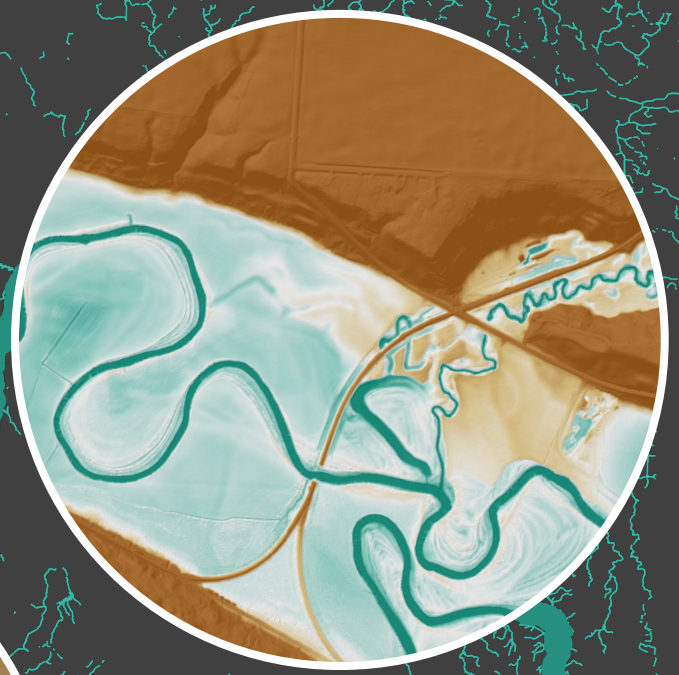
Taking Notice to Take Action:
Integrating Environment, Community, and Health



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A Health in the Watershed Atlas of the Battle River and Sounding Creek Watersheds

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Disclaimer

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Environment Community Health Observatory Network | Réseau observatoire sur l'environnement les communautés et la santé

CIHR IRSC Canadian Institutes of Health Research | Instituts de recherche en santé du Canada

the Prentice Institute for Global Population and Economy

Battle River Watershed Alliance

University of Alberta Alberta Centre for Sustainable Rural Communities

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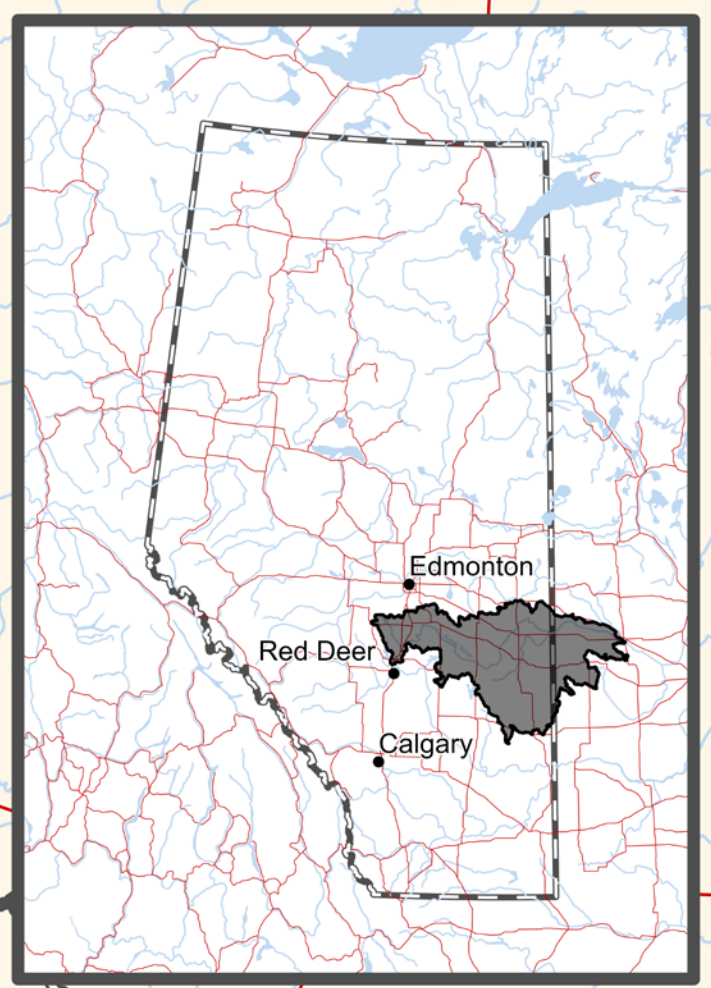

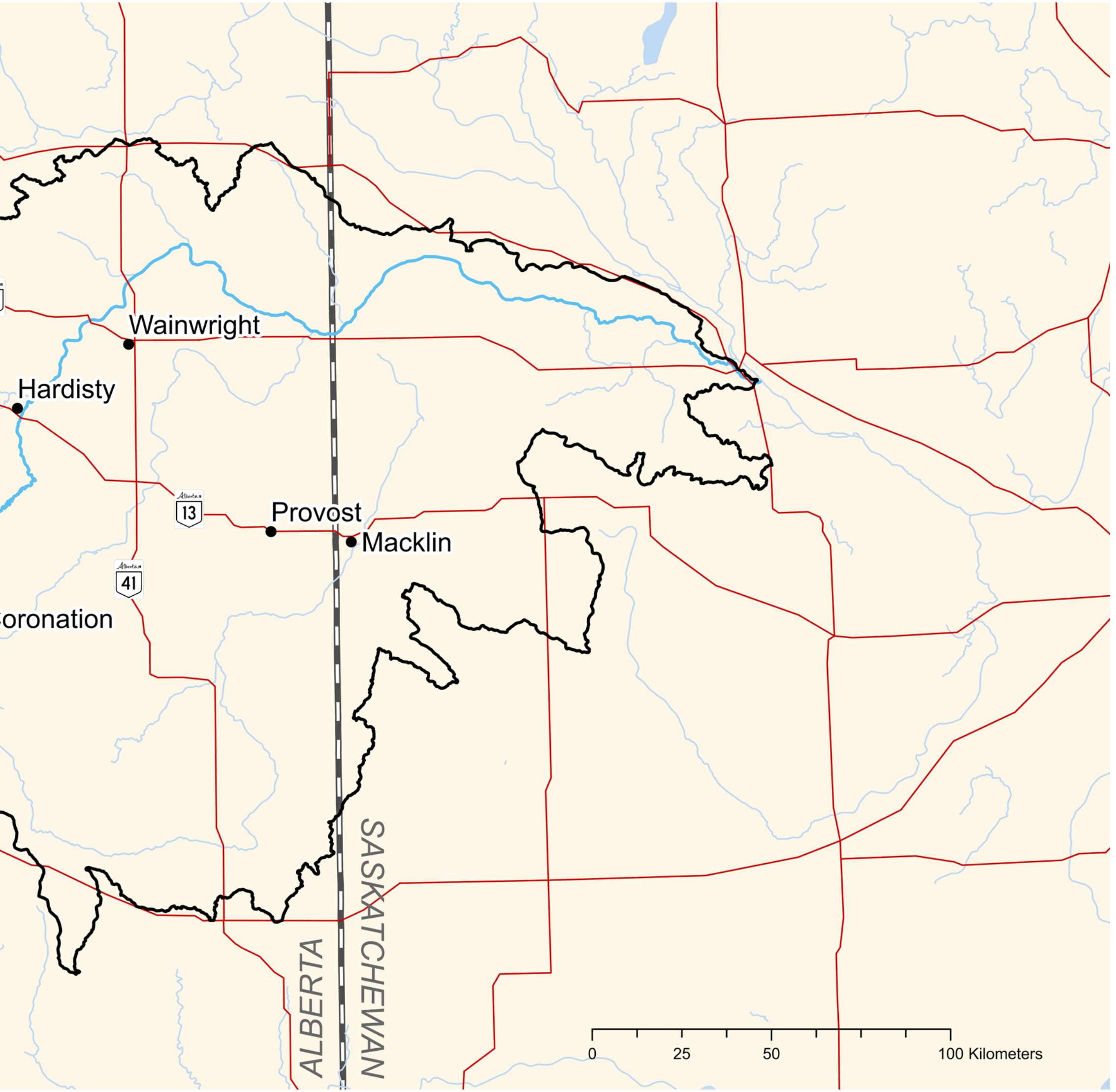
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Photo by Lanie J. Parr, BSc.

