora	Vascular plant	Northeast Region	4	8	8	8	8
Natural Environment	Flora	Vascular plant	Northwest Region	4	4	8	8	8
Natural Environment	Flora	Vascular plant	Southwest Region	4	8	8	8	8
Natural Environment	Provisioning Services	Freshwater Provision	Central Region	4	8	8	16	16
Natural Environment	Provisioning Services	Freshwater Provision	Eastern Region	4	8	8	16	16
Natural Environment	Provisioning Services	Freshwater Provision	Far North Region	4	4	8	8	8
Natural Environment	Provisioning Services	Freshwater Provision	Northeast Region	4	8	8	8	8
Natural Environment	Provisioning Services	Freshwater Provision	Northwest Region	4	4	8	8	8
Natural Environment	Provisioning Services	Freshwater Provision	Southwest Region	4	8	8	16	16
Natural Environment	Provisioning Services	Wood Supplies	Central Region	4	8	8	8	8
Natural Environment	Provisioning Services	Wood Supplies	Eastern Region	4	8	8	8	8
Natural Environment	Provisioning Services	Wood Supplies	Northeast Region	4	4	4	8	8
Natural Environment	Provisioning Services	Wood Supplies	Northwest Region	4	4	4	8	8
Natural Environment	Provisioning Services	Wood Supplies	Southwest Region	4	8	8	8	8
Natural Environment	Regulating services	Carbon Storage	Central Region	2	8	8	8	8
Natural Environment	Regulating services	Carbon Storage	Eastern Region	2	8	8	8	8
Natural Environment	Regulating services	Carbon Storage	Far North Region	8	8	16	16	16
Natural Environment	Regulating services	Carbon Storage	Northeast Region	8	8	8	16	16
Natural Environment	Regulating services	Carbon Storage	Northwest Region	4	8	8	16	16
Natural Environment	Regulating services	Carbon Storage	Southwest Region	2	4	4	8	8
Natural Environment	Regulating Services	Pollination	Central Region	4	16	16	16	16
Natural Environment	Regulating Services	Pollination	Eastern Region	4	8	8	16	16
Natural Environment	Regulating Services	Pollination	Far North Region	4	4	8	8	8
Natural Environment	Regulating Services	Pollination	Northeast Region	4	8	8	8	8
Natural Environment	Regulating Services	Pollination	Northwest Region	4	4	8	8	8
Natural Environment	Regulating Services	Pollination	Southwest Region	4	16	16	16	16
Natural Environment	Regulating services	Water Flow Regulation	Central Region	4	8	8	8	8

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Natural Environment	Regulating services	Water Flow Regulation	Eastern Region	4	8	8	8	8
Natural Environment	Regulating services	Water Flow Regulation	Far North Region	4	4	4	8	8
Natural Environment	Regulating services	Water Flow Regulation	Northeast Region	4	4	4	8	8
Natural Environment	Regulating services	Water Flow Regulation	Northwest Region	4	4	4	8	8
Natural Environment	Regulating services	Water Flow Regulation	Southwest Region	4	8	8	8	8
Natural Environment	Terrestrial Ecosystems	Coniferous Forest	Eastern Region	4	8	8	8	16
Natural Environment	Terrestrial Ecosystems	Coniferous Forest	Far North Region	4	8	8	8	8
Natural Environment	Terrestrial Ecosystems	Coniferous Forest	Northeast Region	4	8	8	8	8
Natural Environment	Terrestrial Ecosystems	Coniferous Forest	Northwest Region	4	8	8	8	8
Natural Environment	Terrestrial Ecosystems	Deciduous Forest	Central Region	4	8	8	8	8
Natural Environment	Terrestrial Ecosystems	Deciduous Forest	Eastern Region	4	8	8	8	8
Natural Environment	Terrestrial Ecosystems	Deciduous Forest	Northeast Region	4	8	8	8	8
Natural Environment	Terrestrial Ecosystems	Deciduous Forest	Northwest Region	4	4	8	8	8
Natural Environment	Terrestrial Ecosystems	Deciduous Forest	Southwest Region	4	8	8	8	8
Natural Environment	Terrestrial Ecosystems	Heath	Far North Region	4	4	4	8	8
Natural Environment	Terrestrial Ecosystems	Open Tallgrass Prairie	Central Region	4	4	4	8	8
Natural Environment	Terrestrial Ecosystems	Open Tallgrass Prairie	Eastern Region	4	4	4	8	8
Natural Environment	Terrestrial Ecosystems	Open Tallgrass Prairie	Southwest Region	4	4	4	8	8
Natural Environment	Terrestrial Ecosystems	Sand Barren and Dune	Central Region	4	8	8	8	8
Natural Environment	Terrestrial Ecosystems	Sand Barren and Dune	Eastern Region	4	8	8	8	8
Natural Environment	Terrestrial Ecosystems	Sand Barren and Dune	Southwest Region	4	8	8	8	8
Natural Environment	Terrestrial Ecosystems	Tallgrass Savannah	Central Region	4	8	8	8	8
Natural Environment	Terrestrial Ecosystems	Tallgrass Savannah	Eastern Region	4	8	8	8	8
Natural Environment	Terrestrial Ecosystems	Tallgrass Savannah	Southwest Region	4	8	8	8	8

People and Communities

Table 7.4: Climate Risk Scores for Level 1 and Level 2 categories across all PCCIA Regions and for People and Communities

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP 4.5)	2050s (RCP 8.5)	2080s (RCP 4.5)	2080s (RCP 8.5)
People & Communities	Population	General Population	Central Region	4	8	8	8	8
People & Communities	Population	General Population	Eastern Region	4	8	8	8	8
People & Communities	Population	General Population	Far North Region	4	4	4	8	8
People & Communities	Population	General Population	Northeast Region	4	8	8	8	8
People & Communities	Population	General Population	Northwest Region	4	4	8	8	8
People & Communities	Population	General Population	Southwest Region	4	8	8	16	16
People & Communities	Health Care	Health Care	Central Region	8	8	8	8	8
People & Communities	Health Care	Health Care	Eastern Region	8	8	8	8	8
People & Communities	Health Care	Health Care	Far North Region	4	8	8	8	8
People & Communities	Health Care	Health Care	Northeast Region	4	8	8	8	8
People & Communities	Health Care	Health Care	Northwest Region	4	8	8	8	8
People & Communities	Health Care	Health Care	Southwest Region	8	8	8	16	16
People & Communities	Population	Unhoused Population	Central Region	8	16	16	16	16
People & Communities	Population	Unhoused Population	Eastern Region	8	16	16	16	16
People & Communities	Population	Unhoused Population	Far North Region	8	8	8	8	16
People & Communities	Population	Unhoused Population	Northeast Region	8	8	8	16	16
People & Communities	Population	Unhoused Population	Northwest Region	8	8	8	16	16
People & Communities	Population	Unhoused Population	Southwest Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Cultural Services	Central Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Cultural Services	Eastern Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Cultural Services	Far North Region	8	8	8	16	16
People & Communities	Indigenous Communities	Indigenous Cultural Services	Northeast Region	8	8	8	16	16
People & Communities	Indigenous Communities	Indigenous Cultural Services	Northwest Region	8	8	8	16	16
People & Communities	Indigenous Communities	Indigenous Cultural Services	Southwest Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Health Care	Central Region	8	8	8	16	16
People & Communities	Indigenous Communities	Indigenous Health Care	Eastern Region	8	8	8	16	16
People & Communities	Indigenous Communities	Indigenous Health Care	Far North Region	4	8	8	16	16
People & Communities	Indigenous Communities	Indigenous Health Care	Northeast Region	8	8	8	16	16
People & Communities	Indigenous Communities	Indigenous Health Care	Northwest Region	8	8	8	16	16
People & Communities	Indigenous Communities	Indigenous Health Care	Southwest Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Population	Central Region	4	8	8	16	16
People & Communities	Indigenous Communities	Indigenous Population	Eastern Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Population	Far North Region	4	8	8	16	16
People & Communities	Indigenous Communities	Indigenous Population	Northeast Region	8	8	8	16	16

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP 4.5)	2050s (RCP 8.5)	2080s (RCP 4.5)	2080s (RCP 8.5)
People & Communities	Indigenous Communities	Indigenous Population	Northwest Region	4	8	8	16	16
People & Communities	Indigenous Communities	Indigenous Population	Southwest Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Social Assistance	Central Region	4	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Social Assistance	Eastern Region	4	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Social Assistance	Far North Region	4	8	8	8	8
People & Communities	Indigenous Communities	Indigenous Social Assistance	Northeast Region	4	8	8	16	16
People & Communities	Indigenous Communities	Indigenous Social Assistance	Northwest Region	4	8	8	16	16
People & Communities	Indigenous Communities	Indigenous Social Assistance	Southwest Region	4	16	16	16	16
People & Communities	Social Assistance and Public Administration	Social Assistance and Public Administration	Central Region	4	8	8	8	8
People & Communities	Social Assistance and Public Administration	Social Assistance and Public Administration	Eastern Region	4	8	8	16	16
People & Communities	Social Assistance and Public Administration	Social Assistance and Public Administration	Far North Region	4	4	8	8	8
People & Communities	Social Assistance and Public Administration	Social Assistance and Public Administration	Northeast Region	4	8	8	8	8
People & Communities	Social Assistance and Public Administration	Social Assistance and Public Administration	Northwest Region	4	8	8	8	8
People & Communities	Social Assistance and Public Administration	Social Assistance and Public Administration	Southwest Region	4	8	8	8	8
People & Communities	Indigenous Communities	Indigenous Infrastructure	Central Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Infrastructure	Eastern Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Infrastructure	Far North Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Infrastructure	Northeast Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Infrastructure	Northwest Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Infrastructure	Southwest Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Food and Agriculture	Central Region	8	8	16	8	16
People & Communities	Indigenous Communities	Indigenous Food and Agriculture	Eastern Region	8	8	16	8	16
People & Communities	Indigenous Communities	Indigenous Food and Agriculture	Northeast Region	8	8	8	8	8
People & Communities	Indigenous Communities	Indigenous Food and Agriculture	Northwest Region	4	8	8	8	8
People & Communities	Indigenous Communities	Indigenous Food and Agriculture	Southwest Region	8	8	16	8	16
People & Communities	Indigenous Communities	Indigenous Business and Economy	Central Region	8	8	8	8	8
People & Communities	Indigenous Communities	Indigenous Business and Economy	Eastern Region	8	8	8	8	8
People & Communities	Indigenous Communities	Indigenous Business and Economy	Far North Region	8	8	8	8	8
People & Communities	Indigenous Communities	Indigenous Business and Economy	Northeast Region	8	8	8	8	8
People & Communities	Indigenous Communities	Indigenous Business and Economy	Northwest Region	8	8	8	8	8
People & Communities	Indigenous Communities	Indigenous Business and Economy	Southwest Region	8	8	8	8	8

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP 4.5)	2050s (RCP 8.5)	2080s (RCP 4.5)	2080s (RCP 8.5)
People & Communities	Indigenous Communities	Indigenous Natural Environment	Central Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Natural Environment	Eastern Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Natural Environment	Far North Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Natural Environment	Northeast Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Natural Environment	Northwest Region	8	16	16	16	16
People & Communities	Indigenous Communities	Indigenous Natural Environment	Southwest Region	8	16	16	16	16

Business and Economy

Table 7.5: Climate Risk Scores for Level 1 and Level 2 categories across all PCCIA Regions and for Business and Economy

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Business & Economy	Accommodation and Food Services	Accommodation and Food Services	Central Region	4	4	4	4	4
Business & Economy	Accommodation and Food Services	Accommodation and Food Services	Eastern Region	4	4	4	4	4
Business & Economy	Accommodation and Food Services	Accommodation and Food Services	Far North Region	4	4	4	4	4
Business & Economy	Accommodation and Food Services	Accommodation and Food Services	Northeast Region	4	4	4	4	4
Business & Economy	Accommodation and Food Services	Accommodation and Food Services	Northwest Region	4	4	4	4	4
Business & Economy	Accommodation and Food Services	Accommodation and Food Services	Southwest Region	4	4	4	4	4
Business & Economy	Arts, Entertainment and Recreation	Arts, Entertainment and Recreation	Central Region	8	8	8	8	8
Business & Economy	Arts, Entertainment and Recreation	Arts, Entertainment and Recreation	Eastern Region	4	8	8	8	8
Business & Economy	Arts, Entertainment and Recreation	Arts, Entertainment and Recreation	Far North Region	4	4	8	8	8
Business & Economy	Arts, Entertainment and Recreation	Arts, Entertainment and Recreation	Northeast Region	4	8	8	8	8
Business & Economy	Arts, Entertainment and Recreation	Arts, Entertainment and Recreation	Northwest Region	4	8	8	8	8
Business & Economy	Arts, Entertainment and Recreation	Arts, Entertainment and Recreation	Southwest Region	4	8	8	8	8
Business & Economy	Construction	Construction	Central Region	2	2	2	2	4
Business & Economy	Construction	Construction	Eastern Region	2	2	2	2	4
Business & Economy	Construction	Construction	Far North Region	2	2	2	2	2
Business & Economy	Construction	Construction	Northeast Region	2	2	2	2	4
Business & Economy	Construction	Construction	Northwest Region	2	2	2	2	4
Business & Economy	Construction	Construction	Southwest Region	2	2	2	2	4
Business & Economy	Financial and Insurance	Insurance Carriers and Related Activities	Central Region	4	8	8	8	8
Business & Economy	Financial and Insurance	Insurance Carriers and Related Activities	Eastern Region	4	8	8	8	8
Business & Economy	Financial and Insurance	Insurance Carriers and Related Activities	Far North Region	4	8	8	8	8
Business & Economy	Financial and Insurance	Insurance Carriers and Related Activities	Northeast Region	4	8	8	8	8
Business & Economy	Financial and Insurance	Insurance Carriers and Related Activities	Northwest Region	4	8	8	8	8

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Business & Economy	Financial and Insurance	Insurance Carriers and Related Activities	Southwest Region	4	8	8	8	8
Business & Economy	Financial and Insurance	Monetary, Credit, Securities, Funds and other Financial Vehicles	Central Region	4	8	8	8	8
Business & Economy	Financial and Insurance	Monetary, Credit, Securities, Funds and other Financial Vehicles	Eastern Region	4	8	8	8	8
Business & Economy	Financial and Insurance	Monetary, Credit, Securities, Funds and other Financial Vehicles	Far North Region	4	8	8	8	8
Business & Economy	Financial and Insurance	Monetary, Credit, Securities, Funds and other Financial Vehicles	Northeast Region	4	8	8	8	8
Business & Economy	Financial and Insurance	Monetary, Credit, Securities, Funds and other Financial Vehicles	Northwest Region	4	8	8	8	8
Business & Economy	Financial and Insurance	Monetary, Credit, Securities, Funds and other Financial Vehicles	Southwest Region	4	8	8	8	8
Business & Economy	Forestry, Fishing and Hunting Economies	Fishing, Hunting and Trapping	Central Region	8	8	8	8	8
Business & Economy	Forestry, Fishing and Hunting Economies	Fishing, Hunting and Trapping	Eastern Region	8	8	8	8	8
Business & Economy	Forestry, Fishing and Hunting Economies	Fishing, Hunting and Trapping	Far North Region	8	8	8	8	8
Business & Economy	Forestry, Fishing and Hunting Economies	Fishing, Hunting and Trapping	Northeast Region	8	8	8	8	8
Business & Economy	Forestry, Fishing and Hunting Economies	Fishing, Hunting and Trapping	Northwest Region	8	8	8	8	8
Business & Economy	Forestry, Fishing and Hunting Economies	Fishing, Hunting and Trapping	Southwest Region	8	8	8	8	8
Business & Economy	Forestry, Fishing and Hunting Economies	Forestry and Logging	Central Region	8	8	8	8	8
Business & Economy	Forestry, Fishing and Hunting Economies	Forestry and Logging	Eastern Region	8	8	8	8	8
Business & Economy	Forestry, Fishing and Hunting Economies	Forestry and Logging	Far North Region	8	8	8	8	8
Business & Economy	Forestry, Fishing and Hunting Economies	Forestry and Logging	Northeast Region	8	8	8	8	8
Business & Economy	Forestry, Fishing and Hunting Economies	Forestry and Logging	Northwest Region	8	8	8	8	8
Business & Economy	Forestry, Fishing and Hunting Economies	Forestry and Logging	Southwest Region	8	8	8	8	8

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Business & Economy	Information and Cultural Industries	Information and Cultural Industries	Central Region	2	4	4	4	4
Business & Economy	Information and Cultural Industries	Information and Cultural Industries	Eastern Region	2	4	4	4	4
Business & Economy	Information and Cultural Industries	Information and Cultural Industries	Northeast Region	2	4	4	4	4
Business & Economy	Information and Cultural Industries	Information and Cultural Industries	Northwest Region	2	4	4	4	4
Business & Economy	Information and Cultural Industries	Information and Cultural Industries	Southwest Region	2	4	4	4	4
Business & Economy	Manufacturing	Manufacturing	Central Region	2	2	2	2	4
Business & Economy	Manufacturing	Manufacturing	Eastern Region	2	2	2	2	4
Business & Economy	Manufacturing	Manufacturing	Northeast Region	2	2	2	2	4
Business & Economy	Manufacturing	Manufacturing	Northwest Region	2	2	2	2	4
Business & Economy	Manufacturing	Manufacturing	Southwest Region	2	2	2	2	4
Business & Economy	Mining, Quarrying and Oil/Gas Extraction	Mining, Quarrying and Oil/Gas Extraction	Central Region	4	4	4	4	4
Business & Economy	Mining, Quarrying and Oil/Gas Extraction	Mining, Quarrying and Oil/Gas Extraction	Eastern Region	4	4	4	4	4
Business & Economy	Mining, Quarrying and Oil/Gas Extraction	Mining, Quarrying and Oil/Gas Extraction	Far North Region	4	4	4	4	4
Business & Economy	Mining, Quarrying and Oil/Gas Extraction	Mining, Quarrying and Oil/Gas Extraction	Northeast Region	4	4	4	4	4
Business & Economy	Mining, Quarrying and Oil/Gas Extraction	Mining, Quarrying and Oil/Gas Extraction	Northwest Region	4	4	4	4	4
Business & Economy	Mining, Quarrying and Oil/Gas Extraction	Mining, Quarrying and Oil/Gas Extraction	Southwest Region	4	4	4	4	4
Business & Economy	Retail Trade	Retail Trade	Central Region	2	2	2	2	4
Business & Economy	Retail Trade	Retail Trade	Eastern Region	2	2	2	2	4
Business & Economy	Retail Trade	Retail Trade	Far North Region	2	2	2	2	2
Business & Economy	Retail Trade	Retail Trade	Northeast Region	2	2	2	2	4
Business & Economy	Retail Trade	Retail Trade	Northwest Region	2	2	2	2	4
Business & Economy	Retail Trade	Retail Trade	Southwest Region	2	2	2	2	4
Business & Economy	Transportation Economy	Air Transportation	Central Region	2	2	2	2	4
Business & Economy	Transportation Economy	Air Transportation	Eastern Region	2	2	2	2	4
Business & Economy	Transportation Economy	Air Transportation	Far North Region	2	2	2	2	2
Business & Economy	Transportation Economy	Air Transportation	Northeast Region	2	2	2	2	4
Business & Economy	Transportation Economy	Air Transportation	Northwest Region	2	2	2	2	4

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Business & Economy	Transportation Economy	Air Transportation	Southwest Region	2	2	2	2	4
Business & Economy	Transportation Economy	Deep Sea, Coastal and Great Lakes	Central Region	8	8	8	8	8
Business & Economy	Transportation Economy	Deep Sea, Coastal and Great Lakes	Eastern Region	8	8	8	8	8
Business & Economy	Transportation Economy	Deep Sea, Coastal and Great Lakes	Far North Region	8	8	8	8	8
Business & Economy	Transportation Economy	Deep Sea, Coastal and Great Lakes	Northeast Region	8	8	8	8	8
Business & Economy	Transportation Economy	Deep Sea, Coastal and Great Lakes	Northwest Region	8	8	8	8	8
Business & Economy	Transportation Economy	Deep Sea, Coastal and Great Lakes	Southwest Region	8	8	8	8	8
Business & Economy	Transportation Economy	Local Freight Trucking and Delivery Services	Central Region	2	2	2	2	4
Business & Economy	Transportation Economy	Local Freight Trucking and Delivery Services	Eastern Region	2	2	2	2	4
Business & Economy	Transportation Economy	Local Freight Trucking and Delivery Services	Far North Region	2	2	2	2	2
Business & Economy	Transportation Economy	Local Freight Trucking and Delivery Services	Northeast Region	2	2	2	2	4
Business & Economy	Transportation Economy	Local Freight Trucking and Delivery Services	Northwest Region	2	2	2	2	4
Business & Economy	Transportation Economy	Local Freight Trucking and Delivery Services	Southwest Region	2	2	2	2	4
Business & Economy	Transportation Economy	Long Distance Freight Trucking	Central Region	2	2	2	2	4
Business & Economy	Transportation Economy	Long Distance Freight Trucking	Eastern Region	2	2	2	2	4
Business & Economy	Transportation Economy	Long Distance Freight Trucking	Far North Region	2	2	2	2	2
Business & Economy	Transportation Economy	Long Distance Freight Trucking	Northeast Region	2	2	2	2	4
Business & Economy	Transportation Economy	Long Distance Freight Trucking	Northwest Region	2	2	2	2	4
Business & Economy	Transportation Economy	Long Distance Freight Trucking	Southwest Region	2	2	2	2	4
Business & Economy	Transportation Economy	Rail	Central Region	4	8	8	8	8
Business & Economy	Transportation Economy	Rail	Eastern Region	4	8	8	8	8
Business & Economy	Transportation Economy	Rail	Northeast Region	4	8	8	8	8
Business & Economy	Transportation Economy	Rail	Northwest Region	4	8	8	8	8
Business & Economy	Transportation Economy	Rail	Southwest Region	4	8	8	8	8
Business & Economy	Utility Services	Electrical Power generation	Central Region	2	4	4	4	4
Business & Economy	Utility Services	Electrical Power generation	Eastern Region	2	4	4	4	4
Business & Economy	Utility Services	Electrical Power generation	Far North Region	2	4	4	4	4
Business & Economy	Utility Services	Electrical Power generation	Northeast Region	2	4	4	4	4
Business & Economy	Utility Services	Electrical Power generation	Northwest Region	2	4	4	4	4
Business & Economy	Utility Services	Electrical Power generation	Southwest Region	2	4	4	4	4
Business & Economy	Utility Services	Electrical Power Transmission, Control and Distribution	Central Region	4	8	8	8	8
Business & Economy	Utility Services	Electrical Power Transmission, Control and Distribution	Eastern Region	4	8	8	8	8
Business & Economy	Utility Services	Electrical Power Transmission, Control and Distribution	Far North Region	4	4	8	8	8

Area of Focus	Level 1 Category	Level 2 Category	Region	Climate Risk Scores				
				Current	2050s (RCP4.5)	2050s (RCP8.5)	2080s (RCP4.5)	2080s (RCP8.5)
Business & Economy	Utility Services	Electrical Power Transmission, Control and Distribution	Northeast Region	4	8	8	8	8
Business & Economy	Utility Services	Electrical Power Transmission, Control and Distribution	Northwest Region	4	8	8	8	8
Business & Economy	Utility Services	Electrical Power Transmission, Control and Distribution	Southwest Region	4	8	8	8	8
Business & Economy	Utility Services	Natural Gas Distribution	Central Region	2	2	2	2	4
Business & Economy	Utility Services	Natural Gas Distribution	Eastern Region	2	2	2	2	4
Business & Economy	Utility Services	Natural Gas Distribution	Northeast Region	2	2	2	2	4
Business & Economy	Utility Services	Natural Gas Distribution	Northwest Region	2	2	2	2	4
Business & Economy	Utility Services	Natural Gas Distribution	Southwest Region	2	2	2	2	4
Business & Economy	Utility Services	Telecommunications	Central Region	4	4	4	4	8
Business & Economy	Utility Services	Telecommunications	Eastern Region	4	4	4	4	8
Business & Economy	Utility Services	Telecommunications	Far North Region	4	4	4	4	4
Business & Economy	Utility Services	Telecommunications	Northeast Region	4	4	4	4	8
Business & Economy	Utility Services	Telecommunications	Northwest Region	4	4	4	4	8
Business & Economy	Utility Services	Telecommunications	Southwest Region	4	4	4	4	8

Appendix 8: Top Climate Variables Driving 'High' and 'Very High' Risks

The following table summarizes the top three climate variable groups, by Area of Focus and by region of Ontario, for current, 2050s and 2080s time periods. It must be noted that these do not comprise the only climate variables driving the risks that were assessed. Rather, these variable groups represent major drivers of 'high' risks (scored 8) and 'very high' risks (scored 16), combined. In some regions and for certain Areas of Focus, there were no 'high', or 'very high' risks identified, which is indicated in Tables 8.1 – 8.5 below. The data in the tables can be considered a subset of all risks assessed and characterized and is one lens as to how to interpret information.

The following interpretations can be made based upon the tables below:

- Some Areas of Focus have a much more diverse suite of climate variables driving the highest risks. This could be reflective of the numerous impact pathways that may be particularly exposed to climate conditions (e.g. food and agriculture commodities and natural environment systems).
- Overall, high and extreme temperatures, extreme precipitation events and temperature-related impacts are the drivers of highest risks across all Areas of Focus, though drought, winter precipitation and low temperatures are also particularly impactful for certain regions and for certain Areas of Focus.

Food and Agriculture

Table 8.1: Top Climate Variables Driving High and Very High Risks for Food and Agriculture

Region	Time Period	Climate Variable Group	Percentage of Scenarios Affected
Northwest Region	Current	None (No High or Very High risks identified)	0%
Northwest Region	2050s	High and Extreme Temperatures	50%
Northwest Region	2050s	Winter precipitation	22%
Northwest Region	2050s	Extreme precipitation events	11%
Northwest Region	2050s	Other variables, combined	17%
Northwest Region	2080s	Drought	33%
Northwest Region	2080s	High and Extreme Temperatures	28%
Northwest Region	2080s	Temperature	17%
Northwest Region	2080s	Other variables, combined	22%
Northeast Region	Current	None (No High or Very High risks identified)	0%

Region	Time Period	Climate Variable Group	Percentage of Scenarios Affected
Northeast Region	2050s	High and Extreme Temperatures	44%
Northeast Region	2050s	Winter precipitation	25%
Northeast Region	2050s	Extreme precipitation events	13%
Northeast Region	2050s	Other variables, combined	19%
Northeast Region	2080s	Drought	24%
Northeast Region	2080s	High and Extreme Temperatures	22%
Northeast Region	2080s	Temperature	16%
Northeast Region	2080s	Other variables, combined	38%
Eastern Region	Current	Low Temperature	35%
Eastern Region	Current	Extreme Precipitation Events	18%
Eastern Region	Current	Winter precipitation	18%
Eastern Region	Current	Other variables, combined	29%
Eastern Region	2050s	High and Extreme Temperatures	35%
Eastern Region	2050s	Drought	16%
Eastern Region	2050s	Extreme precipitation events	14%
Eastern Region	2050s	Other variables, combined	35%
Eastern Region	2080s	High and Extreme Temperatures	28%
Eastern Region	2080s	Drought	15%
Eastern Region	2080s	Temperature	15%
Eastern Region	2080s	Other variables, combined	43%
Central Region	Current	Low Temperature	33%
Central Region	Current	Extreme Precipitation Events	17%
Central Region	Current	Winter precipitation	17%
Central Region	Current	Other variables, combined	33%
Central Region	2050s	High and Extreme Temperatures	33%
Central Region	2050s	Drought	18%
Central Region	2050s	Extreme precipitation events	13%
Central Region	2050s	Other variables, combined	36%
Central Region	2080s	High and Extreme Temperatures	27%
Central Region	2080s	Drought	16%
Central Region	2080s	Temperature	16%
Central Region	2080s	Other variables, combined	41%

Region	Time Period	Climate Variable Group	Percentage of Scenarios Affected
Southwest Region	Current	Low Temperature	42%
Southwest Region	Current	Extreme Precipitation Events	16%
Southwest Region	Current	Drought	16%
Southwest Region	Current	Other variables, combined	26%
Southwest Region	2050s	High and Extreme Temperatures	35%
Southwest Region	2050s	Drought	15%
Southwest Region	2050s	Extreme precipitation events	15%
Southwest Region	2050s	Other variables, combined	35%
Southwest Region	2080s	High and Extreme Temperatures	25%
Southwest Region	2080s	Low Temperature	16%
Southwest Region	2080s	Temperature	16%
Southwest Region	2080s	Other variables, combined	44%

Infrastructure

Table 8.2: Top Climate Variables Driving High and Very High Risks for Infrastructure

Region	Time Period	Climate Variable Group	Percentage Scenarios Affected
Far North	Current	Extreme Precipitation Events	75%
Far North	Current	Winter precipitation	25%
Far North	2050s	High and Extreme Temperatures	42%
Far North	2050s	Extreme Precipitation Events	25%
Far North	2050s	Low Temperature	25%
Far North	2050s	Others	8%
Far North	2080s	High and Extreme Temperatures	42%
Far North	2080s	Extreme Precipitation Events	25%
Far North	2080s	Low Temperature	25%
Far North	2080s	Others	8%
Northwest Region	Current	Extreme Precipitation Events	75%
Northwest Region	Current	Winter precipitation	25%
Northwest Region	2050s	High and Extreme Temperatures	43%
Northwest Region	2050s	Extreme Precipitation Events	43%
Northwest Region	2050s	Winter precipitation	14%
Northwest Region	2080s	Extreme Precipitation Events	50%
Northwest Region	2080s	High and Extreme Temperatures	38%
Northwest Region	2080s	Winter precipitation	13%
Northeast Region	Current	Extreme Precipitation Events	75%
Northeast Region	Current	Winter precipitation	25%
Northeast Region	2050s	High and Extreme Temperatures	43%
Northeast Region	2050s	Extreme Precipitation Events	43%
Northeast Region	2050s	Winter precipitation	14%
Northeast Region	2080s	Extreme Precipitation Events	56%
Northeast Region	2080s	High and Extreme Temperatures	33%
Northeast Region	2080s	Winter precipitation	11%
Eastern Region	Current	Extreme Precipitation Events	75%
Eastern Region	Current	Winter precipitation	25%
Eastern Region	2050s	Extreme Precipitation Events	50%
Eastern Region	2050s	High and Extreme Temperatures	38%

Region	Time Period	Climate Variable Group	Percentage Scenarios Affected
Eastern Region	2050s	Winter precipitation	13%
Eastern Region	2080s	Extreme Precipitation Events	41%
Eastern Region	2080s	High and Extreme Temperatures	27%
Eastern Region	2080s	Winter precipitation	5%
Eastern Region	2080s	Others	27%
Central Region	Current	Extreme Precipitation Events	75%
Central Region	Current	Winter precipitation	25%
Central Region	2050s	High and Extreme Temperatures	40%
Central Region	2050s	Extreme Precipitation Events	40%
Central Region	2050s	Winter precipitation	10%
Central Region	2050s	Others	10%
Central Region	2080s	Extreme Precipitation Events	42%
Central Region	2080s	High and Extreme Temperatures	37%
Central Region	2080s	Winter precipitation	5%
Central Region	2080s	Others	16%
Southwest Region	Current	Extreme Precipitation Events	75%
Southwest Region	Current	Winter precipitation	25%
Southwest Region	2050s	High and Extreme Temperatures	40%
Southwest Region	2050s	Extreme Precipitation Events	40%
Southwest Region	2050s	Winter precipitation	10%
Southwest Region	2050s	Others	10%
Southwest Region	2080s	Extreme Precipitation Events	50%
Southwest Region	2080s	High and Extreme Temperatures	44%
Southwest Region	2080s	Winter precipitation	6%

Natural Environment

Table 8.3: Top Climate Variables Driving High and Very High Risks for Natural Environment

Region	Time Period	Climate Variable Group	Percentage of Scenarios Affected
Far North	Current	Temperature	50%
Far North	Current	High and Extreme Temperatures	33%
Far North	Current	Drought	17%
Far North	2050s	Temperature	75%
Far North	2050s	High and Extreme Temperatures	20%
Far North	2050s	Drought	5%
Far North	2080s	Temperature	52%
Far North	2080s	Drought	12%
Far North	2080s	High and Extreme Temperatures	12%
Far North	2080s	Others	24%
Northwest Region	Current	High and Extreme Temperatures	50%
Northwest Region	Current	Winter precipitation	50%
Northwest Region	2050s	Temperature	76%
Northwest Region	2050s	High and Extreme Temperatures	15%
Northwest Region	2050s	Winter precipitation	7%
Northwest Region	2050s	Others	2%
Northwest Region	2080s	Temperature	57%
Northwest Region	2080s	Drought	14%
Northwest Region	2080s	High and Extreme Temperatures	11%
Northwest Region	2080s	Others	17%
Northeast Region	Current	High and Extreme Temperatures	33%
Northeast Region	Current	Temperature	33%
Northeast Region	Current	Winter precipitation	33%
Northeast Region	2050s	Temperature	75%
Northeast Region	2050s	High and Extreme Temperatures	13%
Northeast Region	2050s	Winter precipitation	13%
Northeast Region	2080s	Temperature	64%
Northeast Region	2080s	High and Extreme Temperatures	10%
Northeast Region	2080s	Drought	8%

Region	Time Period	Climate Variable Group	Percentage of Scenarios Affected
Northeast Region	2080s	Others	18%
Eastern Region	Current	Temperature	100%
Eastern Region	2050s	Temperature	66%
Eastern Region	2050s	High and Extreme Temperatures	13%
Eastern Region	2050s	Winter precipitation	11%
Eastern Region	2050s	Others	11%
Eastern Region	2080s	Temperature	45%
Eastern Region	2080s	Drought	21%
Eastern Region	2080s	High and Extreme Temperatures	13%
Eastern Region	2080s	Others	21%
Central Region	Current	Temperature	100%
Central Region	2050s	Temperature	71%
Central Region	2050s	High and Extreme Temperatures	12%
Central Region	2050s	Winter precipitation	9%
Central Region	2050s	Others	9%
Central Region	2080s	Temperature	44%
Central Region	2080s	Drought	25%
Central Region	2080s	High and Extreme Temperatures	16%
Central Region	2080s	Others	16%
Southwest Region	Current	Temperature	86%
Southwest Region	Current	Drought	14%
Southwest Region	2050s	Temperature	56%
Southwest Region	2050s	High and Extreme Temperatures	14%
Southwest Region	2050s	Drought	12%
Southwest Region	2050s	Others	19%
Southwest Region	2080s	Temperature	39%
Southwest Region	2080s	Drought	28%
Southwest Region	2080s	High and Extreme Temperatures	11%
Southwest Region	2080s	Others	22%

People and Communities

Table 8.4: Top Climate Variables Driving High and Very High Risks for People and Communities

Region	Time Period	Climate Variable Group	Percentage of Scenarios Affected
Far North	Current	High and Extreme Temperatures	31%
Far North	Current	Extreme Precipitation Events	25%
Far North	Current	Low Temperature	25%
Far North	Current	Others	19%
Far North	2050s	High and Extreme Temperatures	50%
Far North	2050s	Extreme Precipitation Events	20%
Far North	2050s	Winter precipitation	15%
Far North	2050s	Others	15%
Far North	2080s	High and Extreme Temperatures	38%
Far North	2080s	Extreme Precipitation Events	27%
Far North	2080s	Low Temperature	19%
Far North	2080s	Others	15%
Northwest Region	Current	High and Extreme Temperatures	31%
Northwest Region	Current	Extreme Precipitation Events	25%
Northwest Region	Current	Low Temperature	25%
Northwest Region	Current	Others	19%
Northwest Region	2050s	High and Extreme Temperatures	45%
Northwest Region	2050s	Extreme Precipitation Events	23%
Northwest Region	2050s	Winter precipitation	14%
Northwest Region	2050s	Others	18%
Northwest Region	2080s	High and Extreme Temperatures	37%
Northwest Region	2080s	Extreme Precipitation Events	26%
Northwest Region	2080s	Low Temperature	19%
Northwest Region	2080s	Others	19%
Northeast Region	Current	High and Extreme Temperatures	31%
Northeast Region	Current	Extreme Precipitation Events	25%
Northeast Region	Current	Low Temperature	25%
Northeast Region	Current	Others	19%

Region	Time Period	Climate Variable Group	Percentage of Scenarios Affected
Northeast Region	2050s	High and Extreme Temperatures	45%
Northeast Region	2050s	Extreme Precipitation Events	18%
Northeast Region	2050s	Winter precipitation	18%
Northeast Region	2050s	Others	18%
Northeast Region	2080s	High and Extreme Temperatures	37%
Northeast Region	2080s	Extreme Precipitation Events	30%
Northeast Region	2080s	Low Temperature	15%
Northeast Region	2080s	Others	19%
Eastern Region	Current	High and Extreme Temperatures	31%
Eastern Region	Current	Extreme Precipitation Events	25%
Eastern Region	Current	Low Temperature	25%
Eastern Region	Current	Others	19%
Eastern Region	2050s	High and Extreme Temperatures	40%
Eastern Region	2050s	Extreme Precipitation Events	28%
Eastern Region	2050s	Winter precipitation	16%
Eastern Region	2050s	Others	16%
Eastern Region	2080s	High and Extreme Temperatures	34%
Eastern Region	2080s	Extreme Precipitation Events	28%
Eastern Region	2080s	Low Temperature	17%
Eastern Region	2080s	Others	21%
Central Region	Current	High and Extreme Temperatures	32%
Central Region	Current	Extreme Precipitation Events	26%
Central Region	Current	Low Temperature	26%
Central Region	Current	Others	16%
Central Region	2050s	High and Extreme Temperatures	43%
Central Region	2050s	Extreme Precipitation Events	26%
Central Region	2050s	Winter precipitation	17%
Central Region	2050s	Others	13%
Central Region	2080s	High and Extreme Temperatures	36%
Central Region	2080s	Extreme Precipitation Events	29%
Central Region	2080s	Low Temperature	18%

Region	Time Period	Climate Variable Group	Percentage of Scenarios Affected
Central Region	2080s	Others	18%
Southwest Region	Current	High and Extreme Temperatures	33%
Southwest Region	Current	Extreme Precipitation Events	27%
Southwest Region	Current	Low Temperature	27%
Southwest Region	Current	Others	13%
Southwest Region	2050s	High and Extreme Temperatures	42%
Southwest Region	2050s	Extreme Precipitation Events	25%
Southwest Region	2050s	Winter precipitation	17%
Southwest Region	2050s	Others	17%
Southwest Region	2080s	High and Extreme Temperatures	37%
Southwest Region	2080s	Extreme Precipitation Events	30%
Southwest Region	2080s	Low Temperature	19%
Southwest Region	2080s	Others	15%

Business and Economy

Table 8.5: Top Climate Variables Driving High and Very High Risks for Business and Economy

Region	Time Period	Climate Variable Group	Percentage of Scenarios Affected
Far North	Current	Drought	40%
Far North	Current	Extreme Precipitation Events	20%
Far North	Current	High and Extreme Temperatures	20%
Far North	Current	Others	20%
Far North	2050s	Drought	40%
Far North	2050s	Extreme Precipitation Events	20%
Far North	2050s	High and Extreme Temperatures	20%
Far North	2050s	Others	20%
Far North	2080s	Drought	40%
Far North	2080s	Extreme Precipitation Events	20%
Far North	2080s	High and Extreme Temperatures	20%
Far North	2080s	Others	20%
Northwest Region	Current	Drought	40%
Northwest Region	Current	Extreme Precipitation Events	20%
Northwest Region	Current	High and Extreme Temperatures	20%
Northwest Region	Current	Others	20%
Northwest Region	2050s	Drought	40%
Northwest Region	2050s	Extreme Precipitation Events	20%
Northwest Region	2050s	High and Extreme Temperatures	20%
Northwest Region	2050s	Others	20%
Northwest Region	2080s	Drought	40%
Northwest Region	2080s	Extreme Precipitation Events	20%
Northwest Region	2080s	High and Extreme Temperatures	20%
Northwest Region	2080s	Others	20%
Northeast Region	Current	Drought	40%
Northeast Region	Current	Extreme Precipitation Events	20%
Northeast Region	Current	High and Extreme Temperatures	20%
Northeast Region	Current	Others	20%
Northeast Region	2050s	Drought	40%

Region	Time Period	Climate Variable Group	Percentage of Scenarios Affected
Northeast Region	2050s	Extreme Precipitation Events	20%
Northeast Region	2050s	High and Extreme Temperatures	20%
Northeast Region	2050s	Others	20%
Northeast Region	2080s	Drought	40%
Northeast Region	2080s	Extreme Precipitation Events	20%
Northeast Region	2080s	High and Extreme Temperatures	20%
Northeast Region	2080s	Others	20%
Eastern Region	Current	Drought	40%
Eastern Region	Current	Extreme Precipitation Events	20%
Eastern Region	Current	High and Extreme Temperatures	20%
Eastern Region	Current	Others	20%
Eastern Region	2050s	Drought	40%
Eastern Region	2050s	Extreme Precipitation Events	20%
Eastern Region	2050s	High and Extreme Temperatures	20%
Eastern Region	2050s	Others	20%
Eastern Region	2080s	Drought	40%
Eastern Region	2080s	Extreme Precipitation Events	20%
Eastern Region	2080s	High and Extreme Temperatures	20%
Eastern Region	2080s	Others	20%
Central Region	Current	Drought	40%
Central Region	Current	Extreme Precipitation Events	20%
Central Region	Current	High and Extreme Temperatures	20%
Central Region	Current	Others	20%
Central Region	2050s	Drought	40%
Central Region	2050s	Extreme Precipitation Events	20%
Central Region	2050s	High and Extreme Temperatures	20%
Central Region	2050s	Others	20%
Central Region	2080s	Drought	40%
Central Region	2080s	Extreme Precipitation Events	20%
Central Region	2080s	High and Extreme Temperatures	20%
Central Region	2080s	Others	20%

Region	Time Period	Climate Variable Group	Percentage of Scenarios Affected
Southwest Region	Current	Drought	40%
Southwest Region	Current	Extreme Precipitation Events	20%
Southwest Region	Current	High and Extreme Temperatures	20%
Southwest Region	Current	Others	20%
Southwest Region	2050s	Drought	40%
Southwest Region	2050s	Extreme Precipitation Events	20%
Southwest Region	2050s	High and Extreme Temperatures	20%
Southwest Region	2050s	Others	20%
Southwest Region	2080s	Drought	40%
Southwest Region	2080s	Extreme Precipitation Events	20%
Southwest Region	2080s	High and Extreme Temperatures	20%
Southwest Region	2080s	Others	20%

Appendix 9: Area of Focus Risk Snapshot Summary Tables

How to Read Risk Profiles				
Rating	**Low**	**Medium**	**High**	**Very High**
Score	2	4	8	16

Food and Agriculture

Table 9.1: Current and Future Risk Profiles by Region Assessed for Food and Agriculture

Region	Time Period	Level 1 Category	Risk Profile (RCP8.5)
Northwest	Current	Field Crops	Medium
Northwest	Current	Fruits and Vegetables	High
Northwest	Current	Livestock	Medium
Northwest	2050s	Field Crops	High
Northwest	2050s	Fruits and Vegetables	High
Northwest	2050s	Livestock	Medium
Northwest	2080s	Field Crops	High
Northwest	2080s	Fruits and Vegetables	High
Northwest	2080s	Livestock	High
Northeast	Current	Field Crops	High
Northeast	Current	Fruits and Vegetables	High
Northeast	Current	Livestock	Medium
Northeast	2050s	Field Crops	High
Northeast	2050s	Fruits and Vegetables	High
Northeast	2050s	Livestock	Medium
Northeast	2080s	Field Crops	High
Northeast	2080s	Fruits and Vegetables	High
Northeast	2080s	Livestock	High
Eastern	Current	Field Crops	High
Eastern	Current	Fruits and Vegetables	High
Eastern	Current	Livestock	Medium
Eastern	2050s	Field Crops	High
Eastern	2050s	Fruits and Vegetables	High
Eastern	2050s	Livestock	High

Region	Time Period	Level 1 Category	Risk Profile (RCP8.5)
Eastern	2080s	Field Crops	Very High
Eastern	2080s	Fruits and Vegetables	Very High
Eastern	2080s	Livestock	High
Central	Current	Field Crops	High
Central	Current	Fruits and Vegetables	High
Central	Current	Livestock	Medium
Central	2050s	Field Crops	High
Central	2050s	Fruits and Vegetables	High
Central	2050s	Livestock	High
Central	2080s	Field Crops	Very High
Central	2080s	Fruits and Vegetables	Very High
Central	2080s	Livestock	High
Southwest	Current	Field Crops	High
Southwest	Current	Fruits and Vegetables	High
Southwest	Current	Livestock	Medium
Southwest	2050s	Field Crops	High
Southwest	2050s	Fruits and Vegetables	High
Southwest	2050s	Livestock	High
Southwest	2080s	Field Crops	Very High
Southwest	2080s	Fruits and Vegetables	Very High
Southwest	2080s	Livestock	High

Infrastructure

Table 9.2: Current and Future Risk Profiles by Region Assessed for Infrastructure

Region	Time Period	Level 1 Category	Risk Profile (RCP8.5)
Northwest	Current	Transportation	Medium
Northwest	Current	Utilities	Medium
Northwest	Current	Stormwater Management	High
Northwest	Current	Buildings	Medium
Northwest	Current	Pipeline Transportation	Medium
Northwest	Current	Waste Management	Medium
Northwest	2050s	Transportation	High
Northwest	2050s	Utilities	High
Northwest	2050s	Stormwater Management	High
Northwest	2050s	Buildings	Medium
Northwest	2050s	Pipeline Transportation	Medium
Northwest	2050s	Waste Management	Medium
Northwest	2080s	Transportation	High
Northwest	2080s	Utilities	High
Northwest	2080s	Stormwater Management	High
Northwest	2080s	Buildings	Medium
Northwest	2080s	Pipeline Transportation	Medium
Northwest	2080s	Waste Management	High
Northeast	Current	Transportation	Medium
Northeast	Current	Utilities	Medium
Northeast	Current	Stormwater Management	High
Northeast	Current	Buildings	Medium
Northeast	Current	Pipeline Transportation	Medium
Northeast	Current	Waste Management	Medium
Northeast	2050s	Transportation	High
Northeast	2050s	Utilities	High
Northeast	2050s	Stormwater Management	High
Northeast	2050s	Buildings	Medium
Northeast	2050s	Pipeline Transportation	Medium
Northeast	2050s	Waste Management	Medium
Northeast	2080s	Transportation	High
Northeast	2080s	Utilities	High

Region	Time Period	Level 1 Category	Risk Profile (RCP8.5)
Northeast	2080s	Stormwater Management	High
Northeast	2080s	Buildings	High
Northeast	2080s	Pipeline Transportation	Medium
Northeast	2080s	Waste Management	High
Eastern	Current	Transportation	Medium
Eastern	Current	Utilities	Medium
Eastern	Current	Stormwater Management	High
Eastern	Current	Buildings	Medium
Eastern	Current	Pipeline Transportation	Medium
Eastern	Current	Waste Management	Medium
Eastern	2050s	Transportation	High
Eastern	2050s	Utilities	High
Eastern	2050s	Stormwater Management	High
Eastern	2050s	Buildings	Medium
Eastern	2050s	Pipeline Transportation	Medium
Eastern	2050s	Waste Management	Medium
Eastern	2080s	Transportation	High
Eastern	2080s	Utilities	High
Eastern	2080s	Stormwater Management	High
Eastern	2080s	Buildings	High
Eastern	2080s	Pipeline Transportation	Medium
Eastern	2080s	Waste Management	High
Central	Current	Transportation	Medium
Central	Current	Utilities	Medium
Central	Current	Stormwater Management	High
Central	Current	Buildings	Medium
Central	Current	Pipeline Transportation	Medium
Central	Current	Waste Management	Medium
Central	2050s	Transportation	High
Central	2050s	Utilities	High
Central	2050s	Stormwater Management	High
Central	2050s	Buildings	Medium
Central	2050s	Pipeline Transportation	Medium
Central	2050s	Waste Management	Medium

Region	Time Period	Level 1 Category	Risk Profile (RCP8.5)
Central	2080s	Transportation	High
Central	2080s	Utilities	High
Central	2080s	Stormwater Management	High
Central	2080s	Buildings	High
Central	2080s	Pipeline Transportation	Medium
Southwest	Current	Transportation	Medium
Southwest	Current	Utilities	Medium
Southwest	Current	Stormwater Management	High
Southwest	Current	Buildings	Medium
Southwest	Current	Pipeline Transportation	Medium
Southwest	Current	Waste Management	Medium
Southwest	2050s	Transportation	High
Southwest	2050s	Utilities	High
Southwest	2050s	Stormwater Management	High
Southwest	2050s	Buildings	High
Southwest	2050s	Pipeline Transportation	Medium
Southwest	2050s	Waste Management	Medium
Southwest	2080s	Transportation	High
Southwest	2080s	Utilities	High
Southwest	2080s	Stormwater Management	High
Southwest	2080s	Buildings	High
Southwest	2080s	Pipeline Transportation	Medium
Southwest	2080s	Waste Management	High
Far North	Current	Transportation	Medium
Far North	Current	Utilities	Medium
Far North	Current	Stormwater Management	High
Far North	Current	Buildings	Medium
Far North	Current	Pipeline Transportation	Medium
Far North	Current	Waste Management	Medium
Far North	2050s	Transportation	Medium
Far North	2050s	Utilities	High

Region	Time Period	Level 1 Category	Risk Profile (RCP8.5)
Far North	2050s	Stormwater Management	High
Far North	2050s	Buildings	High
Far North	2050s	Pipeline Transportation	Medium
Far North	2050s	Waste Management	Medium
Far North	2080s	Transportation	Medium
Far North	2080s	Utilities	High
Far North	2080s	Stormwater Management	High
Far North	2080s	Buildings	High
Far North	2080s	Pipeline Transportation	Medium
Far North	2080s	Waste Management	Medium

Natural Environment

Table 9.3: Current and Future Risk Profiles by Region Assessed for Natural Environment

Region	Time Period	Level 1 Category	Risk Profile (RCP8.5)
Northwest	Current	Fauna	Medium
Northwest	Current	Flora	Medium
Northwest	Current	Aquatic Ecosystem	High
Northwest	Current	Terrestrial Ecosystem	Medium
Northwest	Current	Regulating services	Medium
Northwest	Current	Provisioning Services	Medium
Northwest	Current	Ecosystem Cultural Services	Medium
Northwest	2050s	Fauna	High
Northwest	2050s	Flora	High
Northwest	2050s	Aquatic Ecosystem	High
Northwest	2050s	Terrestrial Ecosystem	High
Northwest	2050s	Regulating services	High
Northwest	2050s	Provisioning Services	Medium
Northwest	2050s	Ecosystem Cultural Services	High
Northwest	2080s	Fauna	High
Northwest	2080s	Flora	High
Northwest	2080s	Aquatic Ecosystem	Very High
Northwest	2080s	Terrestrial Ecosystem	High
Northwest	2080s	Regulating services	Very High
Northwest	2080s	Provisioning Services	High
Northwest	2080s	Ecosystem Cultural Services	Very High
Northeast	Current	Fauna	Medium
Northeast	Current	Flora	Medium
Northeast	Current	Aquatic Ecosystem	High
Northeast	Current	Terrestrial Ecosystem	Medium
Northeast	Current	Regulating services	High
Northeast	Current	Provisioning Services	Medium
Northeast	Current	Ecosystem Cultural Services	Medium
Northeast	2050s	Fauna	High
Northeast	2050s	Flora	High
Northeast	2050s	Aquatic Ecosystem	High
Northeast	2050s	Terrestrial Ecosystem	High

Region	Time Period	Level 1 Category	Risk Profile (RCP8.5)
Northeast	2050s	Regulating services	High
Northeast	2050s	Provisioning Services	High
Northeast	2050s	Ecosystem Cultural Services	High
Northeast	2080s	Fauna	High
Northeast	2080s	Flora	High
Northeast	2080s	Aquatic Ecosystem	Very High
Northeast	2080s	Terrestrial Ecosystem	High
Northeast	2080s	Regulating services	Very High
Northeast	2080s	Provisioning Services	High
Northeast	2080s	Ecosystem Cultural Services	Very High
Eastern	Current	Fauna	Medium
Eastern	Current	Flora	Medium
Eastern	Current	Aquatic Ecosystem	Medium
Eastern	Current	Terrestrial Ecosystem	Medium
Eastern	Current	Regulating services	Medium
Eastern	Current	Provisioning Services	Medium
Eastern	Current	Ecosystem Cultural Services	Medium
Eastern	2050s	Fauna	High
Eastern	2050s	Flora	High
Eastern	2050s	Aquatic Ecosystem	High
Eastern	2050s	Terrestrial Ecosystem	High
Eastern	2050s	Regulating services	High
Eastern	2050s	Provisioning Services	High
Eastern	2050s	Ecosystem Cultural Services	High
Eastern	2080s	Fauna	High
Eastern	2080s	Flora	High
Eastern	2080s	Aquatic Ecosystem	High
Eastern	2080s	Terrestrial Ecosystem	High
Eastern	2080s	Regulating services	Very High
Eastern	2080s	Provisioning Services	Very High
Eastern	2080s	Ecosystem Cultural Services	High
Central	Current	Fauna	Medium
Central	Current	Flora	Medium
Central	Current	Aquatic Ecosystem	Medium