List of Acronyms

Acronym	Term
AAFC	Agriculture and Agri-Food Canada
ABMI	Alberta Biodiversity Monitoring Institute
ABWRET-A	The Alberta Wetland Rapid Evaluation Tool – Actual
ACA	Alberta Conservation Association
ACFB	Alberta Child and Family Benefit
ADI	Aboriginal Diabetes Initiative
AEI	Agri-Environmental Indicator
AEMERA	Alberta Environmental Monitoring Evaluation and Reporting Agency
AEP	Alberta Environment and Parks
AER	Alberta Energy Regulator
AESP	Alberta Environmental Science Program
AHFMP	Alberta Human Footprint Monitoring Program
AGLC	Alberta Gaming, Liquor and Cannabis
AHRE	Alberta Human Resources and Employment
AHS	Alberta Health Services
AlbertaHUB	Northeast Alberta Information Hub Ltd.
ALERT	Alberta Law Enforcement Response Teams
ALGA	Aggregate Local Geographic Area
ALR	Agricultural Land Reserve
ALSA	Alberta Land Stewardship Act
AMWI	Alberta Merged Wetland Inventory
AP	Advanced Placement
AUMA	Alberta Urban Municipalities Association
AVI	Alberta Vegetation Inventory
AWC	Alberta Water Council
AWE	Agricultural Watershed Enhancement Program
B.C.	British Columbia
BMI	Body Mass Index
BMPs	Beneficial Management Practices
BRW	Battle River Watershed
BRWA	Battle River Watershed Alliance
BRAED	Battle River Alliance for Economic Development
BSE	Bovine Spongiform Encephalopathy (Mad Cow Disease)
CAAQS	Canadian Ambient Air Quality Standard
CAEP	Central Alberta Economic Partnership
CAP	Canadian Agricultural Partnership
CBHW	Community Based Health Workers
CCED Net	Canadian Community Economic Development Network
CCHS	Canadian Community Health Survey
CCIR	Carbon Competitiveness Incentive Regulation
CCME	Canadian Council of Ministers of the Environment
CED	Community Economic Development
CERB	Canada Emergency Response Benefit
CFO	Confined Feeding Operations
CIW	Canadian Index of Wellbeing
CLP	Climate Leadership Plan
CNVC	Canadian National Vegetation Classification
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COPD	Chronic Obstructive Pulmonary Disease
CoRe	Parks Canada Conservation and Restoration
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPI	Consumer Price Index
CRA	Canada Revenue Agency
CSD	Census Subdivision
CSI	Crime Severity Index
CVD	Cardiovascular disease
CWB	Community Wellbeing Index
CWCS	Canadian Wetland Classification System
CWQI	Canadian Water Quality Index
DAO	Delegated Administrative Organization
DFO	Fisheries and Oceans Canada
DLS	Dominion Lands Survey
ECCC	Environment and Climate Change Canada
ECS	Early Childhood Services
EIA	Environmental Impact Assessment
ELC	Environmental Law Centre
ELL	English Language Learning
EMS	Emergency Medical Services
EMSD	Environmental Monitoring and Science Division
EPA	Environmental Protection Agency
EPEA	Environmental Protection and Enhancement Act
EPS	Edmonton Police Service
ESRD	Environment and Sustainable Resource Development
FITFIR	First in Time, First in Right
FNHA	First Nations Health Authority
FSI	Fish Sustainability Index
GAD	Generalized Anxiety Disorder
GDP	Gross Domestic Product
GED	General Educational Development
GHG	Greenhouse Gas
GHGRP	Greenhouse Gas Reporting Program
GP	General Practitioner

GVI	Grassland Vegetation Inventory
HATi	Healthy Alberta Trends Index
HBV	Health Based Value
HFI	Human Footprint Inventory
HSE	Health and Safety Executive
IBI	Index of Biological Integrity
IMF	International Monetary Fund
INFI	Index of Native Fish Integrity
IRMS	Integrated Resource Management System
IRP	Integrated Resource Plan
IWMP	Integrated Watershed Management Plan
LED	Local Economic Development
LGA	Local Geographic Area
LGBTQ2+	Lesbian, Gay, Bisexual, Transgender, Queer, Two-Spirit
LICO	Low-Income Cut-off
LIM	Low-Income Measure
LSRS	Land Suitability Rating System
LTRN	Long Term River Network
LUF	Land-Use Framework
MBM	Market Basket Measure
MER	Monitoring, Evaluation and Reporting
MGA	Municipal Government Act
MOU	Memorandum of Understanding
NAPS	National Air Pollution Surveillance
NAYSPS	National Aboriginal Youth Suicide Prevention Strategy
NDP	New Democratic Party
NDT	Network Diagnostic Tool
NGO	Non-Governmental Organization
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NP	Nurse Practitioners
NRCan	Natural Resources Canada
O_3	Ozone
ODPHP	Office of Disease Prevention and Health Promotion
OGP	Open Government Partnership
OHS	Occupational Health and Safety
OSM	Oil Sands Monitoring Program
PALLISER	Palliser Economic Partnership
PDD	Persons with Developmental Disabilities
P.E.I.	Prince Edward Island
PLVI	Primary Land Vegetation Inventory
$PM_{2.5}$	Fine Particulate Matter
PTSD	Post-Traumatic Stress Disorder
RAMP	Regional Aquatics Monitoring Program
RAPID	Rural Alberta Provincial Integrated Defence
RCMP	Royal Canadian Mounted Police
RFS	Renewable Fuels Standard
RLUP	Regional Land-Use Plan
RWQI	River Water Quality Index
SDOH	Social Determinants of Health
SES	Socioeconomic Status
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
SSRB	South Saskatchewan River Basin
TIER	Technology Innovation and Emissions Reduction
TMN	Tributary Monitoring Network
UBI	Universal Basic Income
UCP	United Conservative Party
UHI	Urban Heat Island
VOCs	Volatile Organic Compounds
WHO	World Health Organization
WMP	Watershed Management Plans
WPACs	Watershed Planning and Advisory Councils
WQI	Water Quality Index
WRP	Wetland Restoration Program
WRRP	Watershed Resiliency and Restoration Program
WUI	Wildland-Urban-Interface

Photo by Lanie J. Parr, BSc.

Territorial Acknowledgements

Oki, and welcome to the Prentice Institute, based at the University of Lethbridge. Our University's Blackfoot name is *Iniskim*, meaning Sacred Buffalo Stone. The University of Lethbridge acknowledges and deeply appreciates the *Siksikaitsitapi* peoples' connection to their traditional territory. We, as people living and benefiting from Blackfoot Confederacy traditional territory, honour the traditions of people who have cared for this land since time immemorial. We recognize the diverse population of Aboriginal peoples who attend the University of Lethbridge and the contributions these Aboriginal peoples have made in shaping and strengthening the University community in the past, present, and in the future.

The Battle River and Sounding Creek watersheds have been the home, meeting ground and travelling route for many Indigenous Peoples since time immemorial. The Battle River Watershed Alliance (BRWA) gratefully acknowledges the traditional territory and ongoing presence of Indigenous Peoples and Nations within these watersheds. Their experiences, teachings, knowledge and wisdom inform and enrich our collective efforts to care for the land and water of this region. We also acknowledge that this land is Treaty 6 and 7 territory. Fulfilling the spirit and intent of these treaties is an ongoing process, and the BRWA is committed to building strong and respectful relationships with the Indigenous Peoples of this land, with all living beings, and with the land and water on which we all depend.

The University of Alberta respectfully acknowledges that we are located on Treaty 6 territory, a traditional gathering place for diverse Indigenous peoples including the Cree, Blackfoot, Métis, Nakota Sioux, Iroquois, Dene, Ojibway/Saulteaux/Anishinaabe, Inuit, and many others whose histories, languages, and cultures continue to influence our vibrant community.

Photo by Nicholas T. Yarmey, MSc.

A Health in the Watershed Assessment Framework

Foreword

In 1986, the Ottawa Charter for Health Promotion signaled a call for "Health for All" by 2000, and was an explicit attempt to link primary health care with intersectoral action, health promotion, an emphasis upon social and personal resources, equity across health and other sectors, and in particular the need to "take control of those things which determine their health." In other words, the Ottawa Charter marked a recognition not just of the social determinants of health, but also the importance of health (defined very broadly) to extend, and be extended, beyond the provision of primary care.

The subsequent decades have seen significant policy, political and social change – the WHO launched a Commission on the Social Determinants of Health in the mid-2000s, and the final report made it clear that the social environment (including, but not limited to, the economy) was a critical variable in structure health and health inequities. Courses on the social determinants of health are now common in many universities, and many non-governmental and policy-based organizations seek to include and design for equity-based considerations in their programming and policy tools. At the same time, however, after nearly 4 decades, the COVID-19 pandemic (or syndemic – synergistic pandemic) has laid bare the significant and underlying inequities within, and between, both Canadian and global populations. These inequities have been recognized with both research and policy-based activities, including an acknowledged need to "know more, in order to do more" across social, economic, ecological, international AND health fronts.

This need is long-standing – it is reflected in the concept of the policy sciences and much more recently in the work of the ECHO Network – the Environment, Community and Health Observatory Network funded by the Canadian Institutes for Health Research (CIHR) from 2016 to 2023 to engage in socio-ecological research for health, and specifically to "Take Notice, and to Take Notice for Action. While the ECHO Network encompassed a broad and diverse range of scholars, students, community partners and content areas, two priorities that were present from the beginning were: (1) engagement with the realities, challenges and opportunities presented by rural communities across Canada; and (2) an on-going commitment to working with watersheds and watershed management as an integrative, intersectoral and interdisciplinary "space" in which to consider, and respond to, the combination of environmental, community and health dynamics.

Working in close partnership with the Battle River Watershed Alliance (a prairie-fed watershed cutting across east-central Alberta), one immediate, and significant, opportunity was presented by the provincial approach to, and challenges of, state of the watershed reporting. As often found elsewhere in the world, watershed reporting in Alberta is historically oriented toward understanding the "Health of the Watershed" yet typically does not include any recognition of the social, economic, cultural, historical, regional or distributional dynamics that both influence, and are influenced by, the movement of water through our landscapes and populations. As a response to this opportunity, the concept of an extensive, replicable, and intersectoral assessment of health IN the watershed emerged – not an assessment of the health of the watershed, but explicitly an attempt to development an assessment structure (a framework of indicators and measures, derived in complement with the Sustainable Development Goals), that can complement the ecological indicators typically used.