Region	Time Period	Level 1 Category	Risk Profile (RCP8.5)
Central	Current	Terrestrial Ecosystem	Medium
Central	Current	Regulating services	Medium
Central	Current	Provisioning Services	Medium
Central	Current	Ecosystem Cultural Services	Medium
Central	2050s	Fauna	High
Central	2050s	Flora	High
Central	2050s	Aquatic Ecosystem	High
Central	2050s	Terrestrial Ecosystem	High
Central	2050s	Regulating services	Very High
Central	2050s	Provisioning Services	High
Central	2050s	Ecosystem Cultural Services	High
Central	2080s	Fauna	Very High
Central	2080s	Flora	High
Central	2080s	Aquatic Ecosystem	Very High
Central	2080s	Terrestrial Ecosystem	High
Central	2080s	Regulating services	Very High
Central	2080s	Provisioning Services	Very High
Central	2080s	Ecosystem Cultural Services	High
Southwest	Current	Fauna	High
Southwest	Current	Flora	Medium
Southwest	Current	Aquatic Ecosystem	Medium
Southwest	Current	Terrestrial Ecosystem	Medium
Southwest	Current	Regulating services	Medium
Southwest	Current	Provisioning Services	Medium
Southwest	Current	Ecosystem Cultural Services	Medium
Southwest	2050s	Fauna	Very High
Southwest	2050s	Flora	High
Southwest	2050s	Aquatic Ecosystem	High
Southwest	2050s	Terrestrial Ecosystem	High
Southwest	2050s	Regulating services	High
Southwest	2050s	Provisioning Services	High
Southwest	2050s	Ecosystem Cultural Services	High
Southwest	2080s	Fauna	Very High
Southwest	2080s	Flora	Very High

Region	Time Period	Level 1 Category	Risk Profile (RCP8.5)
Southwest	2080s	Aquatic Ecosystem	High
Southwest	2080s	Terrestrial Ecosystem	High
Southwest	2080s	Regulating services	Very High
Southwest	2080s	Provisioning Services	Very High
Southwest	2080s	Ecosystem Cultural Services	High
Far North	Current	Fauna	Medium
Far North	Current	Aquatic Ecosystem	High
Far North	Current	Terrestrial Ecosystem	Medium
Far North	Current	Regulating services	High
Far North	Current	Provisioning Services	Medium
Far North	Current	Ecosystem Cultural Services	Medium
Far North	2050s	Fauna	High
Far North	2050s	Aquatic Ecosystem	High
Far North	2050s	Terrestrial Ecosystem	High
Far North	2050s	Regulating services	High
Far North	2050s	Provisioning Services	High
Far North	2050s	Ecosystem Cultural Services	High
Far North	2080s	Fauna	High
Far North	2080s	Aquatic Ecosystem	Very High
Far North	2080s	Terrestrial Ecosystem	High
Far North	2080s	Regulating services	Very High
Far North	2080s	Provisioning Services	High
Far North	2080s	Ecosystem Cultural Services	High

People and Communities

Table 9.4: Current and Future Risk Profiles by Region Assessed for People and Communities

Region	Time Period	Risk Profile (RCP8.5)	Risk Profile (RCP8.5)
Northwest	Current	Population	High
Northwest	Current	Health Care	Medium
Northwest	Current	Social Assistance	Medium
Northwest	Current	Indigenous	High
Northwest	2050s	Population	High
Northwest	2050s	Health Care	High
Northwest	2050s	Social Assistance	High
Northwest	2050s	Indigenous	Very High
Northwest	2080s	Population	Very High
Northwest	2080s	Health Care	High
Northwest	2080s	Social Assistance	High
Northwest	2080s	Indigenous	Very High
Northeast	Current	Population	High
Northeast	Current	Health Care	Medium
Northeast	Current	Social Assistance	Medium
Northeast	Current	Indigenous	High
Northeast	2050s	Population	High
Northeast	2050s	Health Care	High
Northeast	2050s	Social Assistance	High
Northeast	2050s	Indigenous	Very High
Northeast	2080s	Population	Very High
Northeast	2080s	Health Care	High
Northeast	2080s	Social Assistance	High
Northeast	2080s	Indigenous	Very High
Eastern	Current	Population	High
Eastern	Current	Health Care	High
Eastern	Current	Social Assistance	Medium
Eastern	Current	Indigenous	High
Eastern	2050s	Population	Very High
Eastern	2050s	Health Care	High
Eastern	2050s	Social Assistance	High
Eastern	2050s	Indigenous	Very High

Region	Time Period	Risk Profile (RCP8.5)	Risk Profile (RCP8.5)
Eastern	2080s	Population	Very High
Eastern	2080s	Health Care	High
Eastern	2080s	Social Assistance	Very High
Eastern	2080s	Indigenous	Very High
Central	Current	Population	High
Central	Current	Health Care	High
Central	Current	Social Assistance	Medium
Central	Current	Indigenous	High
Central	2050s	Population	Very High
Central	2050s	Health Care	High
Central	2050s	Social Assistance	High
Central	2050s	Indigenous	Very High
Central	2080s	Population	Very High
Central	2080s	Health Care	High
Central	2080s	Social Assistance	High
Central	2080s	Indigenous	Very High
Southwest	Current	Population	High
Southwest	Current	Health Care	High
Southwest	Current	Social Assistance	Medium
Southwest	Current	Indigenous	High
Southwest	2050s	Population	Very High
Southwest	2050s	Health Care	High
Southwest	2050s	Social Assistance	High
Southwest	2050s	Indigenous	Very High
Southwest	2080s	Population	Very High
Southwest	2080s	Health Care	Very High
Southwest	2080s	Social Assistance	High
Southwest	2080s	Indigenous	Very High
Far North	Current	Population	High
Far North	Current	Health Care	Medium
Far North	Current	Social Assistance	Medium
Far North	Current	Indigenous	Medium
Far North	2050s	Population	High
Far North	2050s	Health Care	High

Region	Time Period	Risk Profile (RCP8.5)	Risk Profile (RCP8.5)
Far North	2050s	Social Assistance	High
Far North	2050s	Indigenous	Very High
Far North	2080s	Population	Very High
Far North	2080s	Health Care	High
Far North	2080s	Social Assistance	High
Far North	2080s	Indigenous	Very High

Business and Economy

Table 9.5: Current and Future Risk Profiles by Region Assessed for Business and Economy

Region	Time Period	Risk Profile (RCP8.5)	Risk Profile (RCP8.5)
Northwest	Current	Accommodation and Food Services	Medium
Northwest	Current	Arts, Entertainment and Recreation	Medium
Northwest	Current	Construction	Low
Northwest	Current	Financial and Insurance	Medium
Northwest	Current	Forestry, Fishing and Hunting Economies	High
Northwest	Current	Information and Cultural Industries	Low
Northwest	Current	Manufacturing	Low
Northwest	Current	Mining, Quarrying and Oil/Gas Extraction	Medium
Northwest	Current	Retail Trade	Low
Northwest	Current	Transportation Economy	Medium
Northwest	Current	Utility Services	Medium
Northwest	2050s	Accommodation and Food Services	Medium
Northwest	2050s	Arts, Entertainment and Recreation	High
Northwest	2050s	Construction	Low
Northwest	2050s	Financial and Insurance	High
Northwest	2050s	Forestry, Fishing and Hunting Economies	High
Northwest	2050s	Information and Cultural Industries	Medium
Northwest	2050s	Manufacturing	Low
Northwest	2050s	Mining, Quarrying and Oil/Gas Extraction	Medium
Northwest	2050s	Retail Trade	Low
Northwest	2050s	Transportation Economy	Medium
Northwest	2050s	Utility Services	Medium
Northwest	2080s	Accommodation and Food Services	Medium
Northwest	2080s	Arts, Entertainment and Recreation	High

Region	Time Period	Risk Profile (RCP8.5)	Risk Profile (RCP8.5)
Northwest	2080s	Construction	Medium
Northwest	2080s	Financial and Insurance	High
Northwest	2080s	Forestry, Fishing and Hunting Economies	High
Northwest	2080s	Information and Cultural Industries	Medium
Northwest	2080s	Manufacturing	Medium
Northwest	2080s	Mining, Quarrying and Oil/Gas Extraction	Medium
Northwest	2080s	Retail Trade	Medium
Northwest	2080s	Transportation Economy	High
Northwest	2080s	Utility Services	High
Northeast	Current	Accommodation and Food Services	Medium
Northeast	Current	Arts, Entertainment and Recreation	Medium
Northeast	Current	Construction	Low
Northeast	Current	Financial and Insurance	Medium
Northeast	Current	Forestry, Fishing and Hunting Economies	High
Northeast	Current	Information and Cultural Industries	Low
Northeast	Current	Manufacturing	Low
Northeast	Current	Mining, Quarrying and Oil/Gas Extraction	Medium
Northeast	Current	Retail Trade	Low
Northeast	Current	Transportation Economy	Medium
Northeast	Current	Utility Services	Medium
Northeast	2050s	Accommodation and Food Services	Medium
Northeast	2050s	Arts, Entertainment and Recreation	High
Northeast	2050s	Construction	Low
Northeast	2050s	Financial and Insurance	High
Northeast	2050s	Forestry, Fishing and Hunting Economies	High
Northeast	2050s	Information and Cultural Industries	Medium

Region	Time Period	Risk Profile (RCP8.5)	Risk Profile (RCP8.5)
Northeast	2050s	Manufacturing	Low
Northeast	2050s	Mining, Quarrying and Oil/Gas Extraction	Medium
Northeast	2050s	Retail Trade	Low
Northeast	2050s	Transportation Economy	Medium
Northeast	2050s	Utility Services	Medium
Northeast	2080s	Accommodation and Food Services	Medium
Northeast	2080s	Arts, Entertainment and Recreation	High
Northeast	2080s	Construction	Medium
Northeast	2080s	Financial and Insurance	High
Northeast	2080s	Forestry, Fishing and Hunting Economies	High
Northeast	2080s	Information and Cultural Industries	Medium
Northeast	2080s	Manufacturing	Medium
Northeast	2080s	Mining, Quarrying and Oil/Gas Extraction	Medium
Northeast	2080s	Retail Trade	Medium
Northeast	2080s	Transportation Economy	High
Northeast	2080s	Utility Services	High
Eastern	Current	Accommodation and Food Services	Medium
Eastern	Current	Arts, Entertainment and Recreation	Medium
Eastern	Current	Construction	Low
Eastern	Current	Financial and Insurance	Medium
Eastern	Current	Forestry, Fishing and Hunting Economies	High
Eastern	Current	Information and Cultural Industries	Low
Eastern	Current	Manufacturing	Low
Eastern	Current	Mining, Quarrying and Oil/Gas Extraction	Medium
Eastern	Current	Retail Trade	Low
Eastern	Current	Transportation Economy	Medium
Eastern	Current	Utility Services	Medium

Region	Time Period	Risk Profile (RCP8.5)	Risk Profile (RCP8.5)
Eastern	2050s	Accommodation and Food Services	Medium
Eastern	2050s	Arts, Entertainment and Recreation	High
Eastern	2050s	Construction	Low
Eastern	2050s	Financial and Insurance	High
Eastern	2050s	Forestry, Fishing and Hunting Economies	High
Eastern	2050s	Information and Cultural Industries	Medium
Eastern	2050s	Manufacturing	Low
Eastern	2050s	Mining, Quarrying and Oil/Gas Extraction	Medium
Eastern	2050s	Retail Trade	Low
Eastern	2050s	Transportation Economy	Medium
Eastern	2050s	Utility Services	Medium
Eastern	2080s	Accommodation and Food Services	Medium
Eastern	2080s	Arts, Entertainment and Recreation	High
Eastern	2080s	Construction	Medium
Eastern	2080s	Financial and Insurance	High
Eastern	2080s	Forestry, Fishing and Hunting Economies	High
Eastern	2080s	Information and Cultural Industries	Medium
Eastern	2080s	Manufacturing	Medium
Eastern	2080s	Mining, Quarrying and Oil/Gas Extraction	Medium
Eastern	2080s	Retail Trade	Medium
Eastern	2080s	Transportation Economy	High
Eastern	2080s	Utility Services	High
Central	Current	Accommodation and Food Services	Medium
Central	Current	Arts, Entertainment and Recreation	High
Central	Current	Construction	Low
Central	Current	Financial and Insurance	Medium

Region	Time Period	Risk Profile (RCP8.5)	Risk Profile (RCP8.5)
Central	Current	Forestry, Fishing and Hunting Economies	High
Central	Current	Information and Cultural Industries	Low
Central	Current	Manufacturing	Low
Central	Current	Mining, Quarrying and Oil/Gas Extraction	Medium
Central	Current	Retail Trade	Low
Central	Current	Transportation Economy	Medium
Central	Current	Utility Services	Medium
Central	2050s	Accommodation and Food Services	Medium
Central	2050s	Arts, Entertainment and Recreation	High
Central	2050s	Construction	Low
Central	2050s	Financial and Insurance	High
Central	2050s	Forestry, Fishing and Hunting Economies	High
Central	2050s	Information and Cultural Industries	Medium
Central	2050s	Manufacturing	Low
Central	2050s	Mining, Quarrying and Oil/Gas Extraction	Medium
Central	2050s	Retail Trade	Low
Central	2050s	Transportation Economy	Medium
Central	2050s	Utility Services	Medium
Central	2080s	Accommodation and Food Services	Medium
Central	2080s	Arts, Entertainment and Recreation	High
Central	2080s	Construction	Medium
Central	2080s	Financial and Insurance	High
Central	2080s	Forestry, Fishing and Hunting Economies	High
Central	2080s	Information and Cultural Industries	Medium
Central	2080s	Manufacturing	Medium

Region	Time Period	Risk Profile (RCP8.5)	Risk Profile (RCP8.5)
Central	2080s	Mining, Quarrying and Oil/Gas Extraction	Medium
Central	2080s	Retail Trade	Medium
Central	2080s	Transportation Economy	High
Central	2080s	Utility Services	High
Southwest	Current	Accommodation and Food Services	Medium
Southwest	Current	Arts, Entertainment and Recreation	Medium
Southwest	Current	Construction	Low
Southwest	Current	Financial and Insurance	Medium
Southwest	Current	Forestry, Fishing and Hunting Economies	High
Southwest	Current	Information and Cultural Industries	Low
Southwest	Current	Manufacturing	Low
Southwest	Current	Mining, Quarrying and Oil/Gas Extraction	Medium
Southwest	Current	Retail Trade	Low
Southwest	Current	Transportation Economy	Medium
Southwest	Current	Utility Services	Medium
Southwest	2050s	Accommodation and Food Services	Medium
Southwest	2050s	Arts, Entertainment and Recreation	High
Southwest	2050s	Construction	Low
Southwest	2050s	Financial and Insurance	High
Southwest	2050s	Forestry, Fishing and Hunting Economies	High
Southwest	2050s	Information and Cultural Industries	Medium
Southwest	2050s	Manufacturing	Low
Southwest	2050s	Mining, Quarrying and Oil/Gas Extraction	Medium
Southwest	2050s	Retail Trade	Low
Southwest	2050s	Transportation Economy	Medium
Southwest	2050s	Utility Services	Medium

Region	Time Period	Risk Profile (RCP8.5)	Risk Profile (RCP8.5)
Southwest	2080s	Accommodation and Food Services	Medium
Southwest	2080s	Arts, Entertainment and Recreation	High
Southwest	2080s	Construction	Medium
Southwest	2080s	Financial and Insurance	High
Southwest	2080s	Forestry, Fishing and Hunting Economies	High
Southwest	2080s	Information and Cultural Industries	Medium
Southwest	2080s	Manufacturing	Medium
Southwest	2080s	Mining, Quarrying and Oil/Gas Extraction	Medium
Southwest	2080s	Retail Trade	Medium
Southwest	2080s	Transportation Economy	High
Southwest	2080s	Utility Services	High
Far North	Current	Accommodation and Food Services	Medium
Far North	Current	Arts, Entertainment and Recreation	Medium
Far North	Current	Construction	Low
Far North	Current	Financial and Insurance	Medium
Far North	Current	Forestry, Fishing and Hunting Economies	High
Far North	Current	Mining, Quarrying and Oil/Gas Extraction	Medium
Far North	Current	Retail Trade	Low
Far North	Current	Transportation Economy	Medium
Far North	Current	Utility Services	Medium
Far North	2050s	Accommodation and Food Services	Medium
Far North	2050s	Arts, Entertainment and Recreation	High
Far North	2050s	Construction	Low
Far North	2050s	Financial and Insurance	High
Far North	2050s	Forestry, Fishing and Hunting Economies	High

Region	Time Period	Risk Profile (RCP8.5)	Risk Profile (RCP8.5)
Far North	2050s	Mining, Quarrying and Oil/Gas Extraction	Medium
Far North	2050s	Retail Trade	Low
Far North	2050s	Transportation Economy	Medium
Far North	2050s	Utility Services	High
Far North	2080s	Accommodation and Food Services	Medium
Far North	2080s	Arts, Entertainment and Recreation	High
Far North	2080s	Construction	Low
Far North	2080s	Financial and Insurance	High
Far North	2080s	Forestry, Fishing and Hunting Economies	High
Far North	2080s	Mining, Quarrying and Oil/Gas Extraction	Medium
Far North	2080s	Retail Trade	Low
Far North	2080s	Transportation Economy	Medium
Far North	2080s	Utility Services	High

Appendix 10: Area of Focus Adaptive Capacity Assessment

Adaptive Capacity is defined as a way to measure inherent adaptability in a system, organization or industry and their ability to adjust to potential damage, respond to consequences and take advantage of opportunities. Within the PCCIA Adaptive Capacity has been evaluated for each Level 1 category across all Areas of Focus, regardless of each geographic region. For Business and Economy, Food and Agriculture, Infrastructure and Natural Environment Areas of Focus, Adaptive Capacity was assessed with consideration of technology, resource availability, governance and sector complexity. The People and Communities Area of Focus evaluated Adaptive Capacity across one additional component: equity. A characterization of Adaptive Capacity for each Area of Focus involved evaluating relevant components above and assigning a score of Low (1), Medium (4) or High (16) based on literature and expert judgement for particular Level 1 categories. Tables 10.2 to 10.33 provide a summary of Adaptive Capacity characterizations for all Level 1 categories across Food and Agriculture, Infrastructure, Natural Environment, People and Communities and Business and Economy Areas of Focus.

Table 10.1: PCCIA Adaptive Capacity Legend for all Areas of Focus

How to Read Adaptive Capacity Ratings			
Adaptive Capacity Score	**1**	**4**	**16**
Adaptive Capacity Rating	**Low**	**Medium**	**High**

Table 10.2: PCCIA Adaptive Capacity Rating for Field Crops

Field Crops

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Technology advancements are being made for use in field crop management (ex. GPS guidance, advanced weeping tiles, drones, precision machinery) and is mainly focused on increasing yield and building international business. There are several farm-level best practices that increase overall resilience of field crop production. Examples of these best practices include: selection of crop varieties with resistance and tolerance to changing conditions; diversification of field crops; disease and pest management practices (e.g. scouting); covering crops and no-till for soil health and conservation; tile drainage and controlled tile drainage; crop and pasture rotation; increase implementation of irrigation, fertilizer, pesticides, or fungicides; physical barriers (e.g. wind breaks, buffer strips); retrofitting facilities and infrastructure (e.g. storage buildings); changes in planting or harvesting dates; proper monitoring techniques. Trends have shown that younger farm owners are more likely to adopt these practices and technology (e.g. automation) than older farm owners or renters. The number of farms in Ontario is declining, but the size of farms is increasing. Data shows that larger farms are also more likely to invest in technology, compared to smaller operations.	From a financial resource perspective, there are incentive programs for innovative ideas through the Canadian Agricultural Partnership, (a five-year, $3-billon investment), which includes climate change as one of its six priority areas. Additionally, Agricorp, an agency of the Government of Ontario, delivers several risk management programs (e.g., AgriStability and production insurance), to support Ontario's agriculture producers by offsetting financial losses. A large percentage of field crop producers participate in Agricorp's insurance programs, with average claim amounts increasing in recent years. Funding for Business Risk Management (BRM) programs (managed by AgriCorp) helps ensure producers are protected against significant risks that threaten the viability of their farm and are beyond their capacity to manage. The Environmental Farm Plan is another resource available to farmers to complete a risk assessment, develop and implement action plans addressing issues relevant to their farms. However, field crop production is influenced greatly by market and economic conditions, which can impact Adaptive Capacity at the farm-level. Declining profit margins caused by market forces (e.g. high input costs and low commodity prices) can cause farm-level financial debt, and in turn limits the ability to purchase crop insurance or adopt risk mitigation techniques (e.g., fertilizers, upgraded drainage). Additionally, over the past few decades, the average number of farmers and labour has been on the decline in Ontario. From a human resources standpoint, crop producers in Ontario have a history of adapting to challenging weather and climate conditions. To support building skills and expertise across the sector, OMAFRA has developed a Best Management Practices Series for crop producers. Although, the series is not directed at addressing climate risks specifically, the practices do increase overall resilience of field crop production (e.g., soil and irrigation management).	OMAFRA has funded several climate change related research projects on field crop production in Ontario. The projects include a review and scientific assessment of climate thresholds on various field crops, existing and future risks and adaptation options (e.g. crop selection). They also provide public resources on how climate change may impact field crop production in the future and how to prepare (e.g., techniques for managing pests and diseases). Additionally, the Ontario Federation of Agriculture has taken an official position on climate change, recognizing its existence and the need for policies and programs to enable adaptation. However, further cooperation and coordination between levels of government and institutions is required to advance adaptation efforts from the planning phases to implementation. Increased uptake and support of adaptation measures is required to build widespread climate resilience across field crop producers in Ontario.	There are a variety of decision-makers, organizations and stakeholders that can influence the level and uptake of adaptation at the farm-level. There is an additional layer of complexity as there are significant market and economic forces associated with decisions related to commodity production. Government policies (municipal, regional, provincial and federal) influence the market and the decision-making processes of field crop producers, which in turn can impact their ability to manage climatic risks. Decision-makers and stakeholders within field crop production include, but are not limited to: Agriculture and Agri-Food Canada, OMFARA, municipal and regional governments, Agricorp, OFA, specific field crop associations, seed companies (e.g. Pioneer), crop producers and operations.
Adaptive Capacity Rating	**High** (16)	**Medium** (4)	**Medium** (4)	**Low** (1)
Overall Level 1 Adaptive Capacity Rating	**Medium** (4)			

Fruits and Vegetables

Table 10.3: PCCIA Adaptive Capacity Rating for Fruits and Vegetables

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Technology use in fruits and vegetable production is critical and has historically been the focus of adaptation. The agricultural community are some of the most adaptive stakeholders across Ontario, with technological advancements being a critical component as to why. Technology adaptation strategies are often identified or known and depend somewhat on the commodity being produced. For example, technology for grape growers can include the early unburying of vines, spraying the vineyard with antifungal chemicals, pruning vines to allow airflow, and early harvest of wine grapes during extremely hot summers. Other technological advancements cited include the use of wind machines; irrigation; helicopters; heaters; heat-blocks; fog machines; and late pruning depending on the commodity. Technological development will be critical as fruit and vegetable growers face an increasingly variable climate, and the use of climate-adapted cultivated varieties is also a key aspect of that, which is an ongoing area of development	Human, financial, and natural resources available to fruit and vegetable growers are also an important component of Adaptive Capacity. Each type of resource differs to an extent across Ontario and based on the commodity being produced. From a human resource availability perspective, there is a relatively higher Adaptive Capacity that exists. Several networks, associations and partnerships exist that aim to share information, advocate for fruit and vegetable importance regionally and by commodity. For example, the Ontario Federation of Agriculture, regional membership groups, academic institutions, and commodity-specific groups (e.g., Ontario Tender Fruit Growers, Ontario Wine Growers, etc.) continue to build capacity and resource availability in the agricultural community. From a financial resource availability perspective, Adaptive Capacity is considered relatively lesser than human resource availability for fruit and vegetable growers. Some financial resources are available, depending on the commodity and region of Ontario. For example, crop insurance (e.g., via AgriCorp) is frequently cited as a financial resource, along with organizations such as local banks, credit unions, Farm Credit Canada, Advance Payments Program, and Ontario's Rural Economic Development Program. On-farm financial adaptation strategies, to an extent, have been identified as well such as carrying reserves (e.g., planning for bad years in advance by stocking away funds during good years), diversifying revenues and/or taking advantage of on-farm tourism or farmer's markets in urban and semi-urban communities, etc. However, financial limitations are frequently cited as a barrier to adaptation and the ability of farmers to invest in new technology or to re-tool for switching production or commodities in support of adaptation. In consideration of both human resource availability (higher) and financial resource availability (lower), the score applied to this particular category is rated as a "medium" to reflect average conditions of capacity.	Several policies and institutions exist to support fruit and vegetable farmers. However, many are not specifically focused on climate change, adaptation or reducing climate risks at this time. Ontario's Environmental Farm Plan program for example provides one example of a vehicle used to assess environmental conditions, identify environmental concerns and strengths on farm and to develop an action plan to mitigate potential concerns. Depending upon the Region of Ontario, various policies and programs also exist that could enable adaptation measures, such as Conservation Authorities rural water quality programs, land protection designations, etc. The capacity of governance for fruit and vegetable farmers is considered medium in light of the number of institutions and resources that are becoming available – however there remains a need to explicitly support climate change action.	The sector complexity of fruit and vegetable farmers is considered relatively high and therefore the capacity to adapt for this particular category is rated as low. This characterization was developed in light of the high number of fruit and vegetable commodities that exist, many of which are not assessed in detail in this PCCIA. Sector complexity is also considered high in relation to drivers outside of the control of farmers, such as market drivers and pricing, companies developing cultivated varieties and climate-adjusted technologies, and insurance availability.
Adaptive Capacity Rating	**High (16)**	**Medium (4)**	**Low (1)**	**Low (1)**
Overall Level 1 Adaptive Capacity Rating	**Medium (4)**			