As one of the core outputs of this process, this atlas is a rather unique undertaking. While a few others have been attempted in (in watersheds in South America, the United States, and Atlantic Canada) they are a necessarily large, time, labour, and fund-intensive undertaking. In addition to the background research and authorship that such a text requires (there are over 40 specific indicators structuring this atlas), the analyses and mapping that are needed extended across a myriad of data sources, challenges of accessibility and reliability (of data across both time and place), and of integration. While the framework and resulting chapters are intended to be read, and used, as a way of understanding population health and well-being across a range of socio-economic sectors, the default is still to think, and thus focus, within ministerial, bureaucratic, policy, community, and scientific silos. Our hope is that the combinations of place (maps), people (data), and analysis (policy) are informative, and reinforce the need to think, and work, not just across sectors, but across the questions, relationships, and effects that occur on the land, and within our watershed. We also wish to draw particular attention to the equity-based dynamics these maps can high-lite – the barriers facing Indigenous communities, racialized populations, and vulnerable populations are clearly apparent, and worthy not just of acknowledgement, but action. Take Notice. To Take Action.

Acknowledgements:
As noted above, this project was supported with a combination of resources from CIHR (and the ECHO Network), the University of Alberta, the University of Lethbridge, and the Battle River Watershed Alliance. In addition to the many students and research staff who have provided support in authorial, editorial, analytic and background research activities, there is also a collective of researchers and practitioners who have provided a wealth of feedback, encouragement, understanding, and thoughtful criticism. In particular, this atlas has benefitted greatly from the wisdom of the ECHO Research Leads (Margot Parkes, Maya Gislason, Celine Surette, Tim Takaro, Chris Buse, Dawn Hoogeveen, Craig Stephen and Lindsay Galway) as well as the leadership of the BRWA (David Samm), and the many practitioners, researchers and students across the ECHO Network who have informed the thinking, analysis, and framing behind this work.

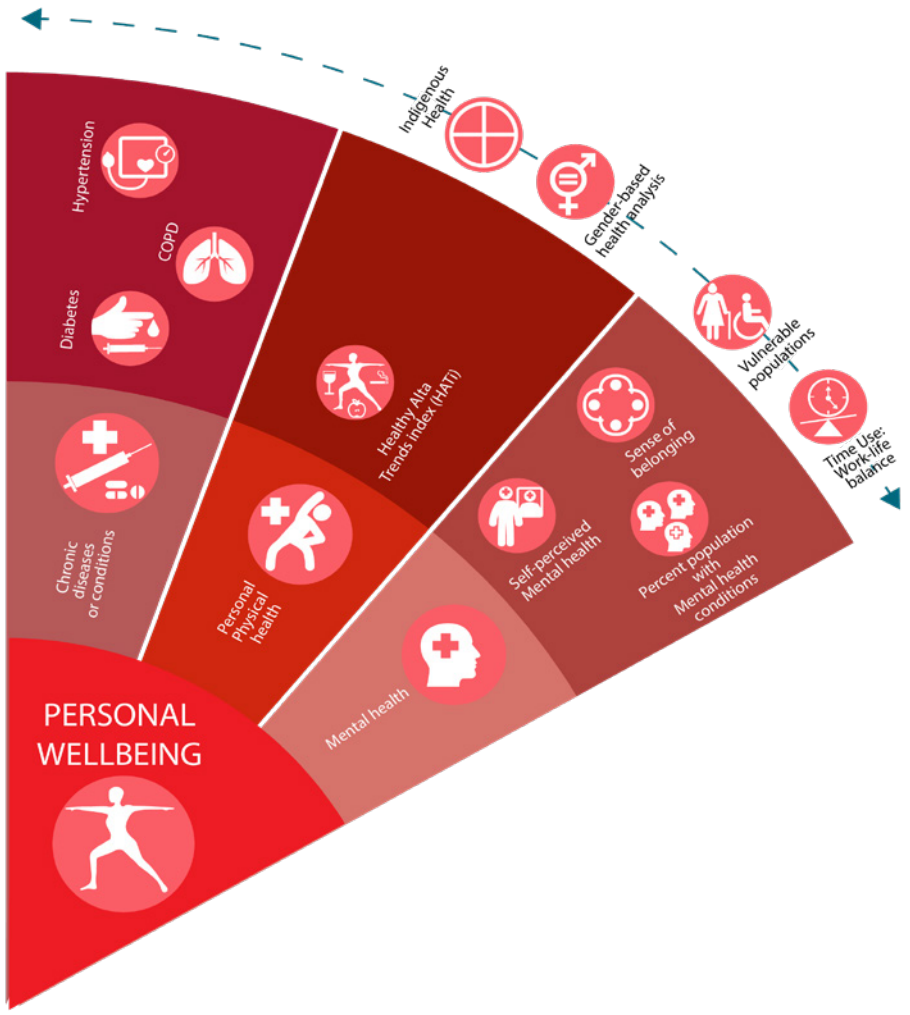
Similarly, the team of students and research staff who have helped to complete this project is extensive. An undertaking such as this cannot fall to one person alone, and the sheer volume of labour hours required to collect, synthesize, analyze, map and write the materials for this atlas is immense. The individuals who have contributed to the creation, design, authorship, editing, proofing and referencing this text are acknowledged by name in the title materials for the atlas, but it is important to acknowledge them again, and in particular their commitment to a long and sometimes arduous journey.

Lars K. Hallstrom, PhD.
Director, Prentice Institute for Global Population and Economy
Professor of Political Science

Lethbridge, August 2022

CHAPTER ONE

PERSONAL WELLBEING



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INTRODUCTION

Personal Wellbeing is largely a subjective measure, meaning the individual interprets their own state of well-being. Personal Wellbeing is "a good, satisfactory, and desirable state of personal existence or life," representing one's quality of life, and includes dimensions of "emotional wellbeing, satisfying life, vitality, resilience and self-esteem, and positive functioning" (Musek and Polic 2014, 4752).

This chapter presents and analyzes several measures of Personal Wellbeing including: chronic diseases/conditions, personal and physical health, and mental health. Some of these measures, like chronic disease, are not subjective, but overall Personal Wellbeing is concerned with how individuals experience and interpret their current state of health and quality of life. A well-managed chronic condition may not significantly undermine a person's quality of life, but a poorly managed condition can have negative effects on other areas of life, including employment, physical health, and relationships. Throughout this chapter, there is an emphasis on Indigenous health, gender-based health analysis, and vulnerable populations such as ethnic minorities and marginalized communities like the LGBTQ2+ community.

Measuring Personal Wellbeing

There are three measures of wellbeing in this chapter. In each case, the measure is constructed of different indicators, and when taken together, the measures and indicators are a way to understand both the disease and wellbeing dimensions of health.

1. Chronic Diseases

The chronic diseases measure includes the following three indicators:

- diabetes,
- hypertension, and
- chronic obstructive pulmonary disease (COPD).

High rates of these conditions may indicate poor levels of community health, and may be a sign that residents are facing barriers to accessing healthcare and treatment. These barriers may compound or increase the risks of developing chronic diseases. Many individual and social risk factors underlie the emergence of these diseases/conditions, and people are significantly more at risk of chronic disease if they smoke, suffer from obesity, or lack access to nutritious food.

2. Personal Physical Health

Personal physical health is measured by the Healthy Alberta Trends index (HATi).

The HATi is a tool that takes into account six risk factors/risky behaviors: life stress, Body Mass Index (BMI), fruit/vegetable consumption, physical activity, smoking, and alcohol consumption. Each of these factors has a health-protective and a health-risk element. For example, high fruit and vegetable consumption is a health-protective behaviour, while low fruit and vegetable consumption is a risk factor for poor physical health. Some behaviours, for example, alcohol consumption, count as health-protective behaviours when an individual receives a low score (*i.e.*, low alcohol consumption), and as risk factors when an individual receives a high score (*i.e.*, high alcohol consumption). Measuring the number and intensity of risky behaviours allows for the analysis of personal wellbeing levels in a given community.

3. Mental Health

The mental health measure focuses upon:

- self-perceived mental health,
- sense of belonging, and
- percent of the population with mental health conditions.

As personal wellbeing is more than physical health, emotional and psychological health are crucial to monitor. In rural communities, sense of belonging is a critical factor that influences mental health and community cohesion, important factors for healthy, resilient communities.

Understanding the Political Context of Personal Wellbeing

In Alberta, and across Canada, the Great Depression in the early 1930s led to increased public demand for social welfare policies that would increase standards of living through healthcare, education for youth, child welfare legislation, and municipal relief (Falvo 2015, 32; Strikwerda 2014; Bella 1986, 86). At the time, the federal government had revenue-generating options, but no responsibility for social services. This is primarily due to Canada's constitutional system, which makes the federal and provincial governments responsible for different powers, duties, and services. The provinces are typically responsible for social services, including education and health care, but in the 1930s the funding and administrative structures to pay for and implement these services on a provincial scale had not yet been developed. This lack of provincial power and infrastructure restricted Albertans' access to these necessary services (Strikwerda 2014; Struthers 2013).

In 1935, Albertans elected a Social Credit Government, which vocally opposed developments in social welfare but still introduced a series of interventions designed to meet Albertans' needs through the new Public Welfare Department (Bella 1986; Strikwerda 2014). Within the next five years, this government began to provide services for (in the language of the time) children, single men, Métis people, veterans, the indigent, widows, disabled people, deserted women, and people living in care homes and

institutions (Strikwerda 2014; Canadian Museum of History 2010a). However, much of this spending was made possible by the discovery of oil near Leduc in 1947, and to this day the province relies on the income earned from the exploitation of natural resources to fund nearly a quarter of all its program expenditures (Morley 2015; Kneebone 2015; Government of Alberta 2020).

However, these revenues are often subject to energy price fluctuations, equity markets, exchange and interest rates, geopolitical events, global economic swings, and even weather, all of which are subject to uncertainties and can fluctuate rapidly (Beattie 2021; Government of Alberta 2020). This means that the province tends to cut back programs and spend less on social services when global oil prices are low (Kneebone 2015, 1).

Chronic Diseases or Conditions

Chronic diseases are the leading causes of death and disability worldwide (Centers for Disease Control and Prevention 2022a). Four of the most prominent chronic diseases - cardiovascular disease (CVD), cancer, chronic obstructive pulmonary disease (COPD), and type 2 diabetes - are linked by common and preventable biological and behavioural risk factors. The biological risk factors include: high blood pressure, high cholesterol, and obesity, while the behavioural risk factors include: unhealthy diet, lack of physical activity, and tobacco use (Centers for Disease Control and Prevention 2022a). Measuring chronic illnesses gives us insight into the health of a given population. Knowing the level of chronic disease allows us to pinpoint areas to target through public health campaigns, planning and infrastructure development, and possibly through legislation. For example, a policy mandate to increase physical activity among a population might lead to more funding and support for installing bike paths, or an effort to reduce smoking might result in public health campaigns and legislation that makes it more difficult to purchase or consume tobacco.

Diabetes

The increasing prevalence of diabetes, itself a complex disease, stems from multiple sources.

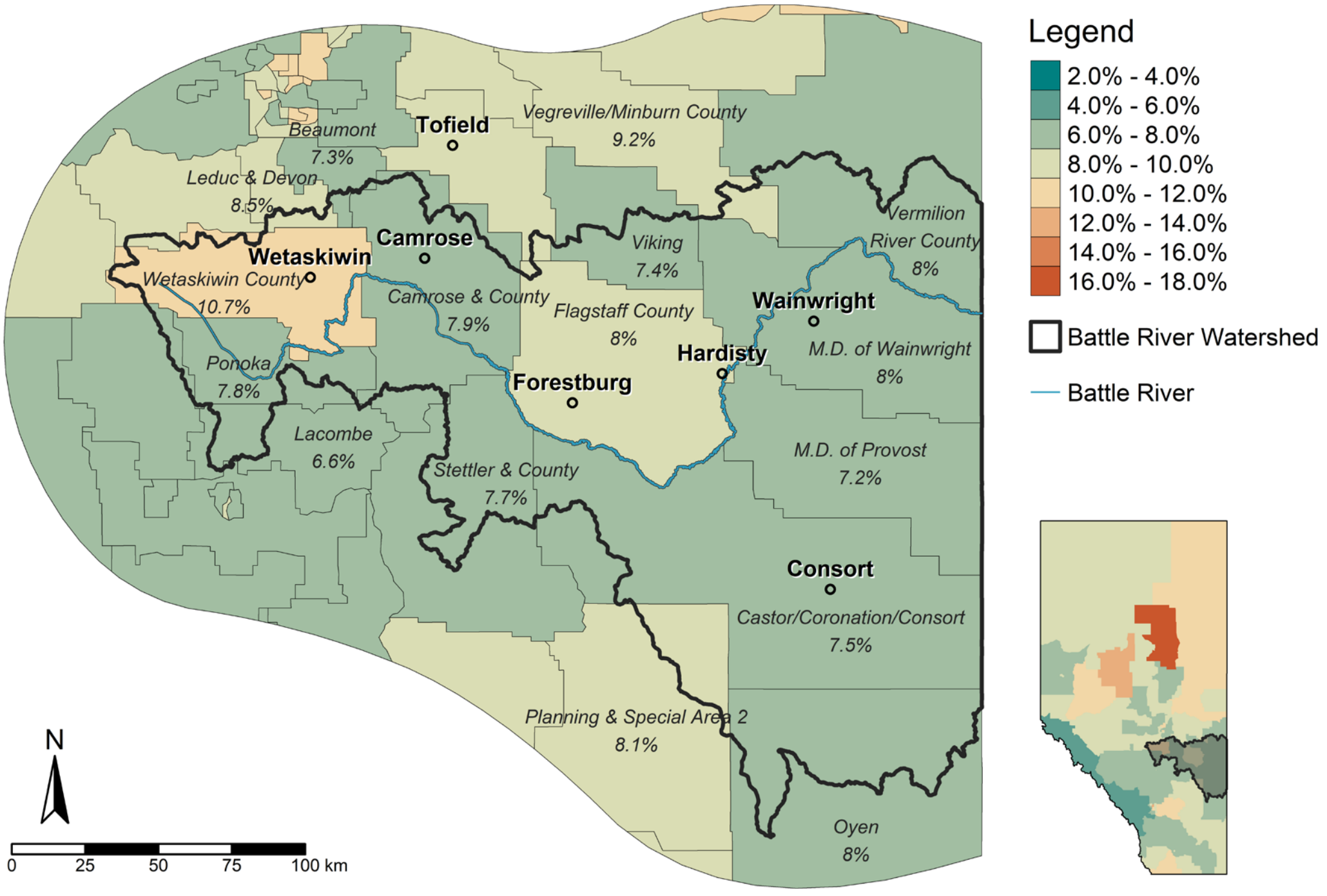
Diabetes exists in two forms: type 1 and type 2. Type 1 diabetes is the result of an autoimmune attack on the insulin-producing beta cells of the pancreas. Individuals with type 1 diabetes are incapable of producing insulin and will have to take insulin injections several times daily for the rest of their lives (Public Health Agency of Canada 2017).

Type 2 diabetes is often characterized as insulin insensitivity, meaning that these individuals produce insulin, often in excessive amounts, but the cells of their body are less sensitive to the signal than non-diabetic cells. Type 1 diabetes is fatal if left untreated, while type 2 diabetes can usually be managed with proper diet and exercise.

Both types of diabetes involve either inaction or reduced action of insulin. Produced in the pancreas, insulin is an important regulator of blood glucose. Blood glucose will be elevated after a meal. Specialized cells in the pancreas detect this change and trigger the release of insulin. After diffusing throughout the body, insulin binds to receptors on nearly every one of the body's cells. Binding triggers the action of a glucose transporter which allows glucose to be taken into the cells for use in cellular respiration. This process results in the lowering of blood glucose back to normal levels. In diabetic patients, there is an error in this process and blood glucose remains high, which can have devastating effects on the body (Fu, Gilbert, and Liu 2013).

Diabetes Prevalence (2019), Males and Females

% of population with condition (age-standardized)



Map 1.1: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Diabetes).

For example, the skin can be affected and patients can suffer from itching, fungal and bacterial infections, and even skin necrosis (American Diabetes Association n.d. d). Increased osmotic pressure due to excess glucose in the blood can lead to eye damage, specifically glaucoma, retinopathy, or cataracts (American Diabetes Association n.d. e). Excess glucose also often leads to neuropathy, or damage to the body's nerve cells. This can cause foot damage due to loss of sensation or blood flow to the area (American Diabetes Association n.d. b). Without the action of insulin, the body must find sources of energy other than glucose. If this continues for too long the body can develop ketoacidosis which results from a buildup of ketone bodies that form when the body utilizes fats as an energy source (American Diabetes Association n.d. a). High blood pressure, due to the increased osmolality of the blood, can result in kidney damage and stroke (American Diabetes Association n.d. c).