Livestock

Table 10.4: PCCIA Adaptive Capacity Rating for Livestock

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Technology use is important in the livestock sector with some of the most promising adaptation measures including genetic diversification of livestock and poultry, assisted reproduction (including artificial insemination), changes to nutrition (dietary supplementation and modifications), precision technologies (monitoring activity, tracking estrus behaviour), and adjustments to (HVAC upgrades). Some adopted best management practices include shifting to mixed crop-livestock systems, rotational grazing and adjustments to handling and transportation of livestock. Investments in energy and digital infrastructure are other examples of actions aimed at increasing the overall resilience of the sector. At the same time, availability of technology does not always correlate with implementation of technological measures and solutions, especially on smaller farms.	Livestock operations are influenced by a number of economic factors. Beef, hog and sheep operators are particularly sensitive to price fluctuations making their income is variable and uncertain from year to year. Dairy and poultry operations, that are in supply-managed, quota systems have more stable income, but can also be impacted by market prices when those affect livestock feed. Shrinking profit margins limit an operation's ability to withstand repeated years of yield decline and purchase risk reducing and adaptive technologies. The Canadian Agricultural Partnership is the primary financial support mechanism used to stimulate growth in the agricultural sector. Through CAP, the federal and provincial governments have committed cost-share support to approximately 2,500 projects to help eligible Ontario farmers, processors, businesses and sector organizations innovate and grow. Funding for Business Risk Management (BRM) programs (managed by AgriCorp) helps ensure producers are protected against significant risks that threaten the viability of their farm and are beyond their capacity to manage. The Environmental Farm Plan is another resource available to farmers to complete a risk assessment, develop and implement action plans addressing issues relevant to their farms. The Livestock Financial Protection Board, an agency of the Ontario Ministry of Agriculture, Food and Rural Affairs is established under the Farm Products Payments Act (FPPA) and is responsible for administering funds for livestock sellers. OMAFRA offers workshops, resources, and eLearning opportunities at no cost for the agri-food and agri-products sectors on a number of important issues including growing farm profits, biosecurity, food safety and more. Some barriers to the sector's Adaptive Capacity include financial limitations and lack of extension services providing advice and recommendations to producers.	The government is undertaking a number of adaptation activities related to agriculture. These include long-term planning for potential water shortages, monitoring and surveillance programs for animal diseases, supporting research into business risk management approaches and enabling demand-driven knowledge transformation and transfer (KTT) into use through synthesis, exchange, dissemination, dialogue, collaboration and brokering among researchers and farmers. OMAFRA has funded several climate change related research projects on agriculture in Ontario and provides online resources on how climate change may impact the agricultural sector. The Ontario Federation of Agriculture has taken an official position on climate change, recognizing its existence and the need for policies and programs to enable adaptation. Other important actions include conducting regional risk and opportunity assessments, supporting farm-level adaptation, developing regional scale adaptation plans. Understanding farmers' perceptions and including them in policy development can improve food security and environmental conservation by promoting widespread practice adoption. In addition, a comprehensive view of costs, time, and effort required from the producer needs to be included to the policy framework to maintain sustainable production systems.	Livestock farming is a complex decision-making environment, with many external and internal forces influencing management decisions. Commodity prices, financial markets, available technologies, health and safety regulations and institutional support all contribute to adaptation decisions and affect overall Adaptive Capacity . There are different levels of control over certain adaptations with some available for implementation at the decision of a single operator, and others being shaped by multiple stakeholders in farming, government and elsewhere. Additionally, dairy and egg farmers are operating in a quota-based system, adding an extra level of complexity compared to other livestock farming operations.
Adaptive Capacity Rating	**High (16)**	**Medium (4)**	**Medium (4)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Infrastructure

Buildings

Table 10.5: PCCIA Adaptive Capacity Rating for Buildings

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	There are weather stations in Ontario, most in the southern regions and near populated areas that provide climate data that contribute to the assessment of resilience of public buildings. Conservation Authorities and municipalities have access to mapping with floodplains delineated that can be updated with future climate modelling when developing new building infrastructure.	The Ontario government's Flood Management Strategy (2020) details a priority to invest in flood risk reduction, including working with the federal government to secure funding. Federal and joint Provincial/Federal funding programs exist to support infrastructure development and Research on Resilience of Buildings and Core Public Infrastructures in light of climate change, with the focus of climate change adaptation. A more wide-reaching set of funding programs aimed specifically at development of adaptation planning/measures implementation would go further. Resources (knowledge and technology) are accessible to the public from cities and conservation authorities. They provide information on basement flooding and mitigation measures that can be taken.	Organizations such as the Ontario Climate Consortium (OCC), Ontario Centre for Climate Impacts and Resources (OCCIAR), and International Council for Local Environmental Initiatives (ICLEI) are actively adapting policies and convening stakeholders to develop and share more information on severe weather events and climate change. The CSA guideline on durability of a building was revised; there is ongoing development for other climate resilience concerns. The Ontario Ministry of the Environment, Conservation and Parks is continuing to develop changes to the Building code. Considerations for climate change prediction models should be incorporated.	There are three level 2 categories (Housing, Public Buildings and Other Buildings) under the Building level 1. Within the buildings category, buildings are owned privately (industry and homeowners) and publicly. There are a number of groups involved in this Level 1 including municipal employees (e.g. engineers, planners, hired consultants, Councilpersons, inspectors etc.), contractors/builders, conservation authorities, branches of the ministry and various levels of approval required for a building to be built and/or modified. Publicly owned buildings go through various levels of approval and a public bidding system prior to larger changes being designed and implemented. Part of this process included securing funding, the proper design team and council approval. A similar process is undertaken for larger private buildings and smaller private buildings, often with a shorter timeline for smaller projects. A cross sectoral impact here is the cost of repairing damages caused by climate change. Depending on insurance, overland flooding (damage from floodplains flooding) may not be covered by insurance and will come at the cost of the building owner. Insurance coverage and requirements related to climate change events can be modified and included in premiums to protect building owners.
Adaptive Capacity Rating	**Medium (4)**	**Low (1)**	**Medium (4)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Transportation

Table 10.6: PCCIA Adaptive Capacity Rating for Transportation

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	There is evidence of technology advancements for adaptation to climate change, and especially specific to individual climate events (ex. Extreme low water levels for marine transport, permafrost degradation for winter roads, etc.). Significant investments in research and development of technology to support adaptation are still needed. Average annual R&D expenditures are low compared to other sectors.	Federal and joint Provincial/Federal funding programs exist to support infrastructure development in light of climate change, with the focus of climate change adaptation. A more wide-reaching set of funding programs aimed specifically at development of adaptation planning/measures implementation would go further. The transportation industry has a highly trained and skilled workforce (especially from the automotive industry) that are available for work and/or can be trained to deliver/implement new technologies for climate change adaptation. There is some funding available to municipalities from the province through the Build Back Better pilot project.	There are municipal, provincial and federal jurisdictions at play for transportation in Ontario. Generally, the areas that are within their jurisdiction are agreed upon and established through documentation. The Ontario Ministry of Transportation released updated IDF curves and a new policy in 2016 to enhance resilience for the highway system in Ontario. Metrolinx has a plan for climate resiliency that benchmarks best practices and is continuing to take action for extreme precipitation and extreme hot/cold. The City of Toronto has developed a Hot Weather Response Plan to more frequently occurring extreme heat waves events. Another example is the Billy Bishop Airport Master Plan that has a section on climate change and extreme weather vulnerability. The Public Infrastructure Engineering Vulnerability Committee (PIEVC) program developed a protocol to be applied to assessing the severity of climate impacts to make informed engineering judgements on the required adaptations. Use of the protocol is overseen by the Institute for Catastrophic Loss Reduction (ICLR) to ensure integrity of the protocol and for public availability. Previous assessments for airport infrastructure, bridges, coastal structures, and roads and associated structures in Canada can be used in policy making and planning.	Transportation has four level two categories (Air, Rail, Lakes, Roads & Bridges) that are impacted by all levels of government in varying capacities that have different capabilities when it comes to Adaptive Capacity. There are municipal, provincial and federal jurisdictions at play for transportation in Ontario and many projects are jointly funded by various levels of government. Transportation projects can be subject to Environmental Assessments in Ontario that include opportunities for public and stakeholder input. What builds complexity into this Level 1 is the variety of transportation considered (e.g. roads/bridge, air, coastal/deep sea) and variety of agencies, owners and interactions (e.g. environmental, public, industry) that make it difficult to implement wide sweeping transportation policies related to climate change.
Adaptive Capacity Rating	**Medium (4)**	**Low (1)**	**Medium (4)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Waste Management

Table 10.7: PCCIA Adaptive Capacity Rating for Waste Management

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	There is ongoing air monitoring for odour and weather patterns at a Toronto landfill which will help identify, visualize, and distinguish odour sources and predict odour trajectories. There are several municipalities in southern and central Ontario which are participating in technology research, development, and testing through the Municipal Mixed Waste Processing Working Group. Most technology review and consideration in the research is geared towards waste reduction for GHG reduction. The considerations for the inverse relationship (climate change on waste management) are not clear but there is potential for incorporation into the Working Group's investigations. The Recycling Council of Ontario, Nishnawbe Aski Nation and Indigenous Services Canada are working to mitigate climate change impacts by advancing circular economy and waste reduction programming in First Nations communities, focusing in Northern Ontario. The Ontario Waste Management Association members develop research and facilitates learning opportunities on new developments in the waste management industry.	There are multiple Infrastructure Canada funding opportunities which waste management may be eligible for (included in or not included in the "Investing in Canada Plan"). The Municipal Mixed Waste Processing (MWP)Working Group has the objective to “identify collaboration opportunities and specific information needs, actions and timelines, in order to determine the feasibility of jointly implementing waste management policies, programs and/or facilities", and includes several municipalities in Ontario (and Canada).The Federation of Canadian Municipalities' Green Municipal Fund funds waste diversion and waste stream management projects. It is unclear the eligibility for infrastructure specific projects since the main concerns are waste quantity and GHG emissions. It was noted by participants from Workshop #2 that there is limited R&D funding for experimental/new technologies.	The Ontario Ministry of the Environment, Conservation and Parks (MECP) manages the regulations and guidelines regarding waste management. New and existing regulations were amended to require landfill gas collection and flaring or use for landfills of certain size. However, most climate related information in the waste management sector is related to waste reduction and diversion, and reducing GHG emissions. The Ontario Waste Management Association is an advocacy group for waste management who review regulatory changes and assist with research. This group works with the provincial government on programs and policies for the waste management sector including those related to climate change.	Waste Management includes private and public stakeholders, including waste management companies, municipalities, provincial government and the public. Many of these members are part of the Ontario Waste Management Association. An area of complexity in Waste Management is resource availability between different Regions, notably between rural and urban areas, where accessibility to waste diversion programs (e.g. blue bins in more rural communities) can be limiting based on the cost to private citizens who wish to participate, or programs, like composting/green bin, do not exist. In addition to these complexities, the materials used for construction will vary based on geographic location. For example, the far north regions rely on ice roads while there are none in southern Ontario. It was noted by a participant in Workshop #2 that "not in my backyard"-ism (NIMBYism) is a factor when it comes to engaging with the public for input on waste management projects. Blue Box program responsibilities will begin transferring to producers on July 1, 2023. Starting January 1, 2026, all producers will be fully responsible province-wide. In addition the new Blue Box program will standardize what goes in the blue box and expand services to more communities across the province.
Adaptive Capacity Rating	**Medium (4)**	**Medium (4)**	**Low (1)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Utilities

Table 10.8: PCCIA Adaptive Capacity Rating for Utilities

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	There is some built in redundancy (e.g. twinning circuiting) that most severe climate events are not likely to significantly affect the delivery of service in the electrical field. Non-hydro assets will need to be replaced or renewed in 2050.	There are funding sources that support the investigation of climate impacts to the electrical production/transmission sector. There are various, other federal funding options for utilities such as the Disaster Mitigation Adaptation Fund and the Investing in Canada Infrastructure Program. There is central repository of climate-resilience codes and standards documents (40+ document), curated by the Canadian Centre for Climate Services. In addition, there is a framework that they can use called the Public Infrastructure Engineering Vulnerability Committee's (PIVEC) Engineering Protocol.	Reported that best practices in adapting to climate change are emerging in this section, but are still in the early stages and not widespread. CSA has identified CD Codes that can be adapted but indicated that some adaptations are better suited for other codes (e.g. Building Code). Needs to be coordination across codes, standards, and practices. The PIEVC protocol has been used to assess climate change risk for electrical distribution and transmission in Canada. Previous assessments can be used to inform on adapting guidelines in this section. In addition, the Canadian Centre for Climate Services created a central repository of climate-resilience codes and standards documents (40+ document).	Utilities has five level two categories (Electrical Power Generation, Electrical Power Transmission/Distribution, Sewage Treatment, Telecommunication and Water Supply & Irrigation) that are impacted by all levels of government in varying capacities. Utilities have varying infrastructure between the level 2 categories that are impacted by different regulations, associations/stakeholders, and design standards. For electrical, it is reported that best practices in adapting to climate change are emerging in this section, but are still in the early stages and not widespread. CSA has identified CD Codes that can be adapted but indicated that some adaptations are better suited for other codes (e.g. Building Code). Needs to be coordination across codes, standards, and practices.
Adaptive Capacity Rating	**Medium (4)**	**Medium (4)**	**Medium (4)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Pipeline Transportation

Table 10.9: PCCIA Adaptive Capacity Rating for Pipeline Transportation

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Terrain analysis tools available that can be used to determine appropriateness of the environment. Operators use computerized monitoring and control systems. Significant investments in research and development of technology to support adaptation related to severe weather events and climate change are still needed. Workshop #2 feedback indicated that the majority of oil/gas transmission in Ontario is underground. Exposed sections of transmission systems are required by code to be designed for exposure to extreme events (Z662) and low temperature (-40oC). Different pipe materials are available and used for different conditions.	Limited information beyond what currently exists under historical climate patterns. Geotechnical analysis is available to date with options like terrain analysis. The expertise in engineering and materials exists but there was little evidence found during the literature review that this was at the forefront of the pipeline transportation industry related to climate change.	There are regulatory bodies that oversee the construction of pipelines in Canada and in Ontario that would be able to implement adaptation measures. Most climate change related information from the pipeline transportation sector is related to GHG emissions.	Regulated federally and provincially, many stakeholders with opposing viewpoints. Opportunities at a provincial level for consultation with relevant stakeholders.
Adaptive Capacity Rating	**High (16)**	**Medium (4)**	**Medium (4)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Stormwater Management

Table 10.10: PCCIA Adaptive Capacity Rating for Stormwater Management

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	NEW INFRASTRUCTURE: Evidence of adaptability is based on the projected change from climate change modelling with outputs that update IDF curves which are the basis of stormwater infrastructure design (design flow). The technology for physical infrastructure does not necessarily need to adapt as pipe and pump sizing comes in various sizes that can accommodate the need to convey larger capacities at a time. Screens or other physical barriers exist that can be installed to minimize the amount of debris build up on equipment. Investment and interest in LID technologies and maintaining wetlands has increased. Pilot projects are underway for LID technologies. EXISTING INFRASTRUCTURE: Evidence that existing infrastructure is undersized with the possibility of retrofits	Municipalities need better tools to manage and build resilient/adaptive stormwater systems. Feedback from participants in Workshop #2 indicated that there is a lot of work that needs to be completed (e.g. flood plain mapping) and it is not readily distributed beyond an organization. It is going to be expensive to upgrade all the stormwater infrastructure. There are various federal funding options such as the Disaster Mitigation Adaptation Fund and the Investing in Canada Infrastructure Program. Federation of Canadian Municipalities (FCM) has resources related to climate change adaptation for stormwater that municipalities can access. ICLEI's Adaptation Library is another good source for tools for adaptation programs. In addition, there is a framework that they can use called the Public Infrastructure Engineering Vulnerability Committee's (PIVEC) Engineering Protocol. There is some funding available to municipalities from the province through the Build Back Better pilot project.	2016 MOE conducted a policy review of municipal stormwater management in light of climate change. Municipalities have conducted stormwater management plans and some larger municipalities have completed flood assessments. The federal government offers funding through the Climate Change Adaptation Program. The PIEVC protocol has been used to assess climate change risk for stormwater projects in Canada. Previous assessments can be used to inform on adapting guidelines in this section.	Stormwater management impacts many different groups (e.g. conservation authorities, building code, stormwater management, new development). Various levels of government control things like stormwater design guidelines and where new development can occur. Municipal governments may define floodplain locations but lack the ability to restrict/limit development in those locations. An additional factor for stormwater management is that some of the existing infrastructure is buried and difficult to access or upgrades. The 2019 independent review of flooding in Ontario provided 66 recommendations that span utilities, municipal, provincial and federal governments, the International Joint Commission, indigenous communities, and conservation authorities. Workshop #2 participants also indicated that there are a lot of players and multiple layers of decision-makers that add to the complexity of this Level 1. In addition, some of the roles and responsibilities are not clearly defined.
Adaptive Capacity Rating	**High (16)**	**Medium (4)**	**Medium (4)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Natural Environment

Fauna

Table 10.11: PCCIA Adaptive Capacity Rating for Fauna

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Technologies for plant AC includes protection of adaptive genetic variation, planning for assisted migration, and maintaining ecological connectivity. AC for plant species is easier to assess than for animal species because plant physiology is closely associated with climatic conditions and more literature is available. However, predicting species interactions (e.g., between trees and pests) within, and evolutionary responses to, a changing climate is uncertain. Substantial work will be required to turn plans into AC interventions.	Extensive knowledge and data exists about plant response to climate change, but information is not consolidated. Canadian, ON governments and stakeholder groups are responsible for implementing AC actions at the species level. Strong institutions exist with some funding. Indigenous and traditional ecological knowledge could be better utilized, while protecting privacy. Challenges persist around prioritization and insufficient funding to match the scale of action required. ON does not have a clearly articulated AC strategy for plant species, with direct financial and institutional commitments.	Although various policies exist to support persistence of species, no regulation exists that is directly related to AC for plants. ECCC and ON MECP have a general mandate to direct adaptation policy, in collaboration with Indigenous communities and municipalities. The CCME uses consensus-based decision-making to facilitate intergovernmental climate change decisions. FPT Ministers also meet to discuss biodiversity issues. The Made-in-Ontario Environment Plan does not specifically address adaptation actions. Governance complexity hampers decision-making and action. In 2018, FPT Ministers summarized "There is an urgent need for strengthened coordination and the translation of scientific knowledge and Indigenous knowledge to support decision making". Biodiversity is not well integrated into climate change policies, programs, or funding (and vice versa).	Complexity is very high, so AC is low, considering the diversity of species in the province. Multiple levels of government (federal, provincial, provincial), land managers (parks, forestry, Crown), Indigenous communities, and stakeholders involved.
Adaptive Capacity Rating	**Medium (4)**	**Medium (4)**	**Low (1)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Flora

Table 10.12: PCCIA Adaptive Capacity Rating for Flora

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Technologies for plant AC includes protection of adaptive genetic variation, planning for assisted migration, and maintaining ecological connectivity. AC for plant species is easier to assess than for animal species because plant physiology is closely associated with climatic conditions and more literature is available. However, predicting species interactions (e.g., between trees and pests) within, and evolutionary responses to, a changing climate is uncertain. Substantial work will be required to turn plans into AC interventions.	Extensive knowledge and data exists about plant response to climate change, but information is not consolidated. Canadian, ON governments and stakeholder groups are responsible for implementing AC actions at the species level. Strong institutions exist with some funding. Indigenous and traditional ecological knowledge could be better utilized, while protecting privacy. Challenges persist around prioritization and insufficient funding to match the scale of action required. ON does not have a clearly articulated AC strategy for plant species, with direct financial and institutional commitments.	Although various policies exist to support persistence of species, no regulation exists that is directly related to AC for plants. ECCC and ON MECP have a general mandate to direct adaptation policy, in collaboration with Indigenous communities and municipalities. The CCME uses consensus-based decision-making to facilitate intergovernmental climate change decisions. FPT Ministers also meet to discuss biodiversity issues. The Made-in-Ontario Environment Plan does not specifically address adaptation actions. Governance complexity hampers decision-making and action. In 2018, FPT Ministers summarized "There is an urgent need for strengthened coordination and the translation of scientific knowledge and Indigenous knowledge to support decision making". Biodiversity is not well integrated into climate change policies, programs, or funding (and vice versa).	Complexity is very high, so AC is low, considering the diversity of species in the province. Multiple levels of government (federal, provincial, provincial), land managers (parks, forestry, Crown), Indigenous communities, and stakeholders involved.
Adaptive Capacity Rating	**Medium (4)**	**Medium (4)**	**Low (1)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Terrestrial Ecosystems

Table 10.13: PCCIA Adaptive Capacity Rating for Terrestrial Ecosystems

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Technologies for ecosystem AC include ecosystem-based management (EbM) and adaptation (EbA), which involve cross-sectoral planning, adaptive management, and facilitation to support shared decision making. Climate projection uncertainties complicate AC assessment at the ecosystem level. Although AC actions exist for terrestrial ecosystems, the scale of implementation needed far exceeds resources available (e.g., forest fertilization in the boreal forest). The climate change adaptation framework for ecosystems developed in 2011 is out of date. Substantial work will be required to improve planning at the ecosystem level and turn plans into AC interventions.	Multilateral organizations and academic institutions provide expertise, guidance, and standards at the global level. The Ontario Forest Research Institute and Centre for Northern Forest Ecosystem Research incorporate climate change studies into their research programs. Canadian and ON governments are responsible for implementing AC actions at the ecosystem level, occasionally with international partners. Strong institutions exist, some of which have begun to mainstream adaptation into organizational planning. The depth of knowledge and expertise in terrestrial ecosystems increases AC.	A climate change adaptation framework for ecosystems was developed in 2011. ON MNRF and CCFM make provides leadership and governance decisions about forests in ON. These institutions are engaged in adaptation planning for forests and have begun to mainstream climate planning in decision making.	Terrestrial ecosystem complexity is high, considering the diversity and complexity of natural terrestrial systems across the province. Socio-cultural and governance complexity is high, considering the number of institutions, rights holders, and stakeholders involved. Ecosystems that cross national borders have even higher complexity (e.g., Carolinian forests). However, private sector industry and provincial ministries have jurisdiction over large land bases, streamlining decision-making for terrestrial ecosystem AC.
Adaptive Capacity Rating	**Medium (4)**	**High (16)**	**High (16)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Aquatic Ecosystems

Table 10.14: PCCIA Adaptive Capacity Rating for Aquatic Ecosystems

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Technologies for freshwater ecosystem AC include ecosystem-based management (EbM) and adaptation (EbA), which involve cross-sectoral planning, adaptive management, and facilitation to support shared decision making. Multi-species EbM has been implemented in the Sydenham River in SW ON. AC planning has occurred at multiple spatial scales in the Great Lakes with recommendations for enabling AC implementation. Although strategies and priorities exist, substantial work remains to turn plans into AC interventions.	Multilateral organizations and academic institutions provide expertise, guidance, and standards at the global level. The Lake Simcoe Adaptation Strategy is a pilot project to be used as a model for other freshwater adaptation project. Canadian and ON governments are responsible for implementing AC actions at the ecosystem level, occasionally with international partners. Strong institutions exist, some of which have begun to mainstream adaptation into organizational planning. The depth of knowledge and expertise in freshwater ecosystems increases AC.	No policy exists for climate adaptation in freshwater systems, although multiple bilateral international agreements exist for water management in the Great Lakes region. ECCC and ON MECP have a general mandate to direct adaptation policy, in collaboration with Indigenous communities and municipalities. The history of water resource planning potentially facilitates adaptation governance, though decision-making and action is challenged by overlapping and disjointed authority. Coordination is difficult to achieve.	Freshwater ecosystem complexity is high, considering the diversity and complexity of freshwater systems across the province. Socio-cultural and governance complexity is high, considering the number of institutions, rights holders, and stakeholders involved. Ecosystems that cross national borders have even higher complexity (e.g., in the Great Lakes). Freshwater systems also have complicated ownership structure, often intersecting jurisdictions, increasing complexity in decision-making for freshwater ecosystem AC.
Adaptive Capacity Rating	**Medium (4)**	**High (16)**	**Medium (4)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Regulating Services

Table 10.15: PCCIA Adaptive Capacity Rating for Regulating

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Technologies for regulating services AC include planning for carbon sequestration in forests and natural areas, protection of water recharge areas, and grey-green NbS (e.g., pollinator roofs and green stormwater infrastructure). Implementation is advancing in green infrastructure through mainstreaming with municipal policy. Carbon storage techniques are advancing through offsetting, protection, and restoration. Additional work is needed to scale successful AC interventions province wide. Work is needed to understand new technologies (e.g., blue carbon), prioritize AC strategies, and improve upon existing implementation approaches.	The Government of Canada, province of Ontario, Indigenous communities, and municipal governments have interest in maintenance of regulating services. Awareness and knowledge of the human value of pollination and carbon storage is growing. Although some financial markets support carbon storage and public funds may help support water flow regulation, additional financial resources are needed to increase AC for regulating services.	The province of ON has jurisdiction of water regulation and the federal government is leading incentives in carbon storage, dictated by targets set out in Canada's Nationally Determined Contributions (NDCs) to the UN Framework Convention on Climate Change and the Paris Climate Agreement. Environmental groups participate in policy advocacy and decision making. Although institutional networks exist, governance on regulating ecosystem services is not clearly defined in ON.	High complexity, considering active participation from multiple levels of government, Indigenous people, and stakeholders. However, established partnerships and division of responsibility exists for regulating services that enter financial markets (e.g., timber and agricultural goods). These partnerships can be leveraged for AC planning.
Adaptive Capacity Rating	**High (16)**	**Medium (4)**	**Medium (4)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Provisioning Services

Table 10.16: PCCIA Adaptive Capacity Rating for Provisioning Services

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Technologies for provisioning services AC may include EbM/EbA, nature-based solutions (NbS), habitat protection, and restoration. Conservation Ontario leads extensive planning on source water protection which provides AC. The forestry sector incorporates climate planning into SFM. Additional work is needed to understand new technologies (e.g., assisted migration), prioritize AC strategies, and improve upon existing implementation approaches.	The Government of Canada, province of Ontario, Indigenous communities, municipal governments, and private industry have interest in maintenance of provisioning services. These institutions have engineers, planners, ecologists, and managers with knowledge to leverage a large and growing literature on AC for provisioning services. Financial incentives in the timber industry and public access to clean freshwater drives strong knowledge, skills, and expertise to initiate AC planning for provisioning services. The depth of knowledge and expertise in provisioning services increases AC.	The province of ON has jurisdiction of water and land title. ON MNRF and CCFM make provides leadership and governance decisions about forests in ON. Municipalities often have authority over quality and quantity of local drinking water supplies. The provision of these ecosystem services is well governed which translates to high governance potential for AC.	Sector complexity is low considering authority is divided among decision makers. Stakeholders and rights holders may get involved in more complicated decisions, but generally decision making is streamlined.
Adaptive Capacity Rating	**Medium (4)**	**Medium (4)**	**High (16)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Cultural Services

Table 10.17: PCCIA Adaptive Capacity Rating for Cultural Services

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Technologies for cultural services AC may include planning for recreational, spiritual, heritage, and/or educational and other uses through EbM, EbA, or NbS. Infrastructure solutions may exist for some recreational services (e.g., snowmaking). The lack of appropriate indicators and data to support planning was identified in the literature.	The Government of Canada, province of Ontario, Indigenous communities, municipal governments, non-profit organizations, and recreational users have interest in maintenance of cultural services. Small businesses may support these services, but most financing is through the public sector. AC could be increased by developing stronger coordination among user groups, decision makers, and funding bodies.	Parks Canada has an adaptation framework published in 2020 that establishes a process to follow for AC planning, which can be used for cultural services AC. Parks Canada also has funding and capacity to act as a lead organization in this effort.	Sector complexity is low and decentralized. No primary point of authority exists for decision making. Low complexity increases AC, but low network connectivity decreases AC.
Adaptive Capacity Rating	**Low (1)**	**Medium (4)**	**High (16)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

People and Communities

General Population

Table 10.18: PCCIA Adaptive Capacity Rating for General Population

Category	Technology	Equity	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	General technology improvements are widely available and proven, particularly associated with communications and alerts, Artificial Intelligence to increase early warning systems, greater access to affordable, portable heating and cooling units, green infrastructure, public realm improvements, etc.	Equity remains a critical concern for climate change adaptation planning, particularly with rapid urbanization. Over 85% of Ontario's population lives in an urban context. The disparities in climate change impacts that exist in cities today disproportionately affect Black people, Urban Indigenous peoples, people of colour, and low income residents, particularly those with disabilities, youth, and older adults, who lack access to green space, cooling shelters, warming centers, and resources to support management of major events requiring evacuation or resulting in property loss or health impacts. Ontario also has one of Canada's largest populations of migrant workers, who are particularly vulnerable to heat stress and infectious disease due to the nature of their work and precarity of employment. There is also a significant population of nearly 600,000 non-permanent residents overall (students, foreign workers, etc.) who would need additional supports to successfully adapt to climate change in their time in Canada.	Resources for climate change adaptation planning have been made broadly available at the municipal level, although funding for implementation can be a key constraint.	Approx. 100 municipalities across Ontario are members of the Partners for Climate Protection program, and have developed climate adaptation plans that consider the needs of vulnerable populations and socio-economic and health considerations associated with climate change adaptation. Public health and planning departments in these municipalities are integrating a climate change lens to mitigate climate risk; however, political will to take action is not consistent across the Province, and prioritization of the climate emergency is greater in some areas. Attention to the deeper systemic inequities (e.g. related to environmental racism) that are linked to and exacerbate climate change impacts remain root issues in many communities. There are broad municipal coalition networks and spaces to share knowledge, receive training, and advance on climate action.	High degree of complexity, multiple stakeholders, but decision-making capacity supported at the municipal level and ability to develop community-based strategies
Adaptive Capacity Rating	**Medium (4)**	**Medium (4)**	**Medium (4)**	**Medium (4)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**				

Unhoused Population

Table 10.19: PCCIA Adaptive Capacity Rating for Unhoused Population

Category	Technology	Equity	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Adaptive housing, modular housing, and sustainable construction methods to support increased diversity of housing stock, climate resilience, and accessibility for affordable options, have been proven in North America and in Ontario specifically.	Ontario's Unhoused Population is difficult to determine in total, and is higher in urban areas. Improvements to supply of housing stock and adequate, safe, accessible shelters remain a critical issue. Unhoused Populations are highly vulnerable to climate change, and do not have the Adaptive Capacity to cope with extreme weather or even moderate changes in temperature which can cause heat/cold stress. In addition, the mental health impacts associated with climate stress, and exposure to infectious disease/illness that increase with climate change are all more evident in communities struggling with housing tenure. The Unhoused Population with disabilities represent a further category of people within this population that are more vulnerable given the lack of accessible shelter or social housing across Ontario. While many municipalities have undertaken housing strategies, funding for social housing remains low and waiting lists for supportive and social housing continue to grow across the Province.	A projected shortfall in housing spending by the year 2027, reducing Provincial spending, and increasing housing market instability all indicate an increase in the number of unhoused residents in Ontario as well as their vulnerability to climate change due to lack of supports.	Emergency response and Institutional capacity to support Unhoused Populations in dealing with the impacts of climate change vary across the Province, based on the size of the Unhoused Population, local political conditions, and availability of resources. Overall, Unhoused Populations are particularly vulnerable to funding cuts and lack of economic stability, which continues to be a critical challenge in Ontario.	High degree of complexity, multiple stakeholders, wide variability in needs of communities, decision-making support and capacity building widely available.
Adaptive Capacity Rating	**Medium (4)**	**Low (1)**	**Low (1)**	**Low (1)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**Low (1)**				

Health Care

Table 10.20 PCCIA Adaptive Capacity Rating for Health Care

Category	Technology	Equity	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Telemedicine advancements and increased accessibility would support longer-term management of mental and physical health impacts from climate change.	Discrimination and racism in the health care sector, as well as a chronic lack of quality in long-term care facilities indicate low focus on climate change adaptability of the health care sector. Some public health units, research institutions, and govt investing in planning and research, but overall funding and supports for vulnerable communities and further research to support vulnerability assessments for at risk populations appear to be limited. Black and Indigenous community health supports and outcomes in particular remain a major gap in funding.	Planning and funding for the healthcare sector in Ontario has experienced significant instability, with funding cuts and a projected deficit that does not meet the needs of Ontario's growing population. The lack of paid sick leave also makes marginalized and low income communities more vulnerable to healthcare impacts.	There is strong academic, practitioner, not for profit, and research strength to support climate change adaptation, and the knowledge on key areas to focus on for impact to support adaptation. Some toolkits have been developed as well as established forums for discussion, networking, knowledge sharing, and capacity building.	High degree of complexity, multiple stakeholders, wide variability in needs of communities, lack of decision-making support or capacity
Adaptive Capacity Rating	**Medium (4)**	**Low (1)**	**Low (1)**	**Medium (4)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**				

Social Assistance

Table 10.21: PCCIA Adaptive Capacity Rating for Social Assistance

Category	Technology	Equity	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Digital equity has been identified as a key gap and area for improvement in order to support greater access to services for marginalized communities. The methods and technology to support social assistance expansion and equity exist, and can be further refined through implementation	Climate change adaptation and the need to consider how vulnerable communities will need support to adapt do not appear to be a key focus in planned improvements to social assistance programs at the Provincial level. Poverty reduction, social inclusion and human rights are key areas that need to be improved upon. Approx. 7 percent of Ontarians rely on social assistance for their primary source of income. Deep barriers exist to accessing needed services due to complexities in navigating different levels of social assistance, as well as lack of supports for single people and people with disabilities.	Planning and funding for the social assistance sector in Ontario has experienced significant instability, with funding cuts and a projected deficit that does not meet the needs of Ontario's growing population. The lack of paid sick leave also makes marginalized and low income communities more vulnerable to healthcare impacts.	The social assistance sector is well connected with policy think tanks, academia, and practitioner knowledge to support identification and implementation of adaptation solutions, and develop successful strategies for climate change adaptation	Sector complexity stems from the wide range of needs of people who require social assistance, and the growing gap in funding. Decision-making and implementation happens at the Provincial level as well as through regional and municipal governments, which means there is significant variability in the accessibility of resources and support to implement changes that can be realized across the Province. Considering Social Determinants of Health, the high degree of dependency in Ontario particularly for the Eastern and Northern areas creates concern for the sector to keep up with demand and adapt at the same time.
Adaptive Capacity Rating	**Low (1)**	**Low (1)**	**Low (1)**	**Low (1)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Low (1)**				

Indigenous Communities

Table 10.22: PCCIA Adaptive Capacity Rating for Indigenous Communities

Category	Technology	Equity	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Improving infrastructure, particularly for water, wastewater, and road access improves ability to adapt to changing conditions and quality of life. Communications infrastructure makes it easier to plan for emergency scenarios and support social assistance and healthcare needs remotely. Mental health needs would need continued support as the long-term impact of climate change takes hold. Several Indigenous communities are investing in climate change adaptation planning.	Indigenous communities continue to have higher rates of unemployment, lower infrastructure quality, lower access to social supports, poorer health outcomes, and higher rates of exposure to environmental pollution.	While funding for climate change adaptation has been made more available for Indigenous communities, the underlying infrastructure, housing, healthcare, and institutional capacity issues would make it difficult to realize the required actions to support adaptation. These elements are underfunded by a significant margin, with infrastructure shortfalls being particularly glaring, and a housing crisis in a number of Indigenous communities contributing to reduced health outcomes.	Climate change adaptation planning must be undertaken by Indigenous peoples in an autonomous way, guided by local knowledge and community needs. There is a range of variability in institutional capacity to support implementation of adaptation plans and community-based engagement across First Nations in Ontario. However, there is shared institutional capacity in the form of the Indigenous Climate Hub and federally funded programs to support climate change adaptation in Indigenous communities. There is also a deep commitment to climate change action in Indigenous communities that builds on traditional knowledge would need to be supported through Provincial funding for infrastructure.	High degree of complexity, multiple stakeholders, wide variability in needs of communities, variability in decision-making support or capacity based on current context, infrastructure constraints, and funding constraints.
Adaptive Capacity Rating	**Low (1)**	**Low (1)**	**Low (1)**	**Low (1)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Low (1)**				

Business and Economy

Accommodation and Food Services

Table 10.23: PCCIA Adaptive Capacity Rating for Accommodation and Food Services

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	AC is highly dependent on the size and scale of business (large to micro). Industry owned and leased buildings typically designed to code/engineering standards and for the climate that existed when they were built, so are not necessarily equipped to cope with current and future climates (e.g., ensuring structural stability and limiting water intrusion and heat gain). Few examples of widespread industry investment in property-level flood protection where buildings are owned, and businesses are otherwise dependent on the third-party building owner. Emergency management and business continuity practices are common, typically designed to meet minimum operating requirements over a short duration. Unclear as to level of generalized adoption of onsite back-up energy supply (generators). Supply chains for materials and commodities are vulnerable to extreme event shocks, with varying degrees of supply chain redundancy and robustness.	Emergency and crisis management, and business continuity positions are common in larger organizations, not as common in smaller organizations. Existence of Back-up power supply across all organization sizes is unclear, and due to building leasing arrangements is often not within the company direct control.	Emergency and crisis management, and business continuity management systems are common in larger organizations, not as common in smaller organizations.	High complexity. Large number, large number of sub-sectors and heterogeneity of size of industry companies. Heavy reliance on third-parties (electricity supply, leasing building owner) to implement risk mitigation and resilience measures on behalf of industry companies.
Adaptive Capacity Rating	**Medium (4)**	**Medium (4)**	**Medium (4)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Arts, Entertainment and Recreation

Table 10.24: PCCIA Adaptive Capacity Rating for Arts, Entertainment and Recreation

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	AC is highly dependent on the size and scale of business (large to micro). Industry owned and leased buildings typically designed to code/engineering standards and for the climate that existed when they were built, so are not necessarily equipped to cope with current and future climates (e.g. ensuring structural stability and limiting water intrusion and heat gain). Few examples of widespread industry investment in property-level flood protection where buildings are owned, and businesses are otherwise dependent on the third-party building owner. Emergency management and business continuity practices are common, typically designed to meet minimum operating requirements over a short duration. Unclear as to level of generalized adoption of onsite back-up energy supply (generators). Supply chains for materials and commodities are vulnerable to extreme event shocks, with varying degrees of supply chain redundancy and robustness. Limits to ability of summer and winter outdoor recreation industries such as golf, snowmobiling, downhill skiing, recreational fishing to mitigate the impact of climate change on outdoor conditions via adoption of water conservation and re-use techniques, and snowmaking.	Industry associations are actively engaged in raising awareness within industry and with provincial policy makers and regulators regarding measures to enhance industry resiliency.	Emergency and crisis management, and business continuity management systems are common in larger organizations, not as common in smaller organizations.	High complexity. Large number, large number of sub-sectors and heterogeneity of size of industry companies. Main risk exposure is via changing mean conditions, with variable flexibility to adjust and adapt (e.g. artificial snowmaking can address up to a certain level of snow loss)
Adaptive Capacity Rating	**Medium (4)**	**Medium (4)**	**Medium (4)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Construction

Table 10.25: PCCIA Adaptive Capacity Rating for Construction

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Industry standard measures to address water conservation and re-use during construction activity, and worker safety related heat stress. See People & Communities Area of Focus for adoption of low-impact development and sustainable urban planning approaches. See Infrastructure Area of Focus for adoption of climate-resilient engineering construction techniques, updates to building codes for climate-resilient infrastructure.	See Infrastructure Area of Focus for description of development of Engineers Canada PIEVC Protocol for infrastructure climate resilience assessments and CSA standards for climate resilient infrastructure. PIEVC training delivered through Climate Risk Institute and Canadian Standards Association. Institute for Catastrophic Loss Reduction has developed data, tools for building resilience/loss & damage estimation and best practices	See Infrastructure Area of Focus for description of development of Engineers Canada PIEVC Protocol for infrastructure climate resilience assessments and CSA standards for climate resilient infrastructure. PIEVC training delivered through Climate Risk Institute and Canadian Standards Association. Commitment in federal Liberal Party election platform to introduce a climate resilience rating for new home construction.	Moderate complexity. Large number and heterogeneity of size of construction and engineering industry companies. Industry dominated by a small number of large construction and engineering companies. Main risk exposure is via supply chain disruption and material availability
Adaptive Capacity Rating	**High (16)**	**Medium (4)**	**Medium (4)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Financial and Insurance

Table 10.26: PCCIA Adaptive Capacity Rating for Financial and Insurance

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Industry standard practices (e.g., actuarial; risk management) for natural hazard/peril loss estimation (insurance), probability of default (debt) in relation to multiple hazards including hydro-meteorological (based on historical event data). Increasing number of examples of banking, asset management and insurance companies making efforts - both individually and as part of collective efforts - to improve the state of private and public climate data and modelling capabilities, portfolio/credit risk and actuarial analysis tools and methodologies, and in engagement with financial counterparties regarding the management and disclosure of climate performance information.	Increasing number of large financial institutions (based in Ontario/holding investments in Ontario) are making significant financial investments in building out their internal climate science and risk modelling competencies via direct hires, acquisitions, and partnerships with specialist technical firms and academia	Increasing number of examples of involvement in international research efforts (e.g. UNEP FI, RMI Centre for Climate Aligned Finance) and voluntary declarations/commitments (e.g., TCFD, UN PRI, UN PRB). Pilot project ongoing to stress-test financial portfolios (carbon only at this point) involving selected large Canadian FIs (banks and insurers), OSFI and the Bank of Canada	High complexity. Large number, large number of sub-sectors and heterogeneity of size of industry companies. Main risk exposure is indirect via the direct risk exposure of financial counterparties
Adaptive Capacity Rating	**High (16)**	**High (16)**	**Medium (4)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**High (16)**			

Forestry, Fishing and Hunting Economies

Table 10.27: PCCIA Adaptive Capacity Rating for Forestry, Fishing and Hunting Economies

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	AC is highly dependent on the size and scale of business (large to micro). See Natural Environment Area of Focus for adoption of land and aquatic nature-based solutions for healthy and resilient forests and forest ecosystems (e.g. sustainable forest management, ecosystem restoration and regeneration planning, biodiversity positive afforestation and reforestation) and fisheries and aquatic ecosystem management (e.g. integrated watershed planning, ecosystem-based approach to fisheries management, stocking plans, species-under-stress approaches). Forestry industry is actively managing forests to address wildfire risk, including via detection of pest outbreaks, drought conditions, adjusting harvesting schedules to favour older and insect-damaged stands. Canadian Forest Services has developed a software tool (BioSIM) for use in predicting how climate change may affect the risk of mountain pine beetle infestations in western Canada.	Individual forestry firms, academia, Canadian Council of Forest Ministers, and Canadian Forest Service are engaged in research to advance science-based knowledge on climate risks to the sector, and to identity options for forest managers to adapt to climate change. CFS has updated Canada's plant hardiness zones map using climate data, and is working with provinces/territories to develop frameworks, guidebooks and tools to assist forest managers in understanding their readiness to adapt	Individual forestry firms, academia, Canadian Council of Forest Ministers, and Canadian Forest Service are engaged in research to advance science-based knowledge on climate risks to the sector, and to identity options for forest managers to adapt to climate change. CFS has updated Canada's plant hardiness zones map using climate data, and is working with provinces/territories to develop frameworks, guidebooks and tools to assist forest managers in understanding their readiness to adapt	Moderate complexity. Large number and heterogeneity of size of industry companies. Main risk exposure is indirect via the direct risk exposure of the terrestrial and aquatic ecosystems upon which their business activity depends
Adaptive Capacity Rating	**High (16)**	**Medium (4)**	**Medium (4)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Information and Cultural Industries

Table 10.28: PCCIA Adaptive Capacity Rating for Information and Cultural Industries

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	AC is highly dependent on the size and scale of business (large to micro). Industry owned and leased buildings typically designed to code and for the climate that existed when they were built, so are not necessarily equipped to cope with current and future climates (e.g., ensuring structural stability and limiting heat gain). Highly dependent on size and scale of business (large to micro). Few examples of widespread industry investment in property-level flood protection where buildings are owned, and otherwise dependent on the third-party building owner. Emergency management and business continuity practices are industry-standard, typically designed to meet minimum operating requirements over a short duration. Unclear as to level of adoption of onsite back-up energy supply (generators). Telecommunications industry most advanced with identifying functional thresholds for critical assets (e.g. towers, wires) and climate impacts on assets, equipment as well as supply chain inputs	Emergency and crisis management, and business continuity positions are common in larger organizations, not common in smaller organizations. Back-up power supply is uncommon across all organization sizes, and due to building leasing arrangements is often not within the company direct control.	Emergency and crisis management, and business continuity management systems are common in larger organizations, not common in smaller organizations.	High complexity. Large number, large number of sub-sectors, and heterogeneity of size of industry companies. Heavy reliance on third parties (electricity supply, leasing building owner) to implement risk mitigation and resilience measures on behalf of industry companies.
Adaptive Capacity Rating	**Medium (4)**	**Medium (4)**	**Medium (4)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Manufacturing

Table 10.29: PCCIA Adaptive Capacity Rating for Manufacturing

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	AC is highly dependent on the size and scale of business (large to micro). Industry owned and leased buildings typically designed to code and for the climate that existed when they were built, so are not necessarily equipped to cope with current and future climates (e.g. ensuring structural stability and limiting heat gain). Highly dependent on size and scale of business (large to micro). Few examples of widespread industry investment in property-level flood protection where buildings are owned, and otherwise dependent on the third-party building owner. Emergency management and business continuity practices are industry-standard, typically designed to meet minimum operating requirements over a short duration. Unclear as to level of adoption of onsite back-up energy supply (generators). Ensuring the resilience of domestic and global supply chains is an important focus of the manufacturing industry, given vulnerability to unanticipated events and shocks including those that are climate-related (e.g. dependence on shipping and air transport, specialized inputs sourced from specific locations spread worldwide, and reduced inventories tied to just-in-time production).	Emergency and crisis management, and business continuity positions are common in larger organizations, not common in smaller organizations. Back-up power supply is more common across all organization sizes, and where buildings are leased, due to building leasing arrangements is often not within the company direct control.	Emergency and crisis management, and business continuity management systems are common in larger organizations, not as common in smaller organizations.	High complexity. Large number, large number of sub-sectors and heterogeneity of size of industry companies. Heavy reliance on third-parties (electricity supply, leasing building owner) to implement risk mitigation and resilience measures on behalf of industry companies. Complexity of local and global just-in-time supply chain exacerbates risk of supply chain disruption and impact to materials/inputs availability
Adaptive Capacity Rating	**Medium (4)**	**Medium (4)**	**Medium (4)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Mining, Quarrying and Oil/Gas Extraction

Table 10.30: PCCIA Adaptive Capacity Rating for Mining, Quarrying and Oil/Ga Extraction

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Water risk (e.g. extreme precipitation, water availability and drought, freshet, tailings ponds, waste rock) is being assessed and managed for select locations using available hydro-meteorological and climate data and projections. Watershed mass balance analysis and site water management/conservation practices are industry standard across the industry life-cycle (new/expansion, construction, operation, reclamation, closure, adaptive management and long-term care & maintenance).Examples of extractive companies with sites in Ontario conducting climate change risk assessments and development of adaptation/resilience.	Hydrological expertise (in-house and contracted) is standard within industry, with surface water management/ conservation/ optimization strategies a common practice for production operations. Permits are required to take and discharge water. Guidance on conducting climate change risk assessment and adaptation planning prepared by Golder for the Mining Association of Canada, available as a knowledge resource for mining companies and their consulting engineers.	Water conservation and management practices, plans and systems are common for producing mine sites. Permits are required to take and discharge water for mining, quarrying and oil & gas activities.	Moderate complexity, Moderate number, differences between sub-sectors, and heterogeneity of size of industry companies. While water conservation and re-use technologies and practices are available, these approaches have limits in ability to mitigate significant loss/disruption in availability of water for industrial production
Adaptive Capacity Rating	**High (16)**	**High (16)**	**Medium (4)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Retail Trade

Table 10.31: PCCIA Adaptive Capacity Rating for Retail Trade

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	AC is highly dependent on the size and scale of business (large to micro). Industry owned and leased buildings typically designed to code and for the climate that existed when they were built, so are not necessarily equipped to cope with current and future climates (e.g. ensuring structural stability and limiting heat gain). Highly dependent on size and scale of business (large to micro). Few examples of widespread industry investment in property-level flood protection where buildings are owned, and otherwise dependent on the third-party building owner. Emergency management and business continuity practices are industry-standard, typically designed to meet minimum operating requirements over a short duration. Unclear as to level of adoption of onsite back-up energy supply (generators). Ensuring the resilience of domestic and global supply chains is an important focus of the retail industry, given vulnerability to unanticipated events and shocks including those that are climate-related (e.g. dependence on shipping, air and marine transport, food and goods sourced from specific locations spread worldwide). For food retailers, a study by City of Toronto identifies key climate stresses/shocks to GTHA regional food system, and high vulnerability and moderate Adaptive Capacity across food system value chain.	Emergency and crisis management, and business continuity positions are common in larger organizations, not common in smaller organizations. Back-up power supply is more common across all organization sizes, and where buildings are leased, due to building leasing arrangements is often not within the company direct control.	Emergency and crisis management, and business continuity management systems are common in larger organizations, not as common in smaller organizations.	High complexity. Large number, large number of sub-sectors, and heterogeneity of size of industry companies. Heavy reliance on third-parties (electricity supply, leasing building owner) to implement risk mitigation and resilience measures on behalf of industry companies. Complexity of local and global just-in-time supply chain exacerbates risk of supply chain disruption and consumer product availability
Adaptive Capacity Rating	**Medium (4)**	**Medium (4)**	**Medium (4)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Transportation Economy

Table 10.32: PCCIA Adaptive Capacity Rating for Transportation Economy

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Local and long-distance commercial road transportation vehicle/fleet owners and operators deal with short-duration extreme climate events in the normal course of doing business. Vulnerability is highly influenced by public and private road network infrastructure design, construction and maintenance standards and practices (see Infrastructure Area of Focus for a description). Industry in Northern Ontario is taking steps, in partnership with provincial government, communities, and industries that are reliant on road transport for materials and product transport (e.g. mining) to address impacts of temperate increase on winter ice roads (shortened season, decreased ice thickness). Industry is taking steps to address extreme heat (prolonged heat events) in relation to refrigeration of heat-sensitive commodities and materials (e.g. resins). Commercial marine transportation and shipping (inter and intra-Great Lakes, St. Lawrence Seaway) vessel owners and operators, as well as port and canal/lock authorities (see Infrastructure Area of Focus for port infrastructure discussion) deal with short-and-medium duration extreme climate events in the normal course of doing business (sea ice extent/ice breaking, extreme storm events, high and low water levels). Climate-resilient business practices are standard such as flexible fleet composition (ocean carrier vessels, standard bulk carrier/laker), docking/loading/off-loading, vessel load lightening, and coordination with provincial/state regulators regarding water levels. Commercial rail transportation and shipping owners and operators deal with short-duration extreme climate events in the normal course of doing business, in relation to interactions with rolling stock, power units, and track and building infrastructure. Insufficient evidence regarding the extent to which long-term changes (e.g. extreme precipitation and flooding trends, wildfire regime, permafrost degradation - ONR/Cochrane to Moosonee) are being factored into asset management and capital investment planning. Commercial air transportation and shipping owners and operators deal with short-duration extreme climate events in the normal course of doing business, in relation to interactions with aircraft/aeroplane fleet (see Infrastructure Area of Focus for a description of airport/aerodrome infrastructure). Instrument landing systems and other innovations allow aircraft to fly safely in difficult weather conditions, and aircraft are grounded in conditions considered unsafe for flight.	Insufficient evidence to ascertain how local and long-distance transport operators are addressing potential changes in climate change-related exposure to disruption of road networks and operating conditions	Insufficient evidence to ascertain how local and long-distance transport operators are addressing potential changes in climate change-related exposure to disruption of road networks and operating conditions	High complexity. Large number, and heterogeneity of size of industry companies. Business risk is indirect, and is a result of direct impacts to road transport infrastructure/network (damage, degraded infrastructure performance)
Adaptive Capacity Rating	**High (16)**	**Medium (4)**	**Medium (4)**	**Low (1)**
Overall Level 1 Adaptive Capacity Ranking	**Medium (4)**			

Utility Services

Table 10.33: PCCIA Adaptive Capacity Rating for Utility Services

Category	Technology	Resource Availability	Governance	Sector Complexity
Qualitative Analysis	Technical studies have been completed on the impact of warming of water intake on nuclear and CCGT generation capacity, drought and reservoir capacity for hydro-electric generation and battery storage, wind and wind power generation. Toronto Hydro and Hydro Ottawa have undertaken vulnerability assessments (PIEVC) to understand climate risk to assets and infrastructure. Technology solutions exist to adapt/mitigate some of potential climate impact, depending on generation source and type. Transmission and distribution risk assessments and resiliency plans have been undertaken, addressing the vulnerability of above and below grade infrastructure.	Assets are long-lived and costly, with budgets approved by regulators based on accepted rate structures - challenge is to successfully integrate the business case (e.g. cost effective solutions) for asset hardening/technology innovation in multi-year regulated budgets. Varied in-house capabilities for climate modelling (reliance on external climate service providers). Companies have a range of methods that can be used to mitigate/enhance system resilience and reliability for near term events.	Electricity is a regulated industry in Ontario, and capital investment/asset renewal plans are prioritized in the context of regulator approval of budgets. The Canadian Electricity Association has a 'Climate Change Adaptation Working Group' that provides guidance to member utilities on climate change risks and adaptation measures.	Moderate complexity (full electricity value chain). The complexity of sub-sectors is relatively low, with OPG and Bruce Power providing nuclear and CCGT generation supported by renewable IPPs, Hydro One for transmission, and 60 LDC's (local/regional).
Adaptive Capacity Rating	**High (16)**	**High (16)**	**Medium (4)**	**Medium (4)**
Overall Level 1 Adaptive Capacity Ranking	**High (16)**			

Appendix 11: Regional Adaptive Capacity Assessment

Far North Region

Table 11.1: PCCIA Adaptive Capacity Rating for Far North Region

Adaptive Capacity Category	Technology	Resource Availability	Sector Complexity
Qualitative Analysis	Due to the remote nature of the communities in the Far North region, low population count, and lower commercial activity, there have been fewer major investments into the development of technological advances in the area aside from those made towards industrial and mining operations. However, due to the recent and current unique challenges presented in the North including melting permafrost, winter road deterioration, etc., more technological investment is being made made towards adaptation to these challenges. Moreover, The Far North Land Use Strategy provides details regarding plans to enable sustainable economic development in the region while also maintaining the biological diversity and ecological processes of natural areas.	Ontario's Far North is home to some of the richest and biodiverse ecosystems, including the world's largest intact boreal forest area. As a significant carbon sink with highly productive wetlands, these natural systems are vital in managing the pace and impact of climate change. The presence of a skilled and mobile labour force is lacking as the region has a relatively small population compared to other regions. Communities are mostly remote and many are only accessible by air or winter roads. Recently, the Ontario Government invested $ 6 million into winter road building in the Far North which will help maintain the connectivity between the communities in the region, and potentially increase skilled labour. In general, however, Northern Ontario has the lowest GDP per capita and low labour force compared to other regions. Additionally, economic development in the far north is limited. Therefore, despite the high level of natural resource availability, the overall adaptive capacity of the region is medium due to economic and human resource limitations	The Far North region of Ontario is home to 31 First Nation communities, 2 municipalities (Pickle Lake and Moosonee), and 1 community with a Local Service Board (Moose Factory). A total of 34 communities is a relatively small number of governing bodies relative to many of the other regions under investigation. Traditionally, First Nations communities and community values represent a deep connection to the natural world; as our climate changes, Indigenous Peoples' deeply rooted environmental understanding and knowledge can support development of innovative adaptation planning. Politically, there are federal and provincial parties that have yet to publicly acknowledge human-caused climate change; Indigenous communities are more likely to take action against climate change both from a mitigation perspective, and adaptation.
Adaptive Capacity Rating	**Low** (1)	**Medium** (4)	**High** (16)
Overall Level 1 Adaptive Capacity Rating	**Medium** (4)		