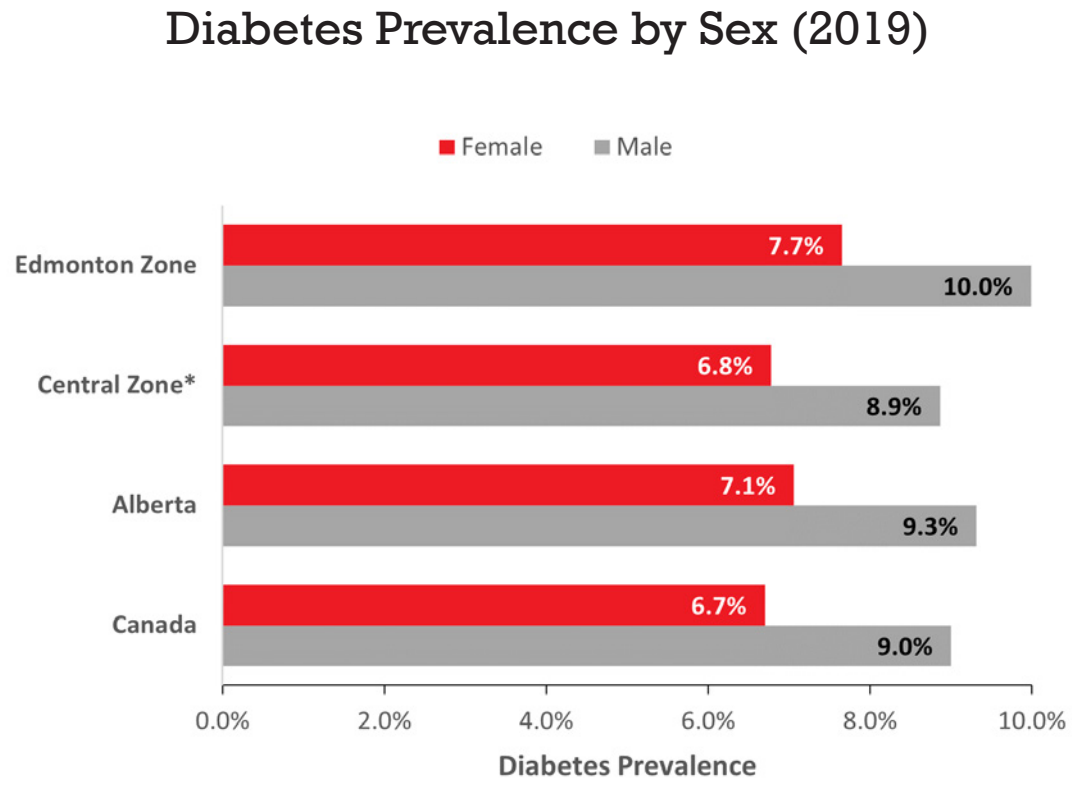


Figure 1.1: Age-standardized prevalence of diabetes in the Edmonton Zone, the Central Zone (*contains the BRW), Alberta, and Canada in 2019 (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Diabetes).

A reduction in the rates of diabetes would save at least some lives from an early death. In addition to the physical complications that can result from diabetes, mental health can be impacted as well. According to Diabetes Canada (2021, 1), 30% of diabetes patients have clinically depressive symptoms.

Map 1.1 shows the age-standardized prevalence of diabetes for men and women in the Battle River Watershed (BRW). Age standardization is a statistical technique that allows populations to be compared when the age profiles of the population are different. Figure 1.1 shows that the Central Zone of Alberta has similar rates of diabetes compared to Canada as a whole, and is slightly better than the Albertan average. More men than women tend to suffer from diabetes, and we also see this reflected in the rates for the Central Zone.

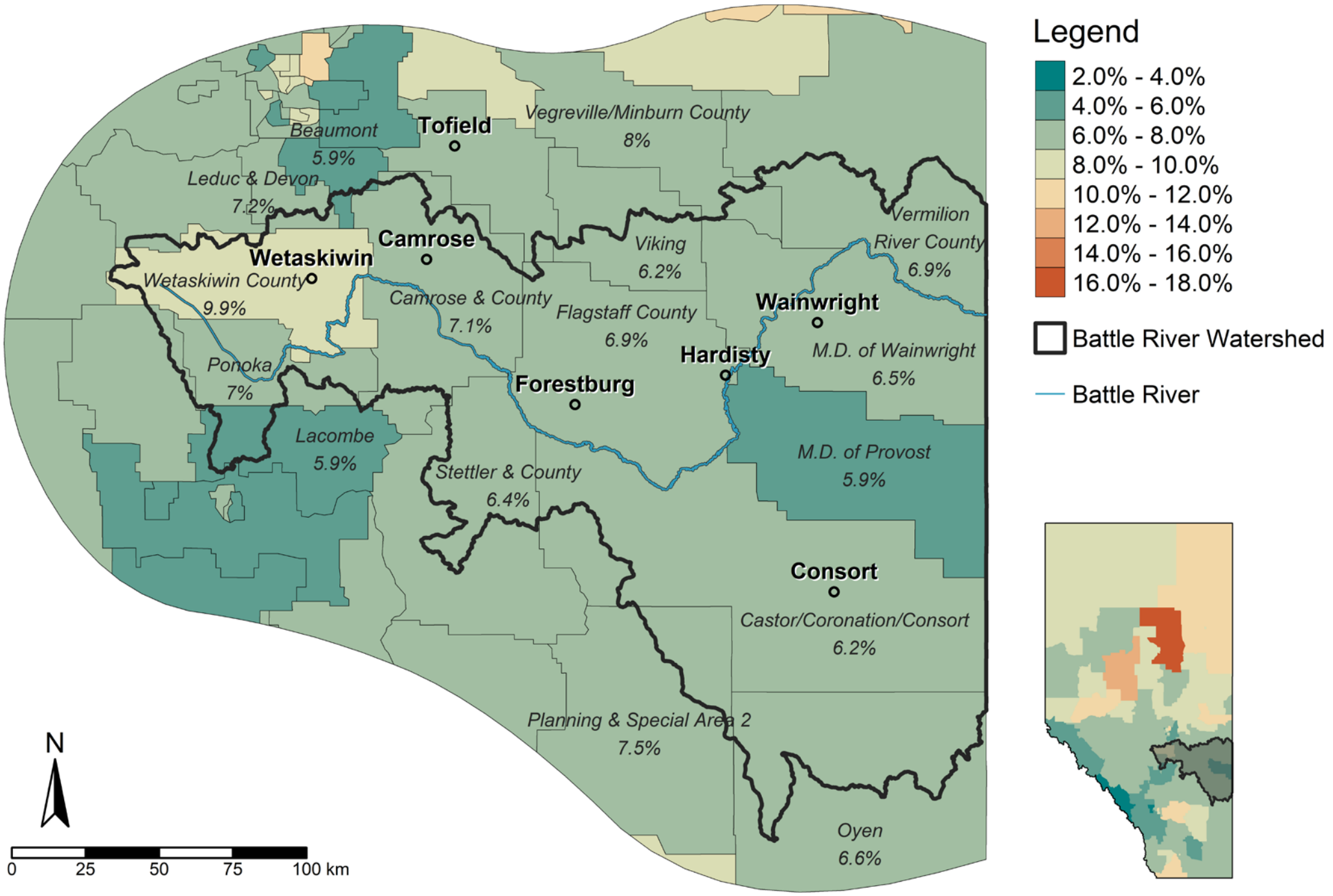
As Map 1.1 shows, most of the regions within the BRW area have a diabetes prevalence rate between 6-8%. A few regions, such as Flagstaff County, Leduc, and Devon have slightly higher diabetes prevalence rates (8-10%). Wetaskiwin & County is the region with the highest diabetes prevalence at a rate of 10.7%. In 2019, the Central Zone of Alberta had a 7.79% diabetes prevalence rate in comparison to an 8.14% diabetes prevalence rate for the entire province of Alberta.

Understanding Diabetes

Diabetes is no small issue for the population of Alberta, nor the population of the BRW. As of 2019, over 350,000 Albertans were living with the life-threatening disease, with the number projected to increase to 521,000 by 2029 (Diabetes Canada 2019). From 2004 to 2019 the age-standardized prevalence of diabetes rose from 5.51% to 8.15% for

Diabetes Prevalence (2019), Females

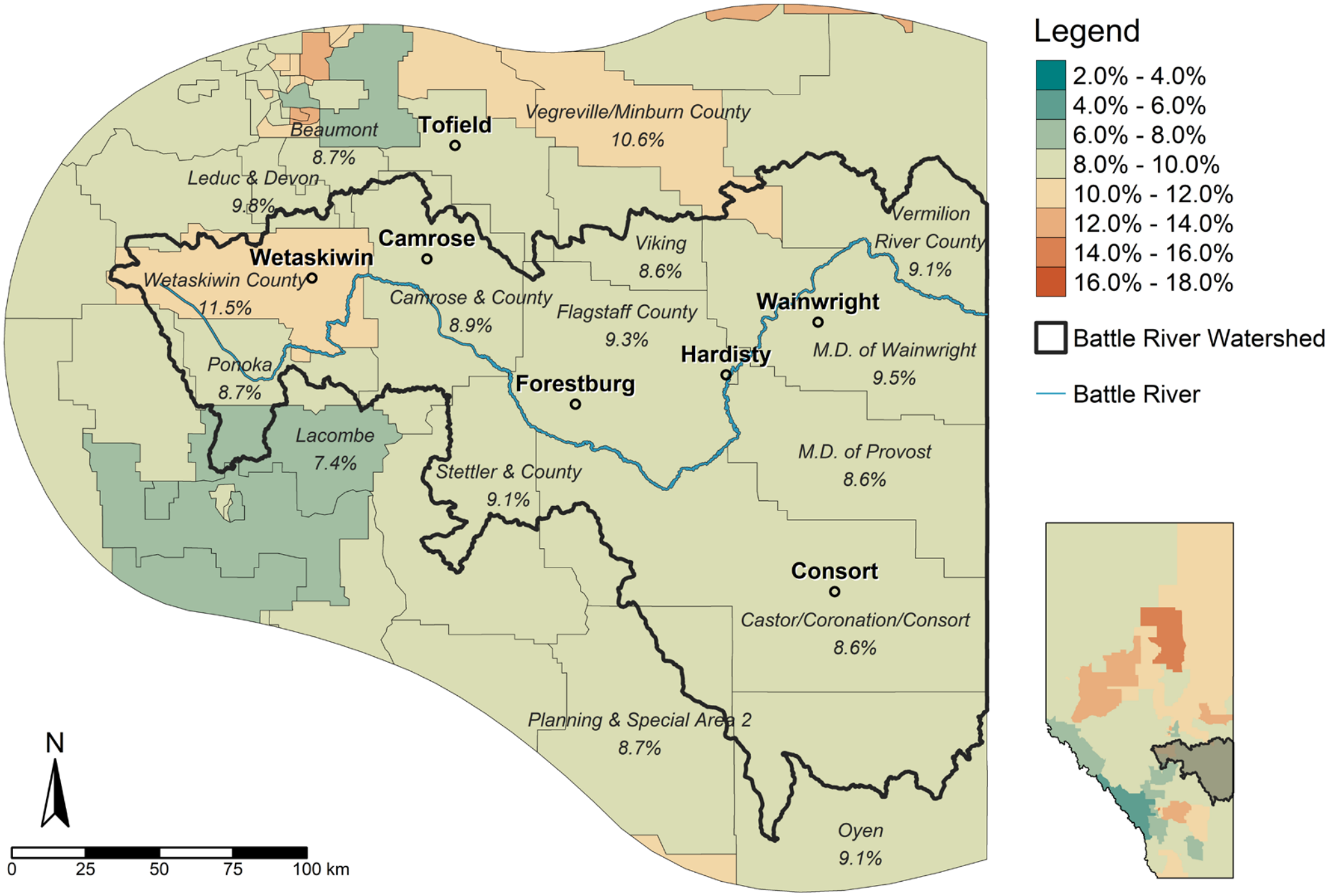
% of population with condition (age-standardized)