Northwest Region

Table 11.2: PCCIA Adaptive Capacity Rating for Northwest Region

Adaptive Capacity Category	Technology	Resource Availability	Sector Complexity
Qualitative Analysis	Within the Northwest Region, the City of Thunder Bay is one of the larger municipalities in the region and serves as a hub for surrounding communities; it is the only municipality with a climate change adaptation strategy (as of August 2021). Strategies are currently being developed to further support innovation and economic development through the *Prosperity and Growth Strategy for Northern Ontario,* however actions therefrom have not yet been undertaken.	In terms of natural resources, Northwest Ontario features both the boreal forest and the Great Lakes-St. Lawrence forest region. Both biomes are home to a wide variety of flora and fauna, and both forests play an important role in managing climate change through carbon sequestration. Federal and joint Provincial/Federal funding programs exist to support infrastructure development in light of climate change, with the focus of climate change adaptation. More programs exist for transportation assets in the North. However, Northern Ontario in general features large numbers of small, rural and remote communities dispersed over a large territory with lower education and employment levels compared to provincial levels, and low level of immigration. Furthermore, communities lack required resources to attract business investments and expansion which can lead to a limited pool of a skilled and mobile labour force. This is further exacerbated by work force/skills mismatch, population decline and outmigration.	Northwestern Ontario consists of an estimated total of 112 communities with a significant Indigenous population, as 65 of those are First Nation communities. This number of municipalities/communities indicates moderate complexity. However, there is an opportunity for Traditional Knowledge to play an important role in adaptation planning and support large-scale planning at a regional level. As our climate changes, Indigenous Peoples' deeply rooted environmental understanding and knowledge can support development of innovative adaptation planning.
Adaptive Capacity Rating	**Low** (1)	**Medium** (4)	**High** (16)
Overall Level 1 Adaptive Capacity Rating	**Medium** (4)		

Northeast Region

Table 11.3: PCCIA Adaptive Capacity Rating for Northeast Region

Adaptive Capacity Category	Technology	Resource Availability	Sector Complexity
Qualitative Analysis	Within the region, mining and forestry are the two major industries present. Under the pressure from climate change, the federal government has invested into greener technologies in industrial processes. An example is the $4 million the federal government gave to Algoma Steel to improve the tar removal and light oil recovery areas of its coke-making plant to reduce emissions and improve ambient air quality. These economic activities are expected to grow in the coming years which can contribute to the continued growth and development of technological advances in the region.	In terms of natural capital, Northeast Ontario features a substantial amount of protected areas that include provincial parks and nature reserves across its districts. Many of which are located in the Algoma District. The presence of protected and biodiverse areas play a crucial role in maintaining more complex ecosystems that can withstand environmental disruption and stress, which is linked to the adaptive capacity of the region. In terms of human and financial capital, Northeast Ontario has three (3) notable learning institutions. Laurentian University , Algoma University, and Nipissing University. Laurentian University in particular has had substantial support from the government to further learning, research, and work regarding climate change adaptation. This includes the $841,000 investment made by the Minister of Natural Resources to support climate change adaptation capacity among Indigenous communities in the North, as well as the signing of an Affiliation Agreement with the Climate Risk Institute (CRI) which will open up new opportunities for collaboration, including student learning, research collaboration, and program development. This may be indicative of an upward trend in available skills and knowledge pertinent to the development of climate change adaptation. Coupled with the anticipated increase in major economic activities related to the mining and forestry industry, the increasing interest in applying greener technologies to the industries, as well as an anticipated growth in population for the larger communities such as Sudbury, this highlights an upward trend in the region's potential adaptive capacity.	Northeastern Ontario consists of 8 districts with at least 161 communities altogether. These include First Nation reserves, villages, townships, towns, and cities. In comparison with other geographic regions in this study, this number of communities, and therefore complexity of large-scale decision-making and policy development, is middle of the range. Several of the larger communities such as Greater Sudbury, City of Sault Ste. Marie, and Muskoka have developed strategies for addressing local climate change impacts. These strategies include developing and using land-use by-laws and permitting to create complete and compact communities, increasing reforestation effort of the Regreening Porgram, and periodically increase energy efficiency of new buildings until all new buildings in 2030 onward are Passive House energy efficient compliant. Since climate change adaptation is a relatively new development for many regions, these efforts can be expected to grow over time.
Adaptive Capacity Rating	**Medium** (4)	**Medium** (4)	**Medium** (4)
Overall Level 1 Adaptive Capacity Rating	**Medium** (4)		

Central Region

Table 11.4: PCCIA Adaptive Capacity Rating for Central Region

Adaptive Capacity Category	Technology	Resource Availability	Sector Complexity
Qualitative Analysis	The region's green sector is strong and growing rapidly under the current global, political, and social environment as people are realizing the value in protecting the environment and addressing climate change efforts. This cluster of key industries in one region could correlate to more opportunities for Research & Development and the development and application of more innovative technologies so that businesses can adapt to market disruptions caused by the changing climate. Multiple municipalities such as Peel Region, Oakville, Mississauga, and Toronto have completed or are in the process of developing climate action plans and strategies that identify opportunities to be taken towards climate change adaptation and mitigation. Green infrastructure, as a relatively new technology for flood control, is prevalent within the region as well. One example is the Don Mouth Naturalization and Port Lands Flood Protection Project which aims to create crucial flood protection and ecological habitat restoration, while integrating development, transportation, infrastructure, and a re-naturalized river mouth.	In terms of natural resources, there are approximately 8,595 ha of terrestrial natural habitat in Toronto. This habitat is found within the Natural Heritage System – a network of ravines, valleys and shoreline that contain protected forests, wetlands, valleys, beaches, bluffs, tall grass prairie and watercourses. Toronto has one of the world's largest ravine systems and systems in this vein are important in managing the region's hydrological cycle especially during heavy rainfall events. However, high population levels and increased demand on these natural systems for recreational and agricultural purposes, in addition to the heavy use of winter road salt across the GTHA, has resulted in a higher input of nutrients and contaminants into the Humber, Don, and Lake Simcoe watersheds, reducing their ability to provide major ecosystem services. Heavy rainfall and storm events have and will continue to cause high levels of flooding and erosion throughout Toronto's deteriorated waterways and ravine system, while also causing shoreline erosion across the Scarborough bluffs. In terms of human and financial capital, Central Ontario contains the GTHA which is home to approximately 7 million people. It contains several of Ontario's central business districts, major universities, hospitals, and enterprises. The region also exhibits high levels of education and employment signifying a large pool of skilled labour and the presence of a strong workforce that spans many occupational sectors including Information & Communications Technology, Natural & Applied Sciences, Finance & Business Administration, Life Science & Healthcare; Agri-Food; Building & Construction; etc. As one of Canada's business hub, Central Ontario/GTHA possesses a large pool of talent considering the fact that it is home to large universities with considerable investments into research and research application such as the University of Toronto, Ryerson University, and York University, and that the region continues to attract global talent beyond the GTHA. Despite the high level of human and financial resource availability, the deteriorated state of the natural resources in this region has reduced it's adaptive capacity score to medium.	Central Ontario is composed of some of the largest cities in Ontario. It consists of the Regional Municipalities Halton, Peel, York, and Durham and the City of Toronto, the City of Hamilton, and Simcoe County. The demographics in this region is highly diverse across approximately 52 communities ranging from townships to large cities. Central Ontario presents substantial regional complexity by the size and diversity of its demographics alone. It is the most densely populated and one of the fastest growing geographic areas in Canada. As such, decision making and policy generation for this geographic region would be highly siloed and would require significant consensus building across a wide spectrum of demographics in order to make consistent and widespread changes with respect to adaptation to climate change.
Adaptive Capacity Rating	**High** (16)	**Medium** (4)	**Low** (1)
Overall Level 1 Adaptive Capacity Rating	**Medium** (4)		

Eastern Region

Table 11.5: PCCIA Adaptive Capacity Rating for Eastern Region

Adaptive Capacity Category	Technology	Resource Availability	Sector Complexity
Qualitative Analysis	Key sectors in this region include education, agriculture, advanced manufacturing and materials technologies. Eastern Ontario's advanced technology companies support a wide range of industries from traditional to new; including aerospace, automotive, medical devices, telecommunications, industrials, energy, and mining to emerging technologies. Eastern Ontario is within proximity to key resources where companies tend to cluster in close geographic proximity, whether to profit from local knowledge flows, access to skilled workers or tap regional supplier networks. All of these translate to greater access to talent and greater availability of R&D expertise from within and neighbouring regions. This region is also an important business hub. It has excellent transportation linkages by road, rail and seaway between Canada and the U.S., including Canada's fifth busiest, U.S. border crossing: the Lansdowne/Alexandria (Thousand Islands Bridge), which connects to Interstate 81 and significant distribution centres. Eastern Ontario also possesses a key role in provincial and national energy generation. The region has access to substantial clean energy related resources - Co-operatives such as Ottawa Renewable Energy Co-operative; Companies such as iSolara Solar Power; Facilities such as the Wolfe Island Wind Facility. Eastern Ontario's green economy is broad based but has particular expertise in solar energy, wastewater treatment, smart grid, environmental services and green construction. There is a growing cluster of green economy companies such as Stratchcona Energy, Fabrack Solar, and EnviraMet. Moreover, as with many other regions in Ontario, funding programs; such as EcoAction Community Funding Program and the Ontario Community Environment Fund, are available to support local, municipal, and provincial action. These findings point towards high adaptive capacity with respect to technology and advancements for the major communities in the region.	Eastern Ontario is within proximity to key resources where companies tend to cluster in close geographic proximity, whether to profit from local knowledge flows, access to skilled workers or tap regional supplier networks. This is exemplified by the region's high accessibility to the GTHA via existing transportation networks. Key sectors in this region include education (6 universities and 7 community colleges), agriculture, and advanced manufacturing and materials technologies. All of these translate to greater access to talent and greater availability of R&D expertise from neighbouring regions. Additionally, as with many other regions in Ontario, funding programs; such as EcoAction Community Funding Program and the Ontario Community Environment Fund, are available to support local, municipal, and provincial action. Most recently in June 21, 2021, it was announced that an investment of $223,750 through the Federation of Canadian Municipalities' (FCM's) Green Municipal Fund (GMF) would be put towards helping reduce greenhouse gas (GHG) emissions and improve the quality of water and energy efficiency in cities and communities in Eastern Ontario.	Eastern Ontario is composed of 99 municipalities ranging from villages and townships of less than 1000 residents to larger cities. This region has the smallest number of census divisions in southern Ontario, suggesting a medium complexity.
Adaptive Capacity Rating	**High** (16)	**High** (16)	**Medium** (4)
Overall Level 1 Adaptive Capacity Ranking	**High** (16)		

Southwest Region

Table 11.6: PCCIA Adaptive Capacity Rating for Southwest Region

Adaptive Capacity Category	Technology	Resource Availability	Sector Complexity
Qualitative Analysis	This diverse region is one of the fastest growing in Canada. The Southwest region is home to complex construction projects, and large numbers of trade unions and special interest groups. It has the second highest number and dollar value of building permits in Canada after the Greater Toronto Area. Each fiscal year, the number of building permits issued for commercial, industrial and agricultural development in the region exceeds the number for the previous year. Several regions such as Niagara are witnessing emerging tech sectors, with an influx of technology and innovation companies setting up ventures in this region. Moreover, the manufacturing industry is also active in this region, due in large part to its proximity to the US border and access to high quality binational land-based transportation routes, water ways and air freight facilities. Technology hubs exist in this region, including the Bioindustrial Innovation Canada (BIC), which supports the implementation of sustainable solutions in areas ranging from wastewater remediation to creating fuel from agricultural waste. The "TechAlliance" group, based in this region, provides support to business for advancement of their technologies by supporting launches of new startups, accelerating growth for established tech companies, and attracting the next generation of tech talent and innovative entrepreneurs. Southwestern Ontario is a host for key large industries that greatly contribute to Ontario's economy and include significant R&D, suggestive of high potential technological adaptive capacity.	In terms of natural resources, Southwestern Ontario has high biodiversity that has unfortunately been in decline due to factors such as agricultural intensification over the last 3 decades, and urban growth. The region is home to 138 at-risk species of wildlife, 36 species of plants and animals considered rare globally and one plant — called Hooker's bugseed — believed to be found almost nowhere else. A study by the Nature Conservancy found much of the area that makes Southwestern Ontario (specifically The Lake Erie Lowland ecoregion) stand out is also one of the most altered regions in Canada, with only 14 per cent natural land cover left in the area and few large, intact blocks of natural habitat. In terms of human and financial capital, Southwestern Ontario is also home to several premier post-secondary institutions that continue to attract talent from around the country and the rest of the world. These institutions include Western University, and the University of Waterloo. In June of 2021, the Federation of Canadian Municipalities (FCM) announced a $1.2 million investment through the Green Municipal Fund for adaptation and mitigation projects in five communities in Southwestern Ontario. Communities in Southwest Ontario can also access funding for environmental restoration projects under the Ontario Community Environment Fund (OCEF). A 2021 grant amount of $306,151.65 is available to the region. Furthermore, the population of Southwestern Ontario is projected to grow up to 30% by the 2050s, which can translate to an increase in the available labour force in the region.	Southwestern Ontario is composed of 10 counties, 3 regional municipalities, 4 single-tier municipalities, and 13 separated municipalities that sit within various counties. This region has an estimated total of 17 census-divisions.
Adaptive Capacity Rating	**High** (16)	**High** (16)	**Medium** (4)
Overall Level 1 Adaptive Capacity Rating	**High** (16)		

Appendix 12: Combined Area of Focus and Regional Adaptive Capacity

Table 12.1: PCCIA Adaptive Capacity Score Matrix

Adaptive Capacity Score Matrix		Regional Adaptive Capacity Rating		
		Low (1)	**Medium** (4)	**High** (16)
Level 1 Adaptive Capacity Rating	**Low** (1)	**1**	**4**	**16**
	Medium (4)	**4**	**16**	**64**
	High (16)	**16**	**64**	**256**

Combined Adaptive Capacity	
1	Low
4	Lower
16	Medium
64	Higher
256	High

Table 12.2: PCCIA Adaptive Capacity for all Areas of Focus Level 1 Categories and Regions

Area of Focus	Level 1 Category	Central Region	Eastern Region	Far North Region	Northeast Region	Northwest Region	Southwest Region
Food & Agriculture	Field Crops	Medium	Higher	N/A	Medium	Medium	Higher
Food & Agriculture	Fruits and Vegetables	Medium	Higher	N/A	Medium	Medium	Higher
Food & Agriculture	Livestock	Medium	Higher	N/A	Medium	Medium	Higher
Infrastructure	Transportation	Medium	Higher	Medium	Medium	Medium	Higher
Infrastructure	Waste Management	Medium	Higher	Medium	Medium	Medium	Higher
Infrastructure	Utilities	Medium	Higher	Medium	Medium	Medium	Higher
Infrastructure	Pipeline Transportation	Medium	Higher	Medium	Medium	Medium	Higher
Infrastructure	Stormwater	Medium	Higher	Medium	Medium	Medium	Higher
Infrastructure	Buildings	Medium	Higher	Medium	Medium	Medium	Higher
Natural Environment	Flora	Medium	Higher	Medium	Medium	Medium	Higher
Natural Environment	Fauna	Medium	Higher	Medium	Medium	Medium	Higher
Natural Environment	Terrestrial Ecosystems	Medium	Higher	Medium	Medium	Medium	Higher
Natural Environment	Freshwater Ecosystems	Medium	Higher	Medium	Medium	Medium	Higher
Natural Environment	Regulating Services	Medium	Higher	Medium	Medium	Medium	Higher
Natural Environment	Provisioning Services	Medium	Higher	Medium	Medium	Medium	Higher
Natural Environment	Cultural Ecological Services	Medium	Higher	Medium	Medium	Medium	Higher
People & Communities	General Population	Medium	Higher	Medium	Medium	Medium	Higher
People & Communities	Housing/Unhoused	Lower	Medium	Lower	Lower	Lower	Medium
People & Communities	Health Care	Medium	Higher	Medium	Medium	Medium	Higher
People & Communities	Social Assistance	Lower	Medium	Lower	Lower	Lower	Medium
People & Communities	Indigenous	Lower	Medium	Lower	Lower	Lower	Medium
Business & Economy	Accommodation and Food Services	Medium	Higher	Medium	Medium	Medium	Higher

Area of Focus	Level 1 Category	Central Region	Eastern Region	Far North Region	Northeast Region	Northwest Region	Southwest Region
Business & Economy	Arts, Entertainment and Recreation	Medium	Higher	Medium	Medium	Medium	Higher
Business & Economy	Construction	Medium	Higher	Medium	Medium	Medium	Higher
Business & Economy	Financial and Insurance	Higher	High	Higher	Higher	Higher	High
Business & Economy	Forestry, Fishing and Hunting Economies	Medium	Higher	Medium	Medium	Medium	Higher
Business & Economy	Information and Cultural Industries	Medium	Higher	Medium	Medium	Medium	Higher
Business & Economy	Manufacturing	Medium	Higher	Medium	Medium	Medium	Higher
Business & Economy	Mining, Quarrying and Oil/Gas Extraction	Higher	High	Higher	Higher	Higher	High
Business & Economy	Retail Trade	Medium	Higher	Medium	Medium	Medium	Higher
Business & Economy	Transportation Economy	Medium	Higher	Medium	Medium	Medium	Higher
Business & Economy	Utility Services	Higher	High	Higher	Higher	Higher	High

Appendix 13: Level 1 Risk Profiles by Area of Focus

Food and Agriculture

Figure 13.1: Current and Future Risk Profiles for Field Crops (RCP8.5)

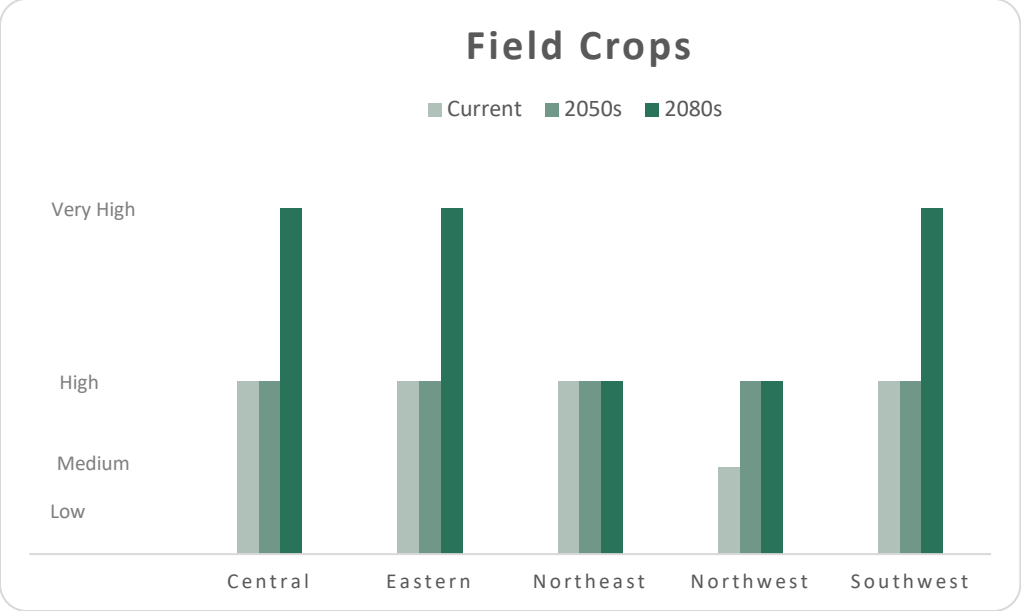


Figure 13.2: Current and Future Risk Profiles for Fruits and Vegetables (RCP8.5)

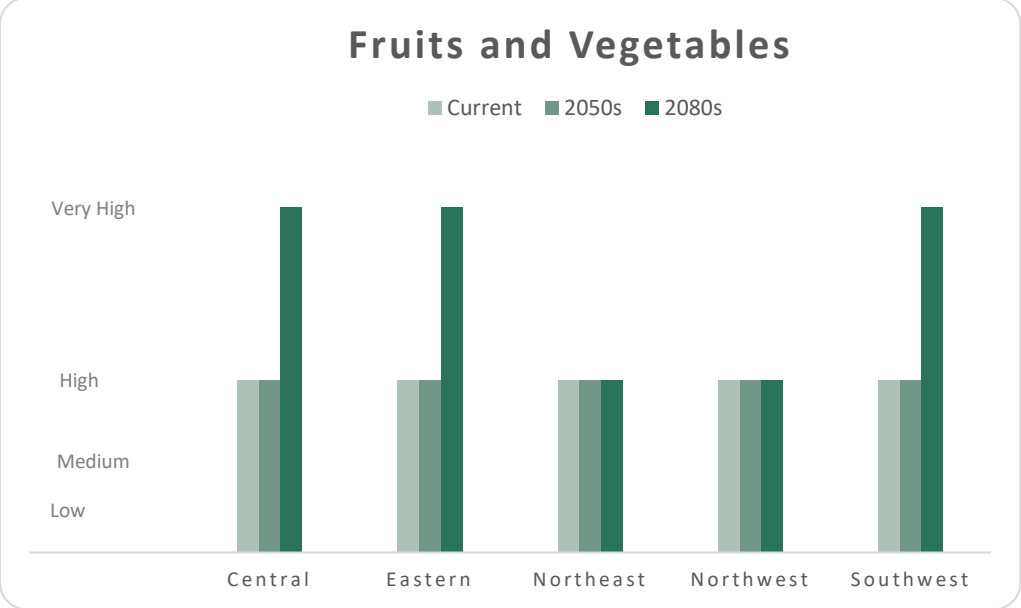
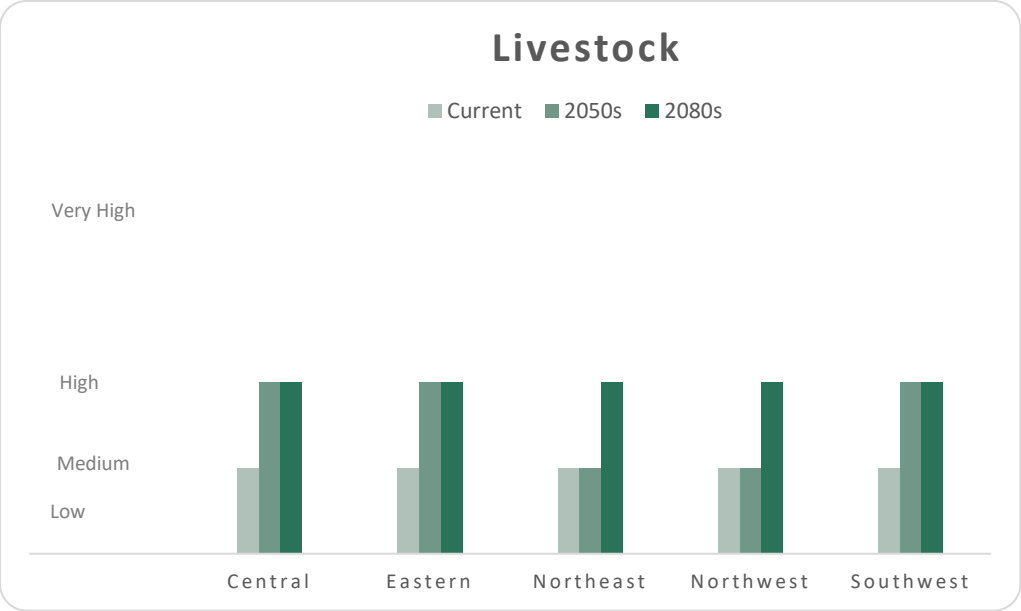


Figure 13.3: Current and Future Risk Profiles for Livestock (RCP8.5)



Infrastructure

Figure 13.4: Current and Future Risk Profiles for Buildings (RCP8.5)

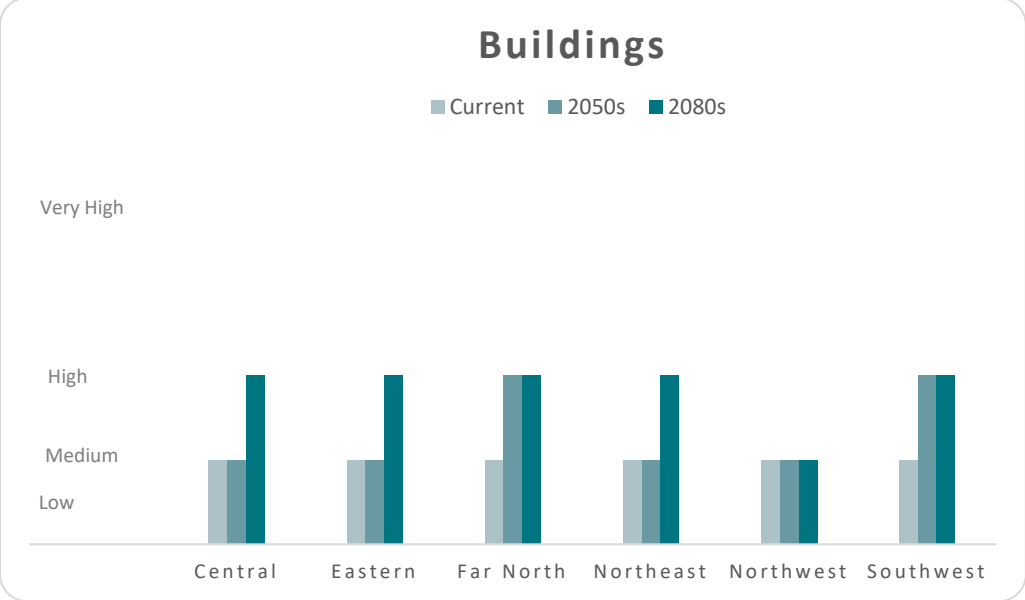


Figure 13.5: Current and Future Risk Profiles for Stormwater Management (RCP8.5)

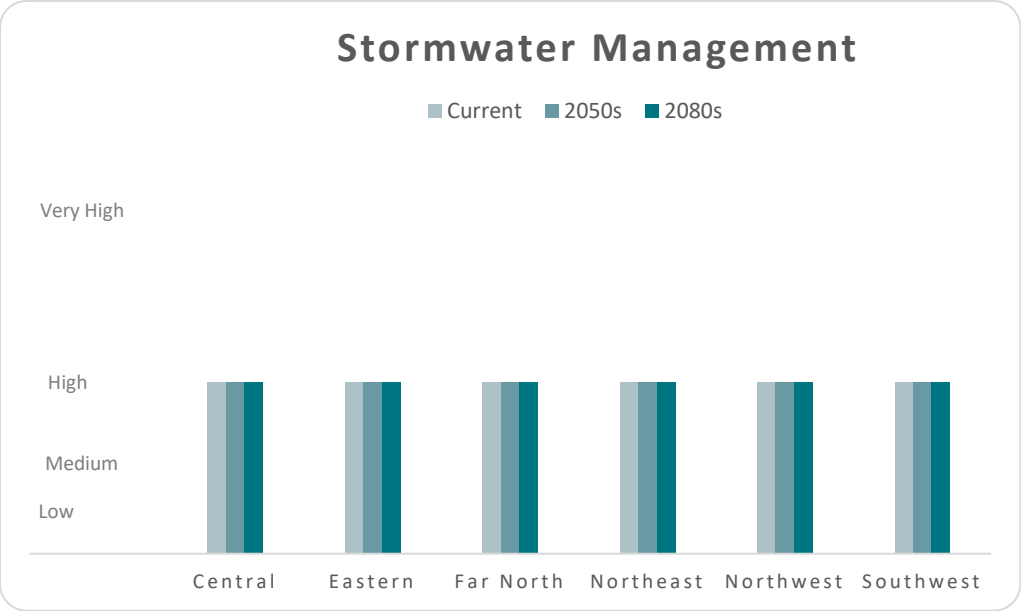


Figure 13.6: Current and Future Risk Profiles for Transportation (RCP8.5)

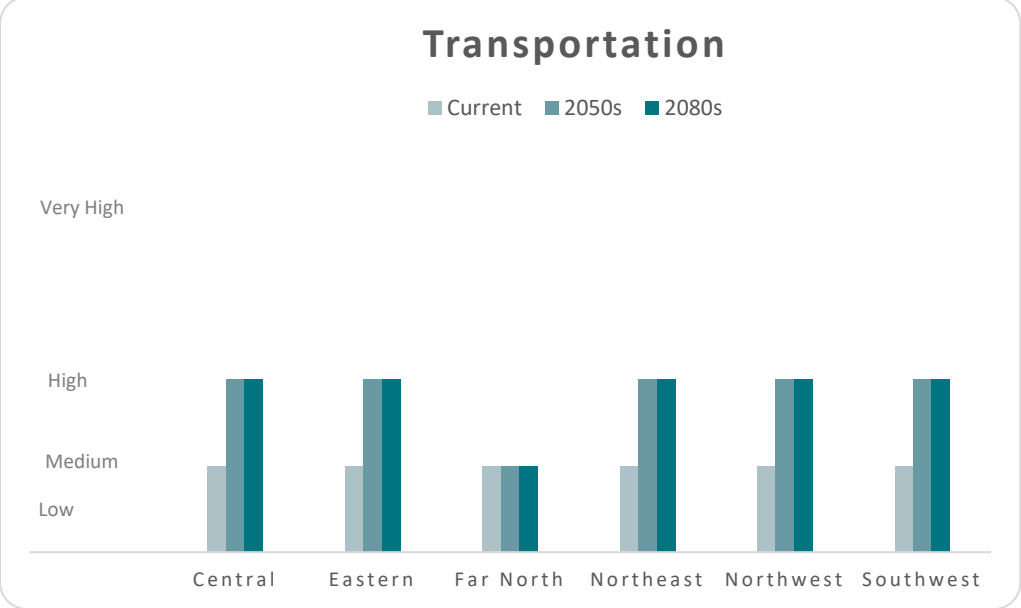


Figure 13.7: Current and Future Risk Profiles for Utilities (RCP8.5)

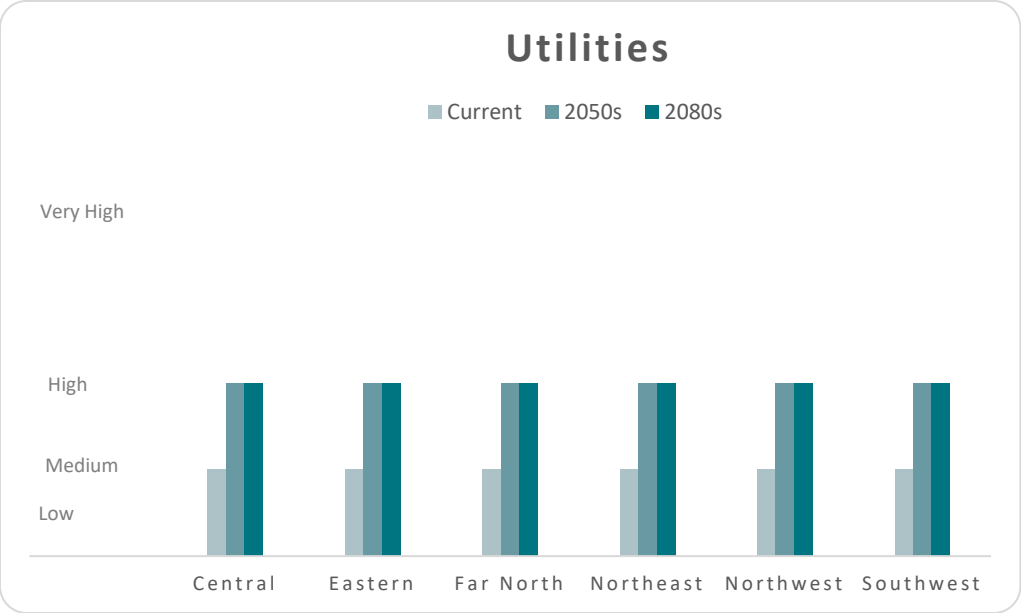


Figure 13.8: Current and Future Risk Profiles for Waste Management (RCP8.5)

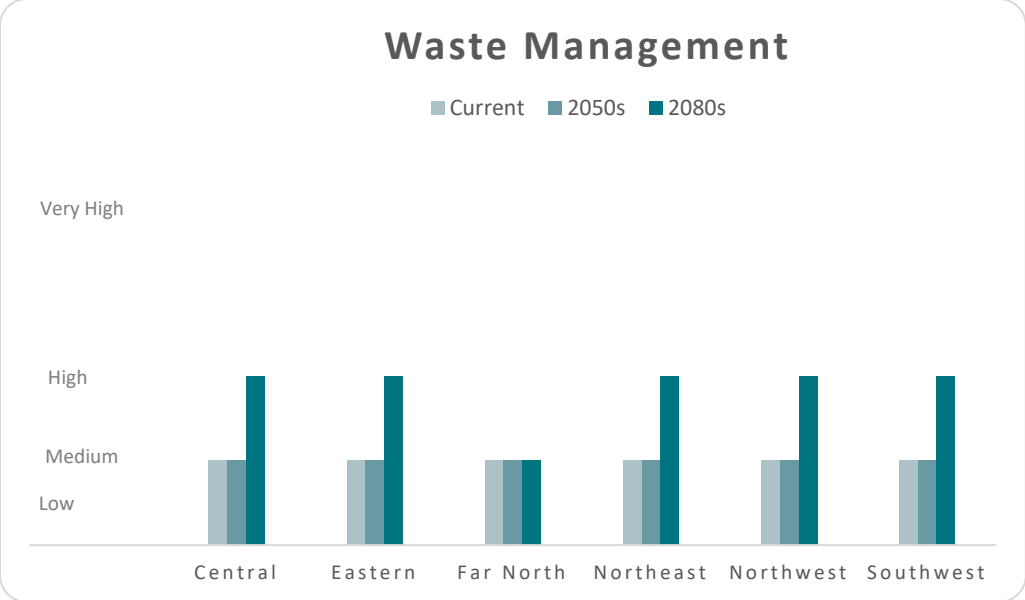
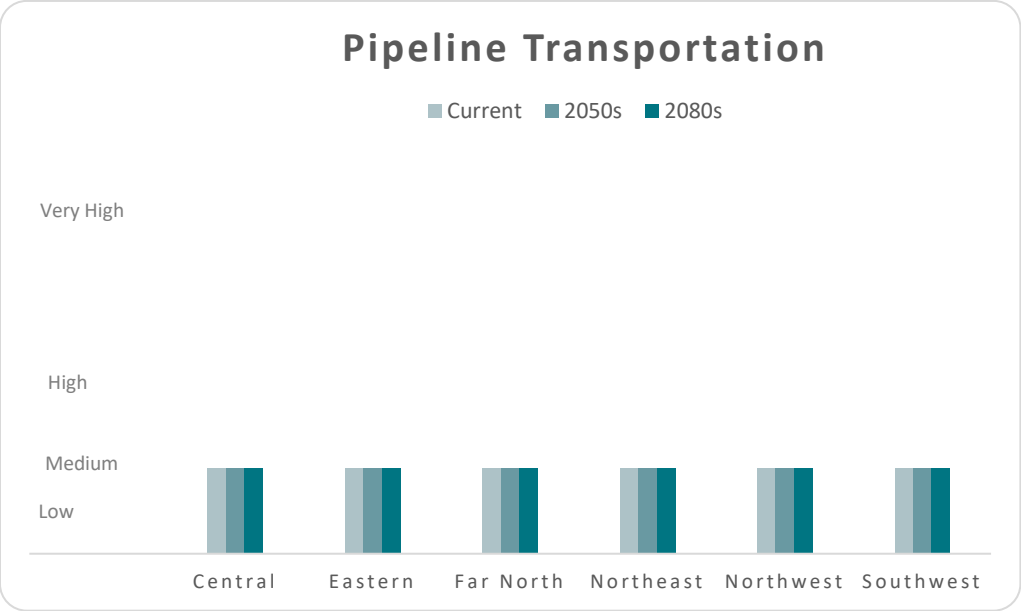


Figure 13.9: Current and Future Risk Profiles for Pipeline Transportation (RCP8.5)



Natural Environment

Figure 13.10: Current and Future Risk Profiles for Fauna (RCP8.5)

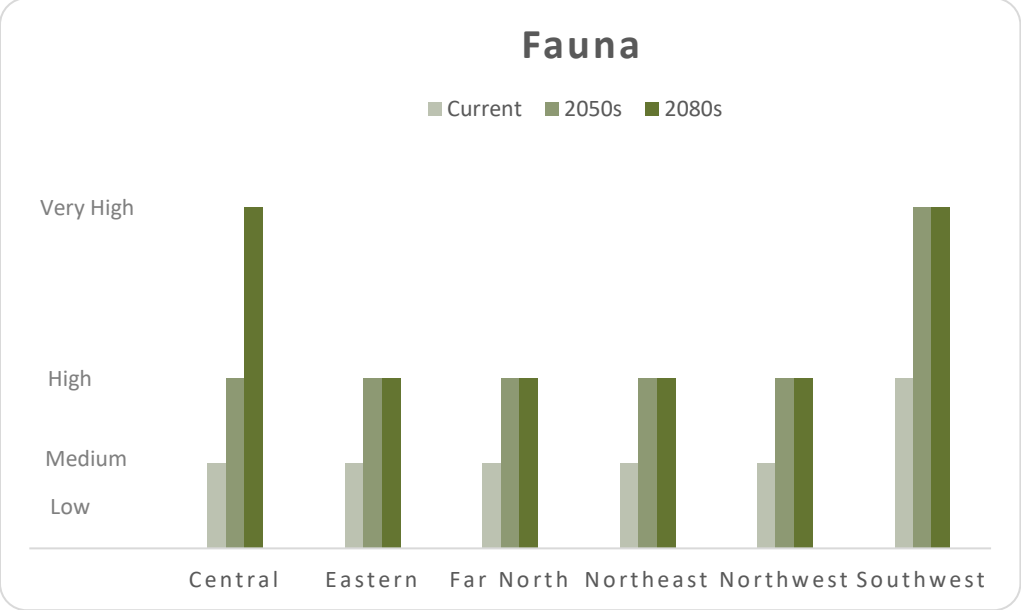


Figure 13.11: Current and Future Risk Profiles for Flora (RCP8.5)

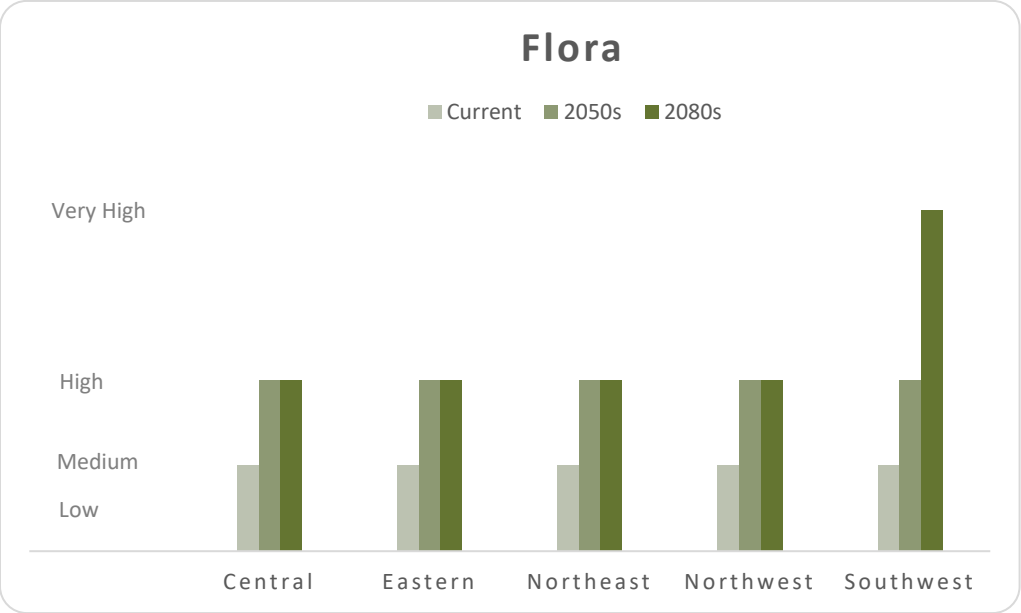


Figure 13.12: Current and Future Risk Profiles for Aquatic Ecosystem (RCP8.5)

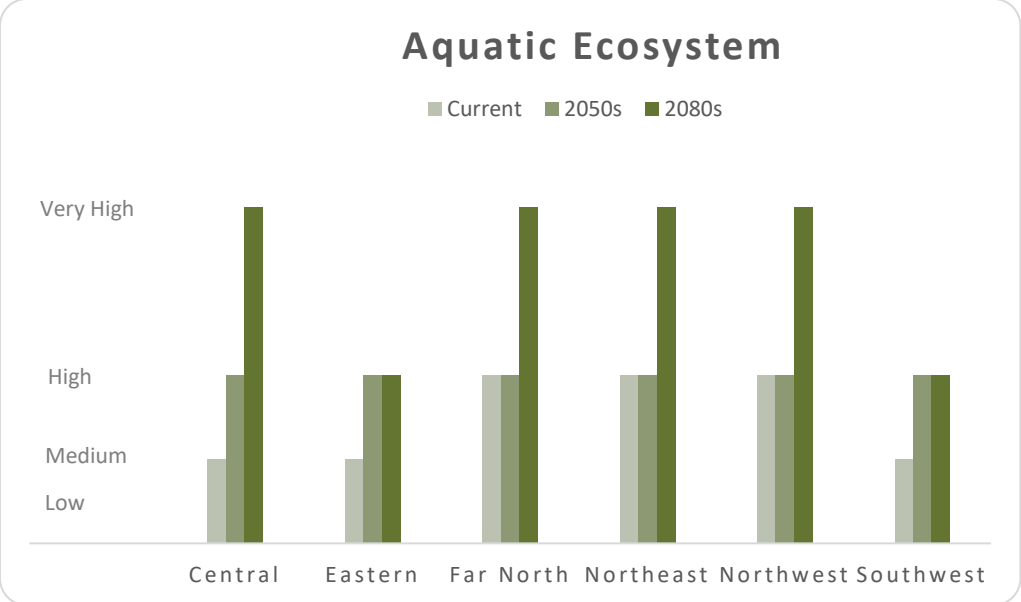


Figure 13.13: Current and Future Risk Profiles for Terrestrial Ecosystem (RCP8.5)

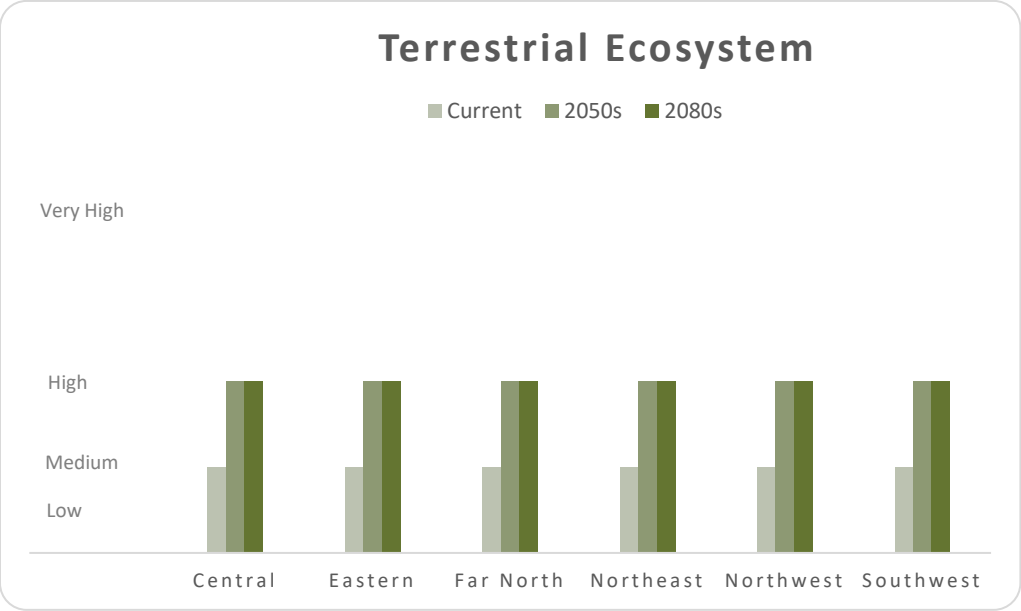


Figure 13.14: Current and Future Risk Profiles for Regulating Services (RCP8.5)

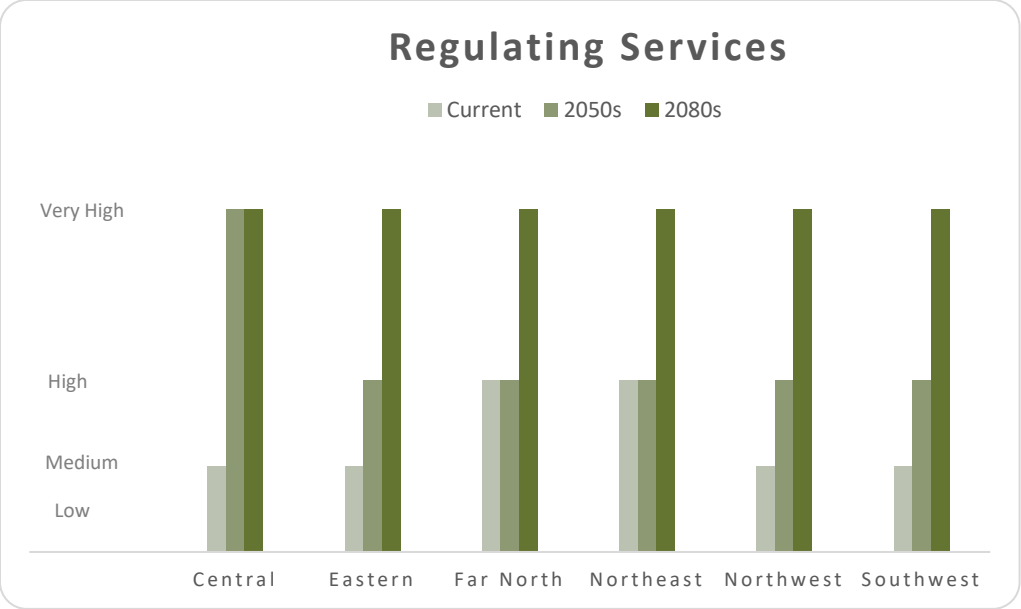


Figure 13.15: Current and Future Risk Profiles for Provisioning Services (RCP8.5)

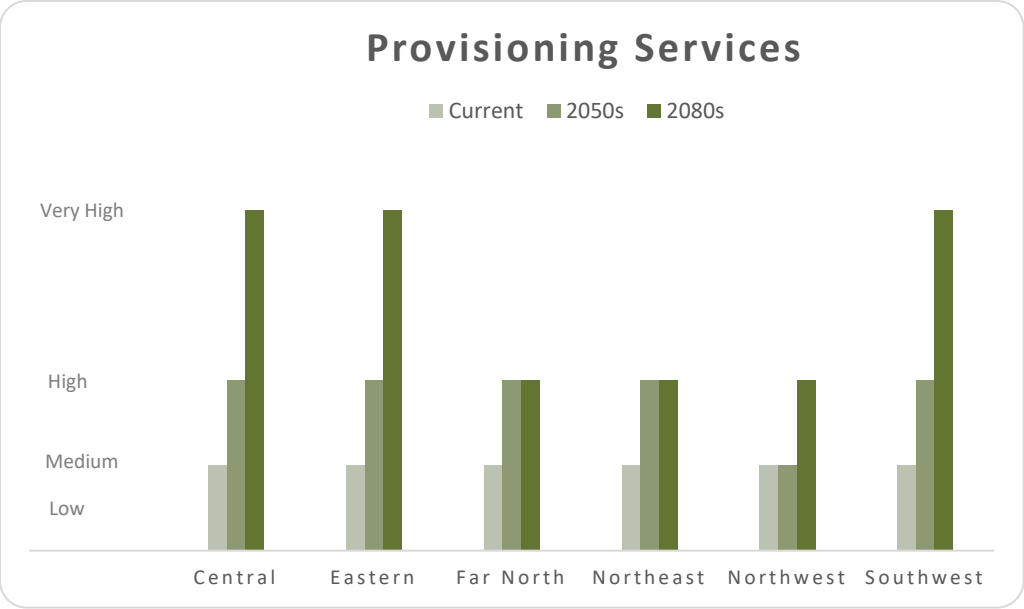
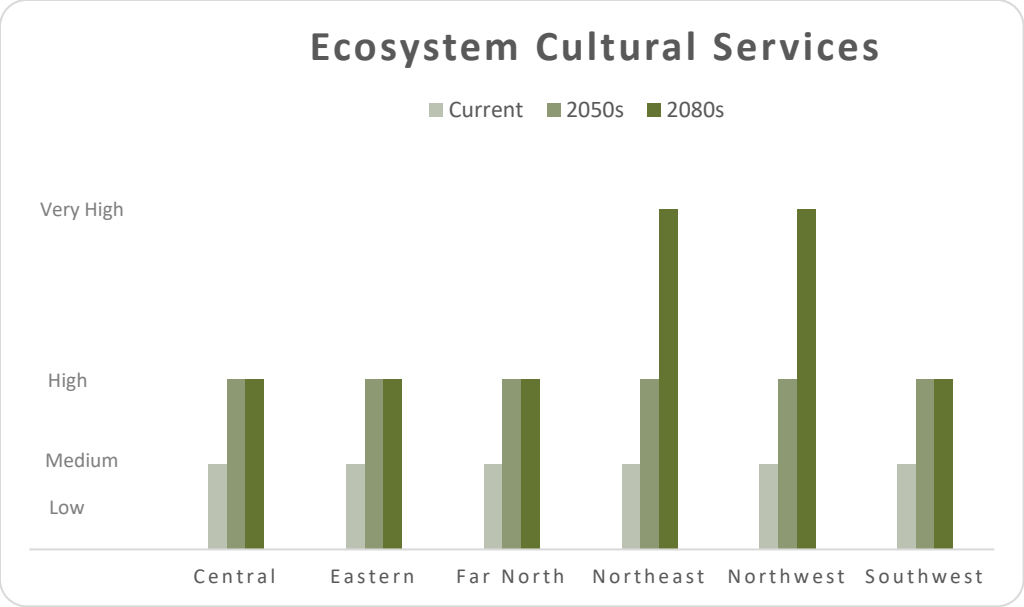


Figure 13.16: Current and Future Risk Profiles for Ecosystem Cultural Services (RCP8.5)



People and Communities

Figure 13.17: Current and Future Risk Profiles for Population (RCP8.5)

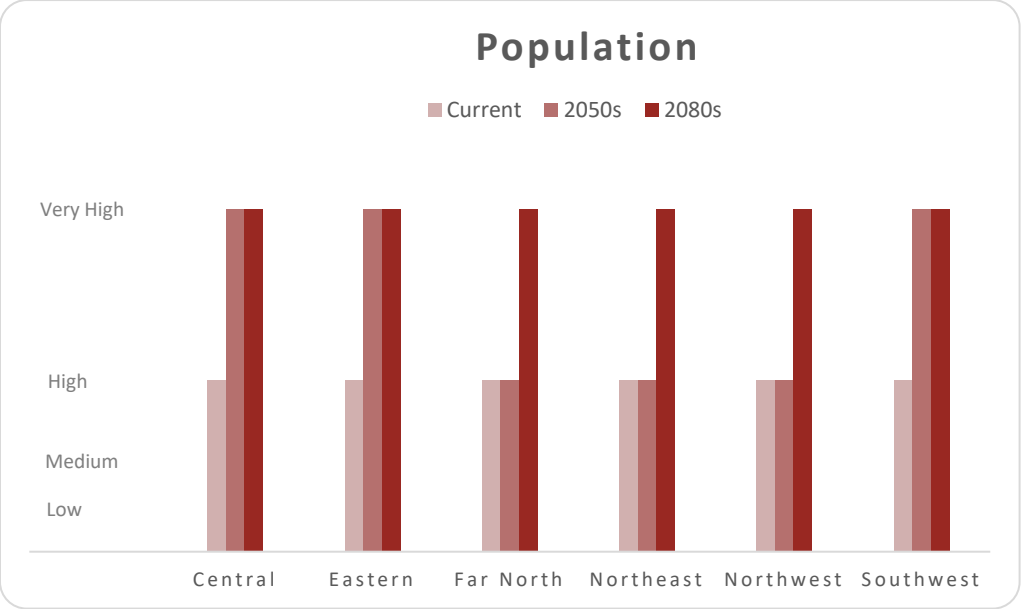


Figure 13.18: Current and Future Risk Profiles for Health Care (RCP8.5)