Map 1.2: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Diabetes).

Diabetes Prevalence (2019), Males

% of population with condition (age-standardized)



Map 1.3: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Diabetes).

the Albertan population and from 5.46% to 7.79% for the Central Zone population that includes the BRW (Alberta Health n.d. d).

While these figures reflect rates of diagnosis for both type 1 and type 2 diabetes, it should be noted that type 1 diabetes accounts for between 5 and 10% of diabetes prevalence (Diabetes Canada 2019, 1). This means that between 17,000 and 35,000 Albertans currently living with diabetes suffer from type 1, while the majority, 315,000 to 333,000, live with type 2. While many cases of diabetes can be controlled with lifestyle and diet changes, most cases require other forms of treatment that impose additional costs upon multiple layers of health care in the province. Aside from the dangerous comorbidities that often accompany diabetes (such as heart attacks, kidney failure, and vision loss) diabetes is detrimental financially to both the patient and the healthcare system.

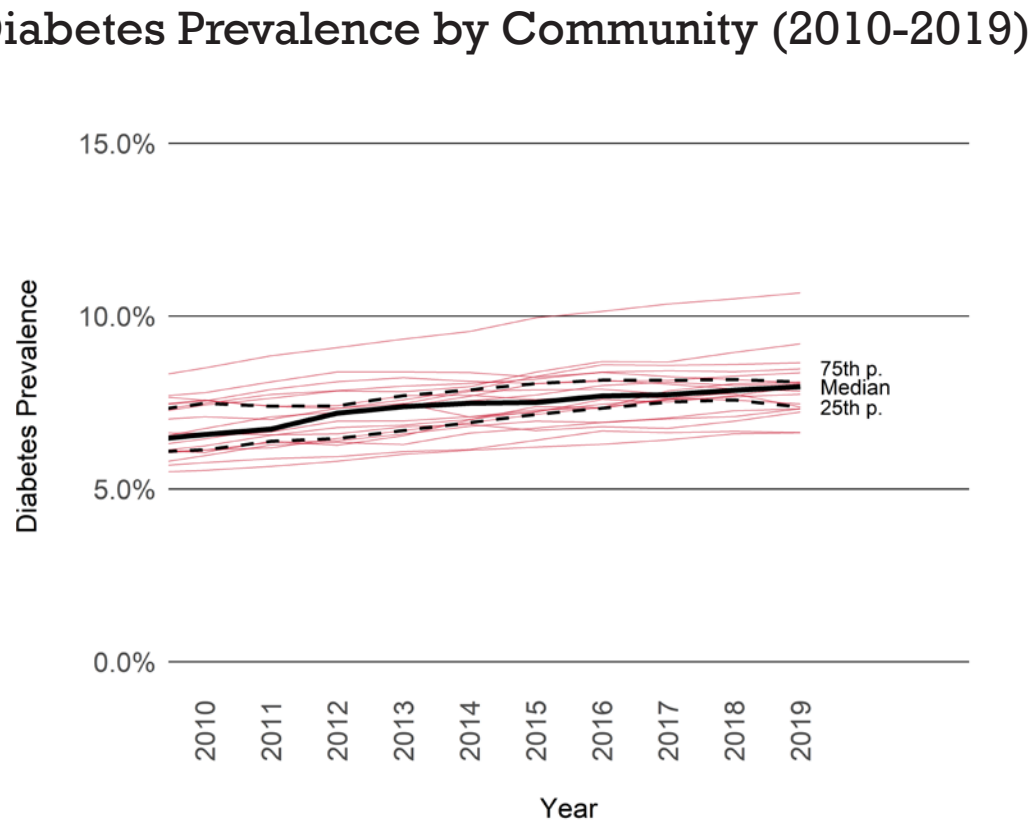


Figure 1.2: Diabetes prevalence for each LGA within the BRW from 2010 to 2019; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Diabetes).

Populations at Risk:

First Nations

Indigenous peoples have a higher rate of diabetes within their population in comparison to non-Indigenous people. For Indigenous peoples living off-reserve, that rate is 5.9 times higher than non-Indigenous adults (Diabetes Canada 2020, 2). The determinants of diabetes in First Nations populations can be based on two frameworks: biomedical and Indigenous (Halseth 2019, 11).

The biomedical framework focuses on physical risk factors for diabetes, such as "older age, family history, high blood pressure, history of heart disease or stroke, obesity, genetic susceptibility, depression, poor diet, and physical inactivity" (Halseth 2019, 11). Smoking is another risk factor for the development of diabetes, and First Nations populations have higher rates of smoking than non-Indigenous populations (Spanakis and Golden 2013, 819). For example, smoking rates among Indigenous youth are approximately three times higher than for comparable non-Indigenous youth (Jetty et al. 2017, 395).

In contrast to the biomedical framework, the Indigenous framework is based on a holistic understanding of health, one that encompasses physical, mental, emotional, and spiritual dimensions of health (Halseth 2019, 11). In this framework, the prevalence of diabetes is associated with deep-rooted colonial processes, including loss of traditional lifestyles and spirituality, displacement, and socio-economic marginalization (Halseth 2019, 11).

Ethnic Minorities

In comparison with Caucasians, the incidence rates of diabetes are two times higher in African, Caribbean, and Black communities,

3.4 times higher in South Asian communities, and 1.9 times higher in Chinese communities (Diabetes Canada 2022). This may be due to genetic predispositions but the lower quality of healthcare for minorities is a factor in the development of diabetes. Ethnic minorities often face barriers regarding equal and accessible healthcare in comparison to non-ethnic populations, including barriers of language, geography, and cultural familiarity (Institute of Medicine (US) Committee on Understanding and Eliminating Racial and Ethnic Disparities in Health Care 2003, 1). Minorities can often, although not exclusively, be located in neighborhoods that lack healthy food options and the social environment that can promote unhealthy lifestyle choices, such as smoking (Spanakis and Golden 2013, 820).

Socioeconomic status (SES) is another risk factor for the development of diabetes. SES is measured using income, education, occupation, and insurance type (O'Connor and Wellenius 2012, 814). Those with a lower level of income or education are at higher risk of developing type 2 diabetes. Diabetes in low-income groups is 4.9 times higher than adults in high-income categories (Diabetes Canada 2020, 2).

Low SES is also correlated to greater adverse health outcomes and more severe disease presentation, such as peripheral neuropathy (O'Connor and Wellenius 2012, 814). This may be due to lack of medication compliance, or absence of proper standard of care in health facilities (O'Connor and Wellenius 2012, 814).

Risk Factors for Diabetes

- Weight: in 2017, 33.7% of Central Zone residents were classified as 'overweight', and 28.8% were classified as 'obese' (Alberta Health 2019b, 3),
- Physical activity: this mitigates the development of diabetes as it controls weight and allows cells to become more sensitive to insulin (Diabetes Canada n.d.). In 2017, 26.8% of Central Zone residents were categorized as inactive (Alberta Health 2019b, iii),
- Socio-economic status: Those with a lower level of income or education are at higher risk of developing type 2 diabetes (Diabetes Canada 2020, 2). In Wetaskiwin County, an area representing a relatively higher rate of diabetes prevalence in the BRW, 25.6% of residents are classified as 'low-income' in comparison to the provincial rate of 15.6% (Alberta Health 2019b, iii). In Camrose, 21.2% of residents are classified as 'low-income' (Alberta Health 2019a, 11),
- Aging: the risk of developing diabetes increases as you get older. The Public Health Agency of Canada reports that 25.4% of those aged between 65 and 69 are diagnosed with diabetes (2017, 1). In the Central Zone of Alberta, the prevalence rate of diabetes increases with increasing age groups (Alberta Health n.d. c). In this region, the 20-24 age group has a prevalence rate of 1%, rising to a prevalence rate of 20.60% in the 65-69 age group (Alberta Health n.d. c),
- Sex: The male population of the BRW have a higher diabetes prevalence rate in comparison to the female population. Males in the BRW exhibit a diabetes prevalence rate on average between 8-10%, while females have a 6-8% diabetes prevalence rate on average. Wetaskiwin & County have greater diabetes prevalence rates for both males and females in comparison to the rest of the BRW. The male population may be at greater risk for multiple risk factors; for example, more males than females were categorized as either overweight or obese in the Central Zone of Alberta (Alberta Health 2019b, 3).

Rural Location

Geographic location is another risk factor for the development of diabetes. (Tran, Tran, and Tran 2019, 1). This is due to the higher prevalence of other risk factors in rural communities, such as being overweight/obese, having high blood pressure and cholesterol, and being physically inactive (Tran, Tran, and Tran 2019, 3). There is also reduced access to preventative care as rural residents often need to travel longer distances to reach healthcare facilities, have reduced access to recreational activities, and also have reduced access to fresh fruit and healthy meal options.

Mental Health

Another risk factor linked to geographic location is mental health. Individuals diagnosed with depression have a 40-60% increased risk of developing diabetes (Robinson et al. 2018,

S131). Risk factors for developing diabetes in people with depression are physical inactivity and obesity, psychological stress leading to hormone dysregulation and insulin resistance, and decreased neurogenesis (Robinson et al. 2018, S132). In the Central Zone of Alberta, 27% of residents rate their self-perceived mental health as poor, fair, or good, indicating a population of people at risk for developing diabetes (Alberta Health n.d. i).

Rural mental health is an important factor in the consideration of precursors of developing diabetes. The mental health of farmers and those working in agricultural fields is important to consider. Canadian farmers are often subject to challenges with their mental health, including "occupational stressors, agricultural social stigmas, social isolation, and lacking services to meet their individual needs" (Jones-Bitton and the University of Guelph 2016, 2). Across Canada, 45% of farmer respondents had high stress, and 35-58% met classifications for anxiety and depression (Jones-Bitton and the University of Guelph 2016, 2).

Diet

One precursor to type 2 diabetes is decreased insulin sensitivity, and this can be influenced by excessive carbohydrate consumption. Historically, carbohydrates made up a smaller portion of the typical diet, with one study finding that most hunter-gatherer societies derived 56-65% of their energy from animal products (Cordain et al. 2000, 682). The boom in agriculture in the early 20th century allowed for cheaper food production and the use of products with lower nutritional value. An increase in access to cheap processed food today has left Canadians at an increased risk for diabetes. Refined sugars and other processed oils and fats are much more prevalent in people's diets, with healthier food options at greater cost.

Physical Activity

The Canadian 24-Hour Movement Guidelines recommend levels of physical activity for children and adults. For children and youth (ages 5-17 years), at least 1 hour of the day should be spent on moderate to vigorous physical activity, and this age group should not exceed more than 2 hours of recreational screen time per day (Canadian Society for Exercise Physiology n.d. b). For adults (aged 18-64 years), at least 150 minutes per week should be attributed to moderate to vigorous physical activity, with muscle-strengthening activities being performed at least twice a week (Canadian Society for Exercise Physiology n.d. a). Adults should spend several hours a day on light physical activities, including standing and limit sedentary time to 8 hours or less (Canadian Society for Exercise Physiology n.d. a).

In 2016 and 2017, only 16.4% of Canadian adults and 39.2% of children/youth were meeting these physical activity guidelines (Statistics Canada 2019b). 53% of children/youth did not exceed the 2-hour per day screen time recommendation; girls were more likely than boys to meet this recommendation (Statistics Canada 2019a, 5).

Chronic Obstructive Pulmonary Disease

COPD is a term used to describe several progressive lung diseases including refractory asthma, chronic bronchitis, and emphysema. Because the term encompasses a number of distinct diseases, the causes of COPD vary. However, COPD-type diseases have similar symptoms. COPD is currently incurable and is characterized by increasing breathlessness. The shortness of breath that is characteristic of COPD has the potential to severely reduce quality of life by reducing the capacity to perform work, participate in physical recreational activities, or even accomplish daily tasks that involve physical activity.

Emphysema is caused by damage to the alveoli in the lungs, the site of oxygen and carbon dioxide transfer. Reduced gas transfer leads to chronic shortness of breath.

Chronic bronchitis is caused by damage to the bronchial tubes that carry gases in and out of the lungs. This reduces the overall capacity of the lungs. While the alveoli are still healthy, they do not receive a sufficient supply of oxygen which causes shortness of breath.

Refractory asthma is considered irreversible, meaning that it does not respond to typical asthma medications. This means that during an asthma attack, where the bronchial tubes swell and tighten, medications cannot help.

Communities with a higher prevalence of COPD are both more likely to have exposure issues (such as poor air quality or high smoking rates), and also a reduced quality of life for those affected.

Most prevalence rates for COPD in the BRW area range between 3-4%. The Lamont/Two Hills/Minburn region has the highest prevalence rate at 5.8%. Wetaskiwin & County comes close second with a rate of 5.2%. In 2019, the Central Zone of Alberta had a COPD prevalence rate of 3.76 per 100,000 population, compared to the Alberta COPD rate of 2.66 per 100,000 population (Alberta Health n.d. a). This indicates that the Central Zone of Alberta, including the BRW, has relatively more COPD than the province of Alberta as a whole.

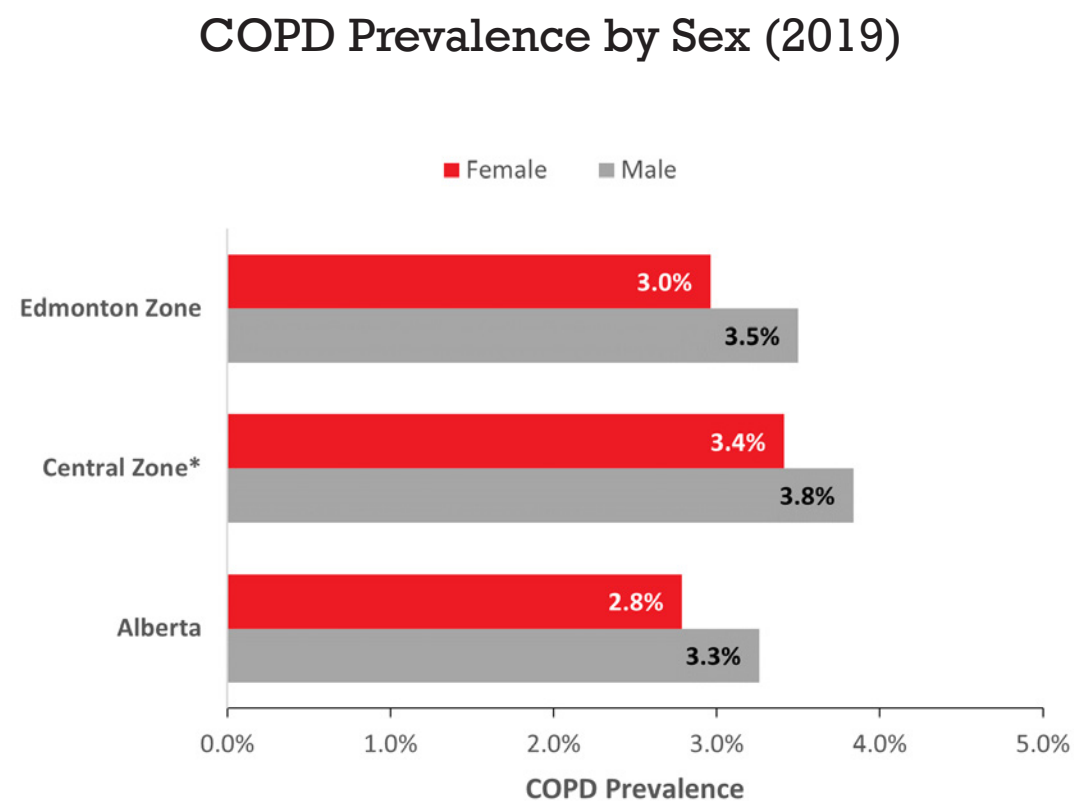


Figure 1.3: Age-standardized prevalence of chronic obstructive pulmonary disease (COPD) in the Edmonton Zone, the Central Zone (*contains the BRW), and Alberta in 2019 (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Chronic Obstructive Pulmonary Disease).

Understanding Chronic Obstructive Pulmonary Disease

It is estimated that two-thirds of Canadian COPD patients are undiagnosed (Waye et al. 2016). Since COPD is a respiratory disease, services extend past just seeing your family doctor - specialists, rehabilitation, and home care services are necessary in the treatment and management of COPD. There are not enough pulmonary rehabilitation services available for every patient diagnosed with COPD, and there is no information on home care visits in Alberta for severe cases (Waye et al. 2016). These types of services are also typically not found in rural areas or smaller urban municipalities, so residents in the BRW may lack access to proper treatment and support. Funding is also not allocated towards preventative programs, but rather goes towards hospitalization when patients have already reached the severe stage of their disease (Waye et al. 2016).