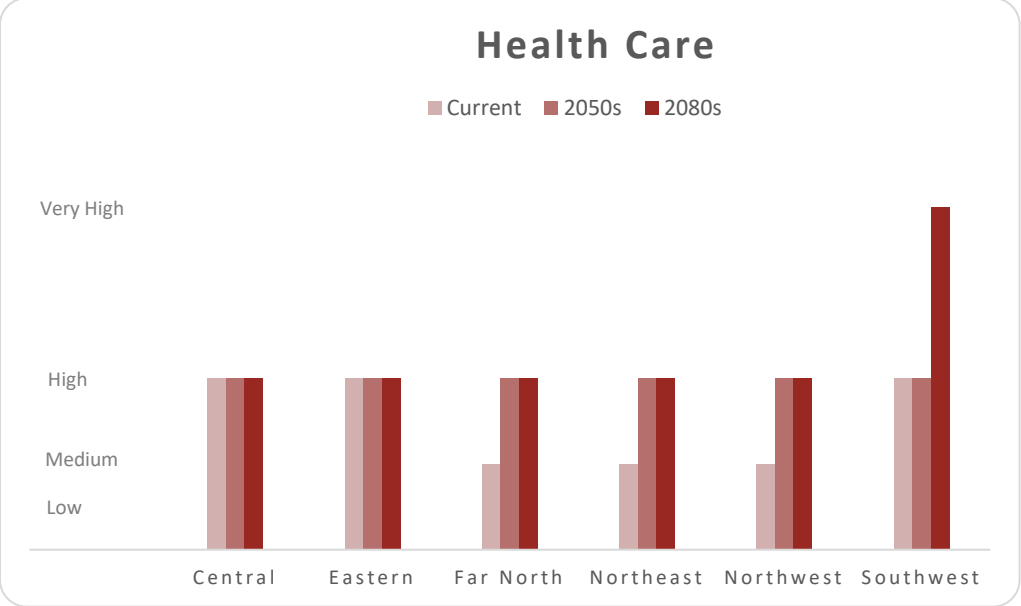


Figure 13.19: Current and Future Risk Profiles for Social Assistance and Public Administration (RCP8.5)

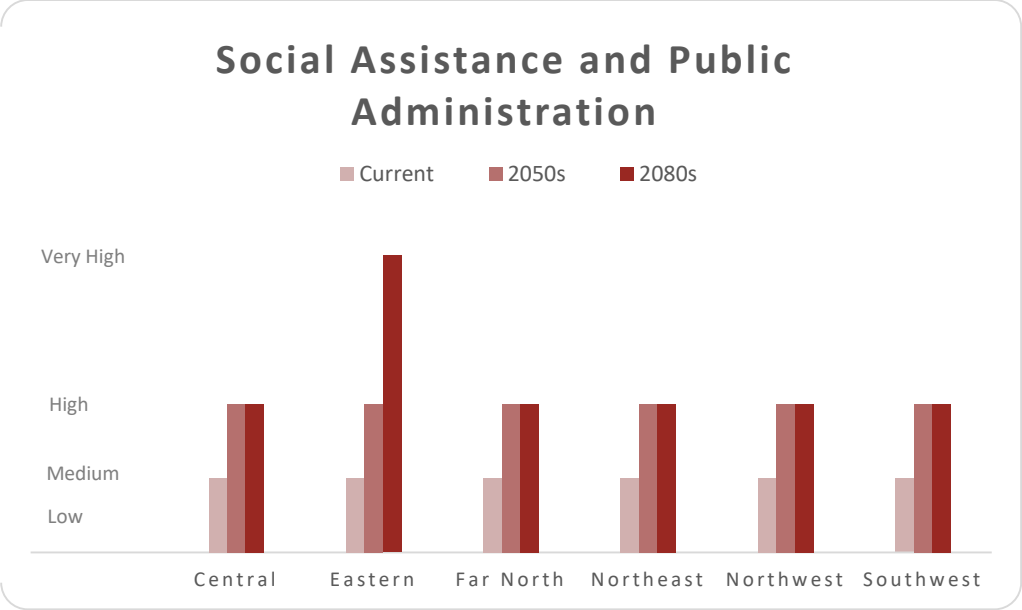
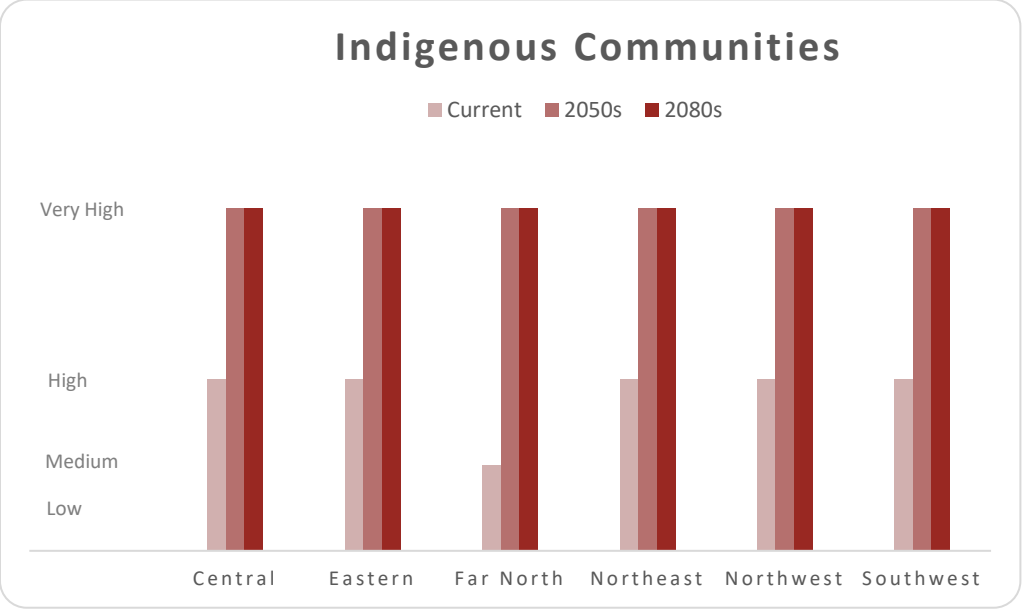


Figure 13.20: Current and Future Risk Profiles for Indigenous Communities (RCP8.5)



Business and Economy

Figure 13.21: Current and Future Risk Profiles for Accommodation and Food Services (RCP8.5)

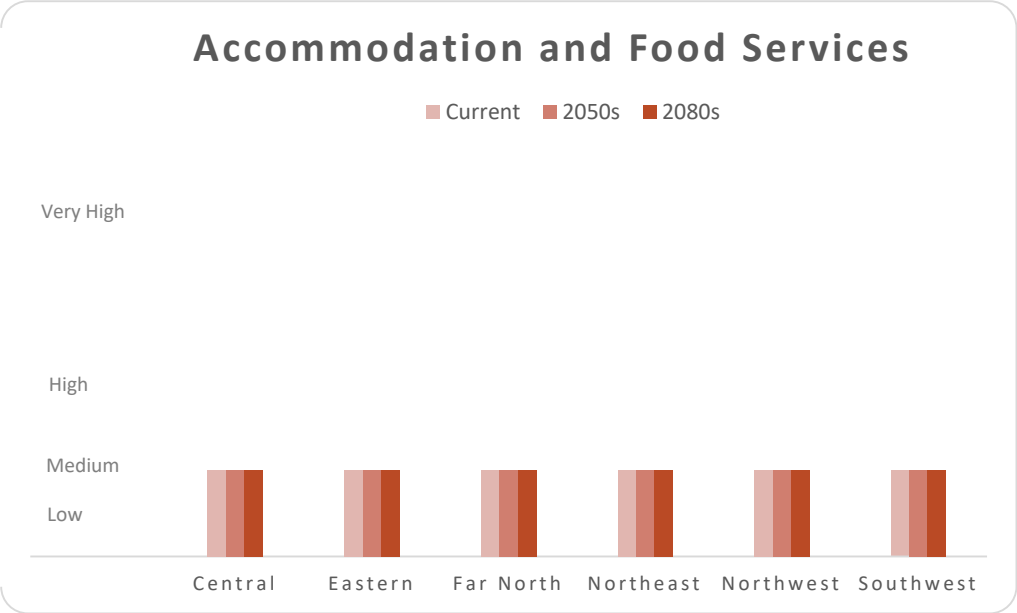


Figure 13.22: Current and Future Risk Profiles for Arts, Entertainment and Recreation (RCP8.5)

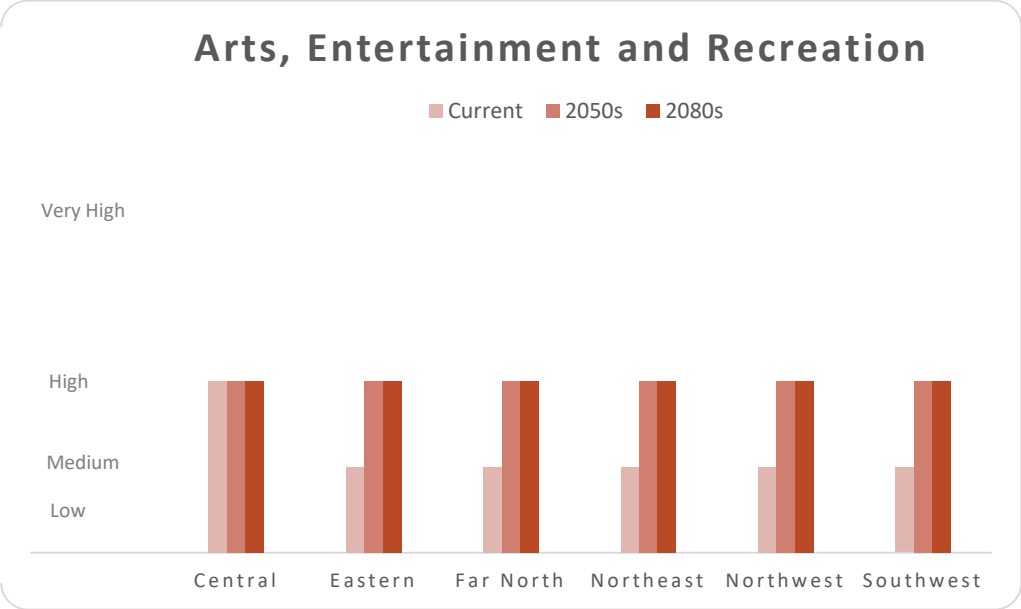


Figure 13.23: Current and Future Risk Profiles for Construction (RCP8.5)

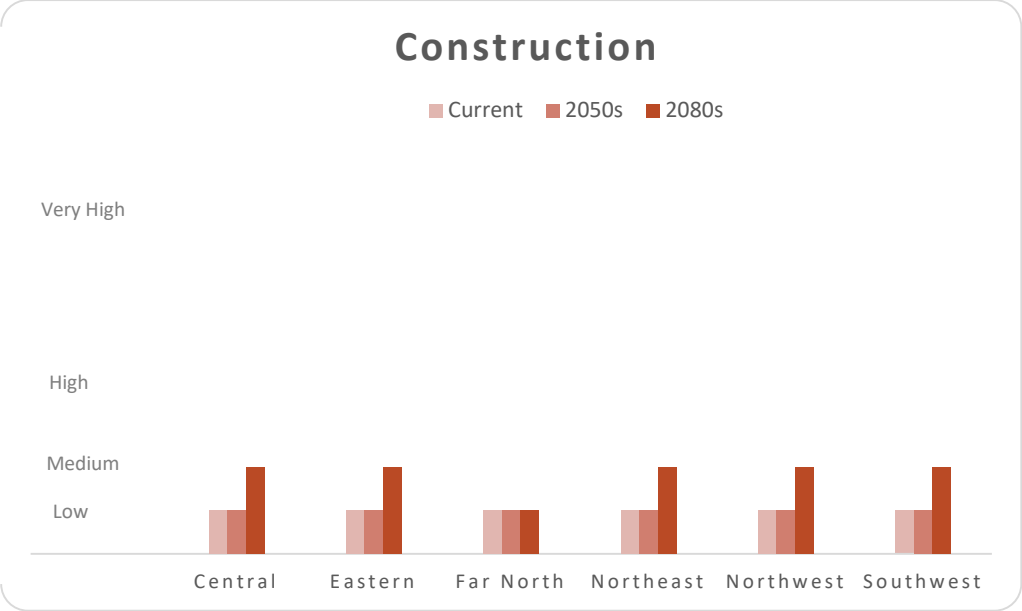


Figure 13.24: Current and Future Risk Profiles for Financial and Insurance (RCP8.5)

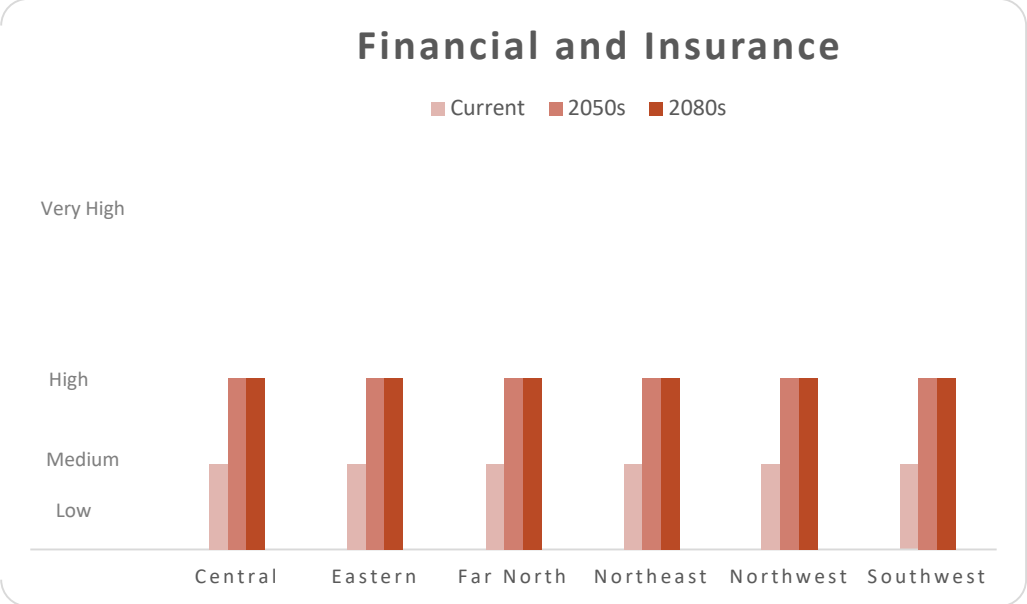


Figure 13.25: Current and Future Risk Profiles for Forestry, Fishing and Hunting Economies (RCP8.5)

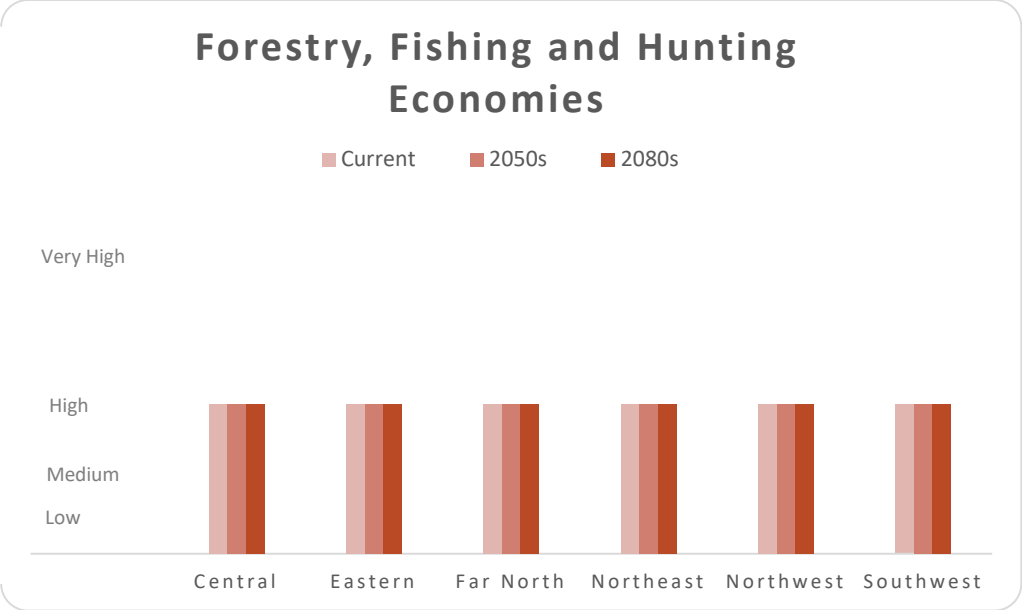


Figure 13.26: Current and Future Risk Profiles for Insurance and Cultural Industries (RCP8.5)

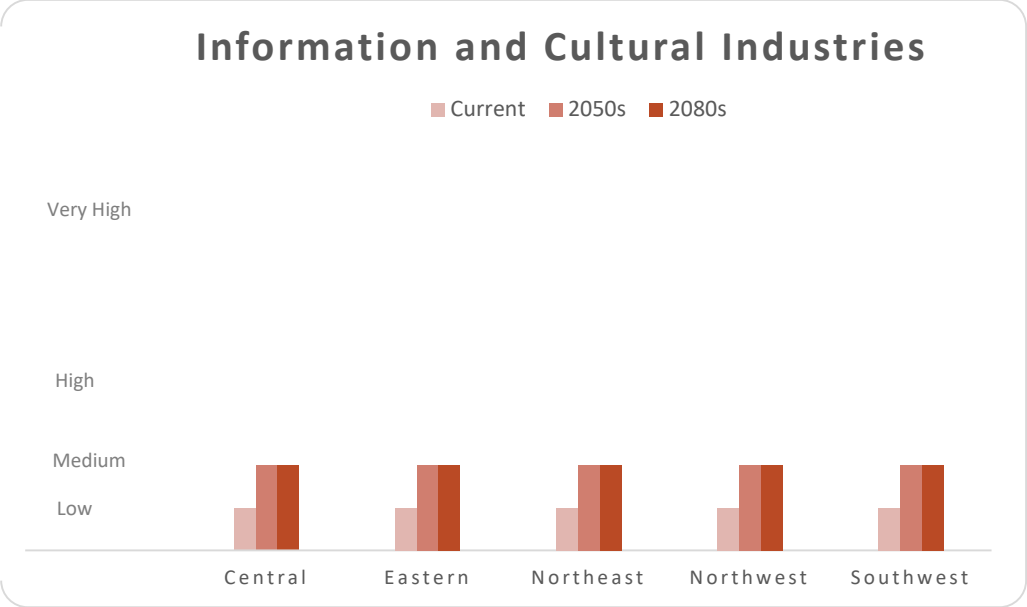


Figure 13.27: Current and Future Risk Profiles for Manufacturing (RCP8.5)

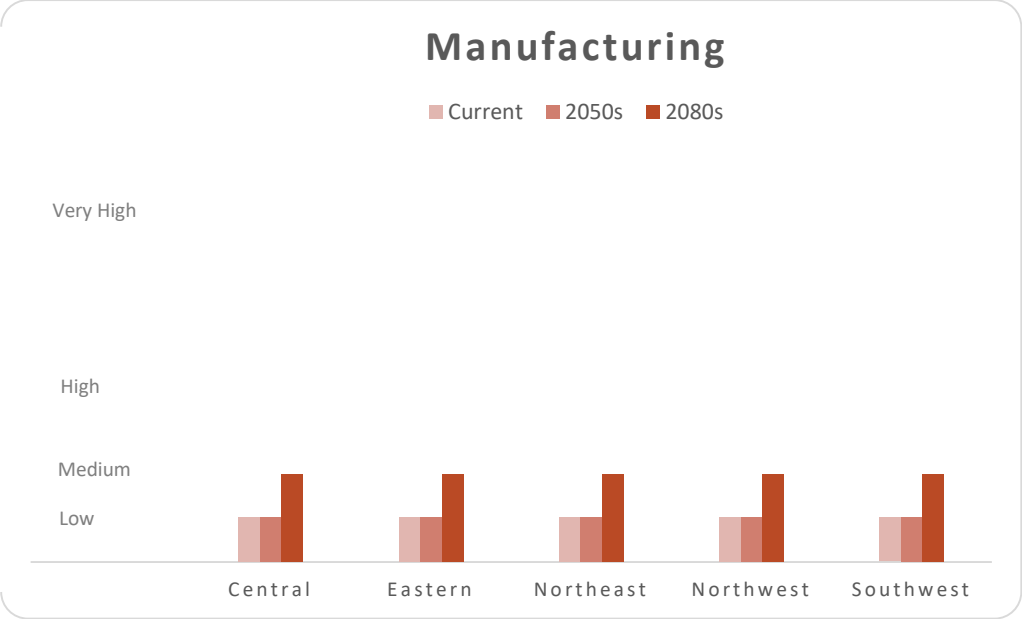


Figure 13.28: Current and Future Risk Profiles for Mining, Quarrying and Oil/Gas Extraction (RCP8.5)

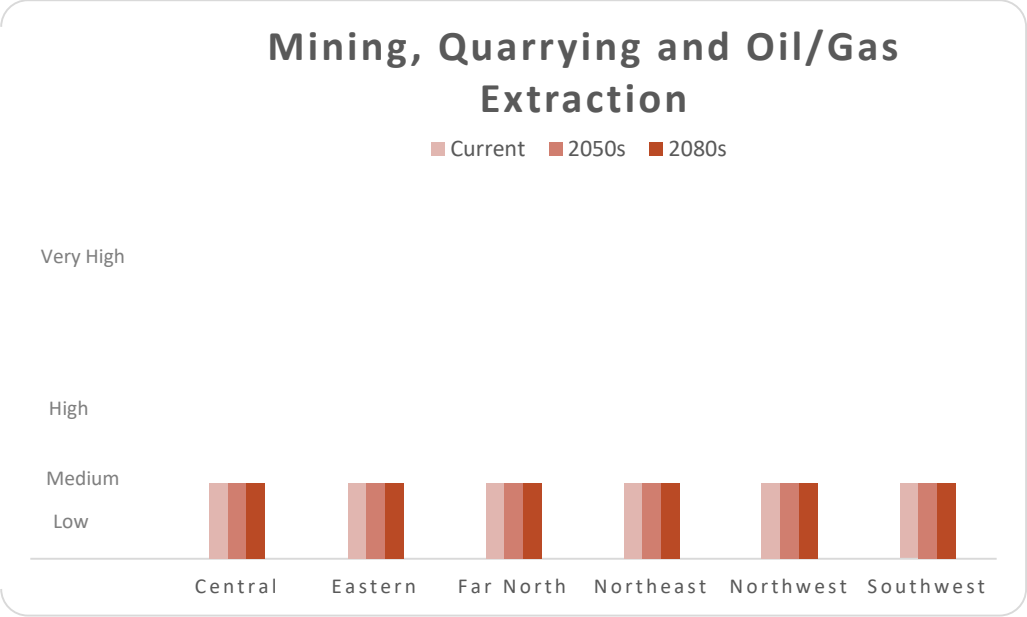


Figure 13.29: Current and Future Risk Profiles for Retail Trade (RCP8.5)

Figure 13.30: Current and Future Risk Profiles for Transportation Economy (RCP8.5)

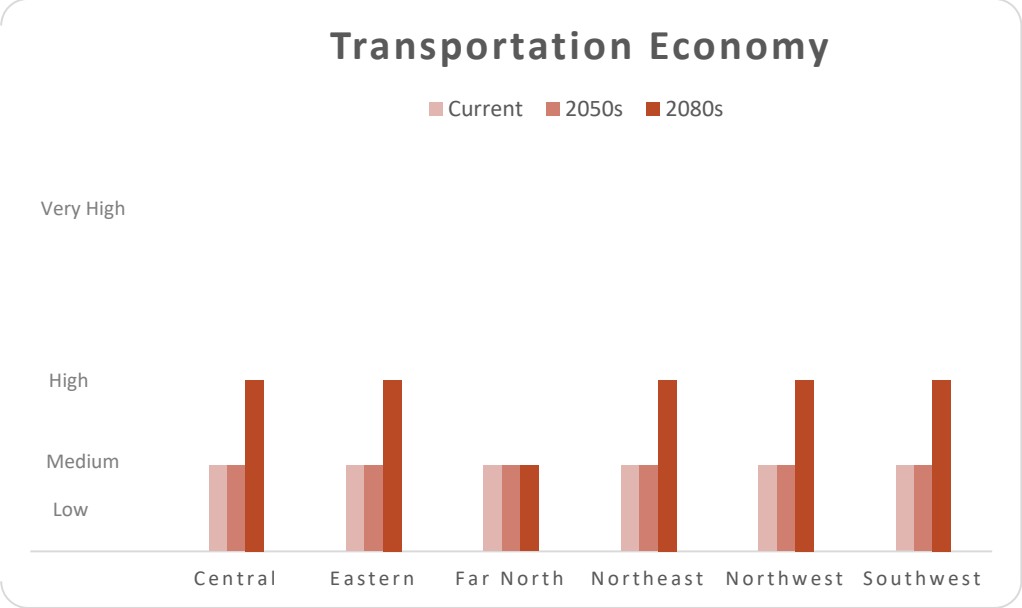
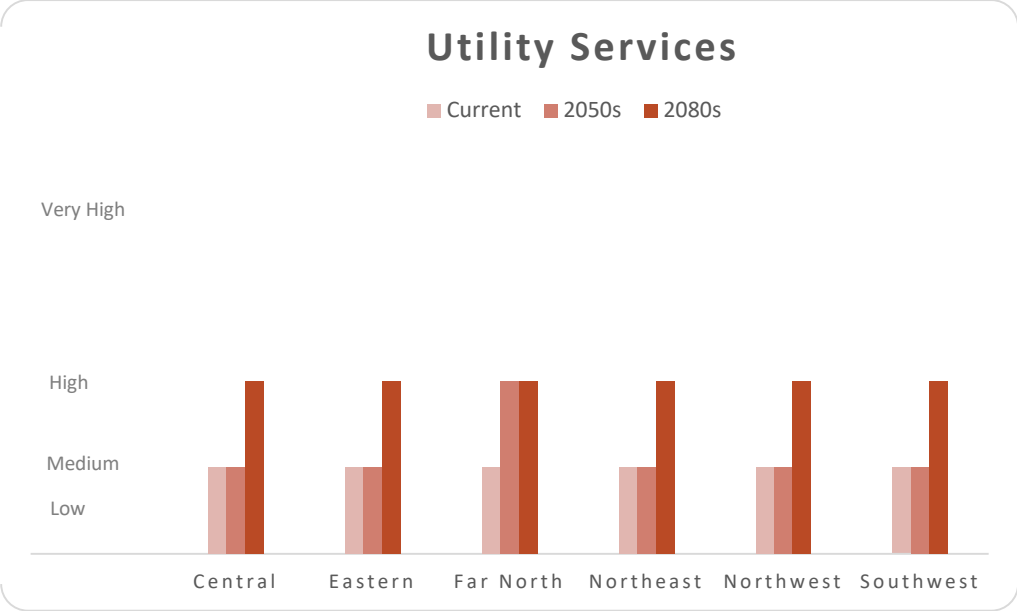


Figure 13.31: Current and Future Risk Profiles for Utility Services (RCP8.5)



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