Populations at Risk

Marginalized groups often have a disproportionately high number of smokers. This may be due to reduced access to proper resources and education, and racial inequalities. For example, in Wetaskiwin, 26.7% of the population is First Nations or Inuit, compared to 2.8% of Alberta (Alberta Health 2017, 9). Smoking rates among Canadian Indigenous youth are approximately three times higher than non-Indigenous people (Jetty et al. 2017, 395). Smoking is also more prevalent in those with lower SES and poses a larger economic burden due to the higher proportion of their income spent on smoking products (Nargis et al. 2019, 2).

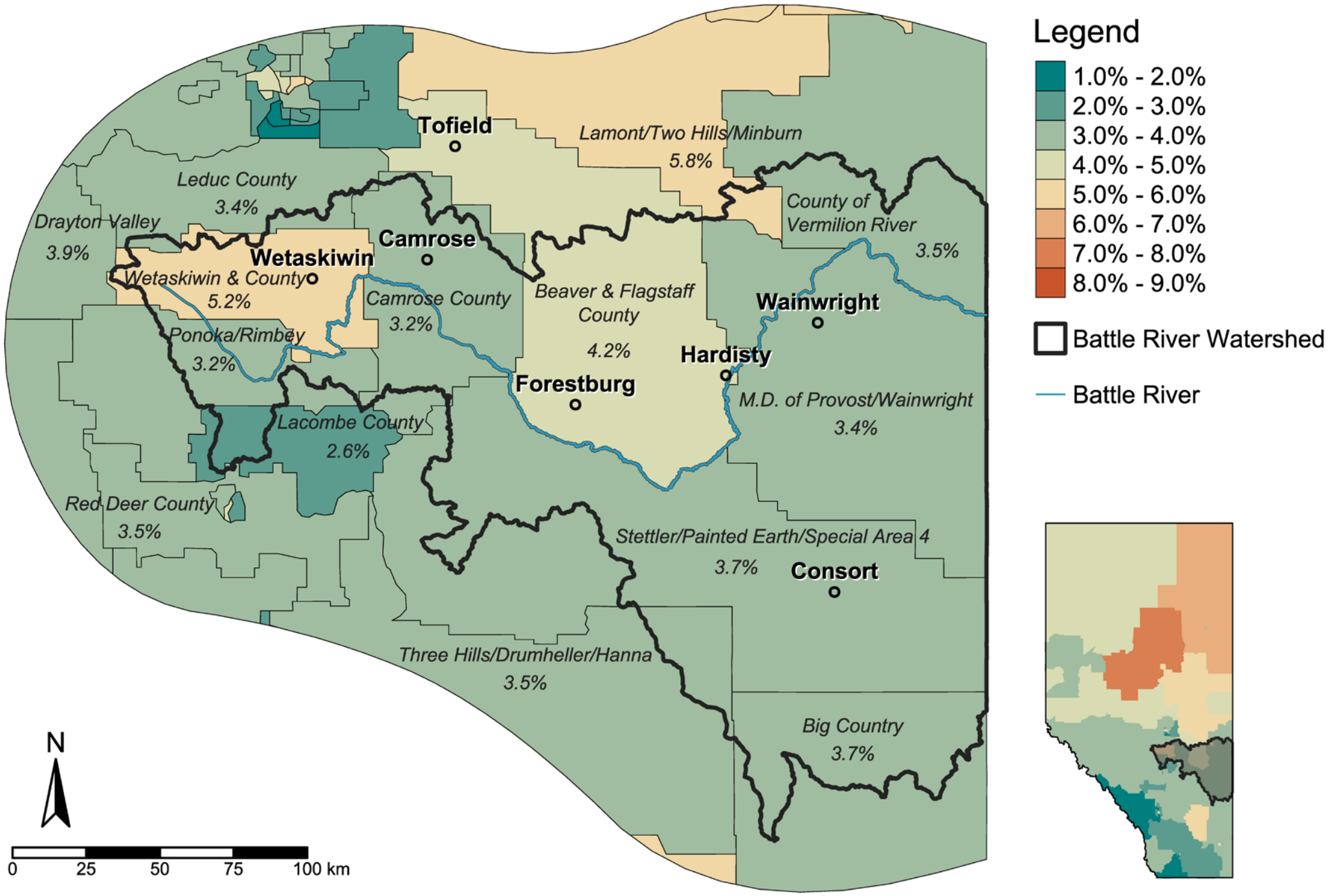
Risk Factors for Chronic Obstructive Pulmonary Disease

Smoking

Smoking rates in Alberta have decreased significantly over time, from 26% in 1999 to 15.8% in 2015 (Reid et al. 2019, 22). The

Chronic Obstructive Pulmonary Disease (COPD) Prevalence (2019)

% of population with condition (age-standardized)



Map 1.4: (Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Chronic Obstructive Pulmonary Disease).

drop in tobacco use is likely due to the change in societal views and healthcare education that surround the implications of smoking, as well as new laws.

Alberta prohibited smoking in public spaces in 2008. The Tobacco and Smoking Reduction Act (2005), prohibited smoking in public places, smoking by minors, advertising or promoting tobacco products, and the prohibition of flavored tobacco products (Government of Alberta 2021a).

The Government of Canada has initiated Canada's Tobacco Strategy, which aims to reduce tobacco use to less than 5% by 2035 (Government of Canada and Health Canada 2022). The strategy focuses on helping Canadians quit tobacco through improved services, taking preventative measures by protecting youth and non-tobacco users from nicotine addiction, working with Indigenous groups to create specific plans, and increasing funding and aiding research (Government of Canada and Health Canada 2022).

The rising popularity of e-cigarettes has caused another increase in smoking prevalence, with the smoking rate in Alberta rising from 15.8% to 18.9% from 2015 to 2017 (Reid et al. 2019, 22). E-cigarettes have been extremely popular since 2017, especially among youth. E-cigarettes are a relatively new form of smoking, in which a battery-powered device heats up a liquid that contains nicotine and other chemicals. They are marketed as more desirable than the standard cigarette, with sleek designs and flavored profiles, such as bubble-gum or cotton candy. These devices are popular with youth and teenagers, and pop culture often promotes these devices as many online influencers are seen smoking from e-cigarettes. Unfortunately, a significant number of e-cigarette users do not know that e-cigarettes contain nicotine.

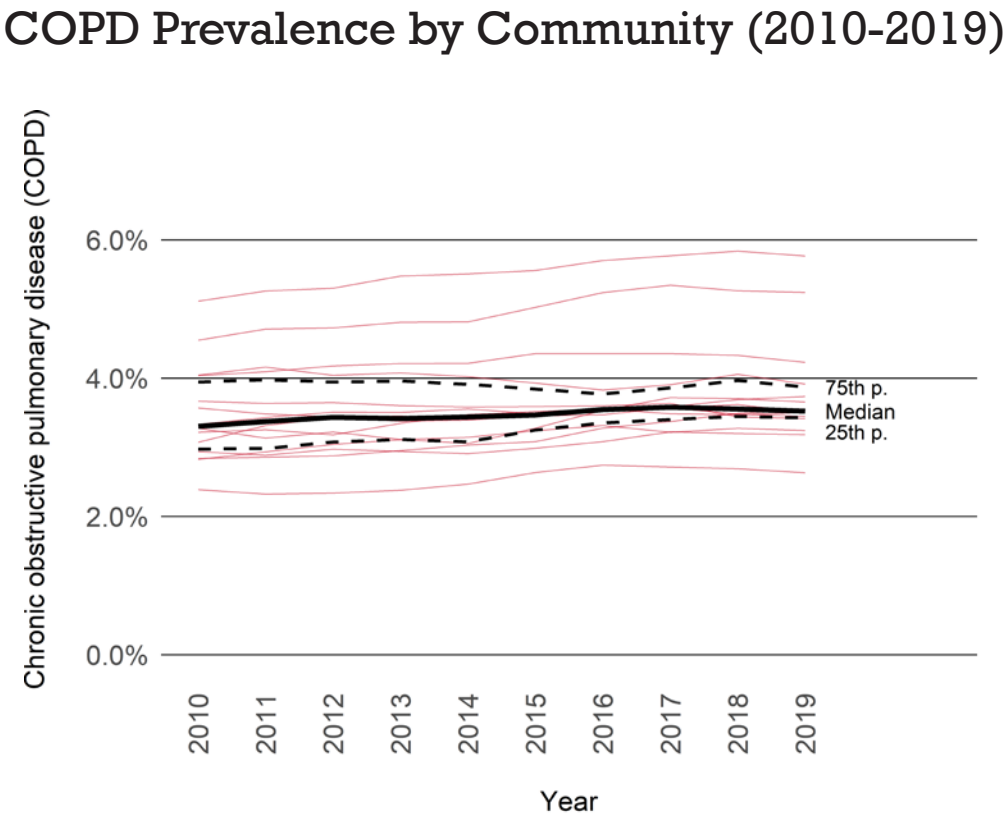


Figure 1.4: Chronic Obstructive Pulmonary Disease (COPD) prevalence for each LGA within the BRW from 2010 to 2019; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Chronic Obstructive Pulmonary Disease).

Chronic Smoking

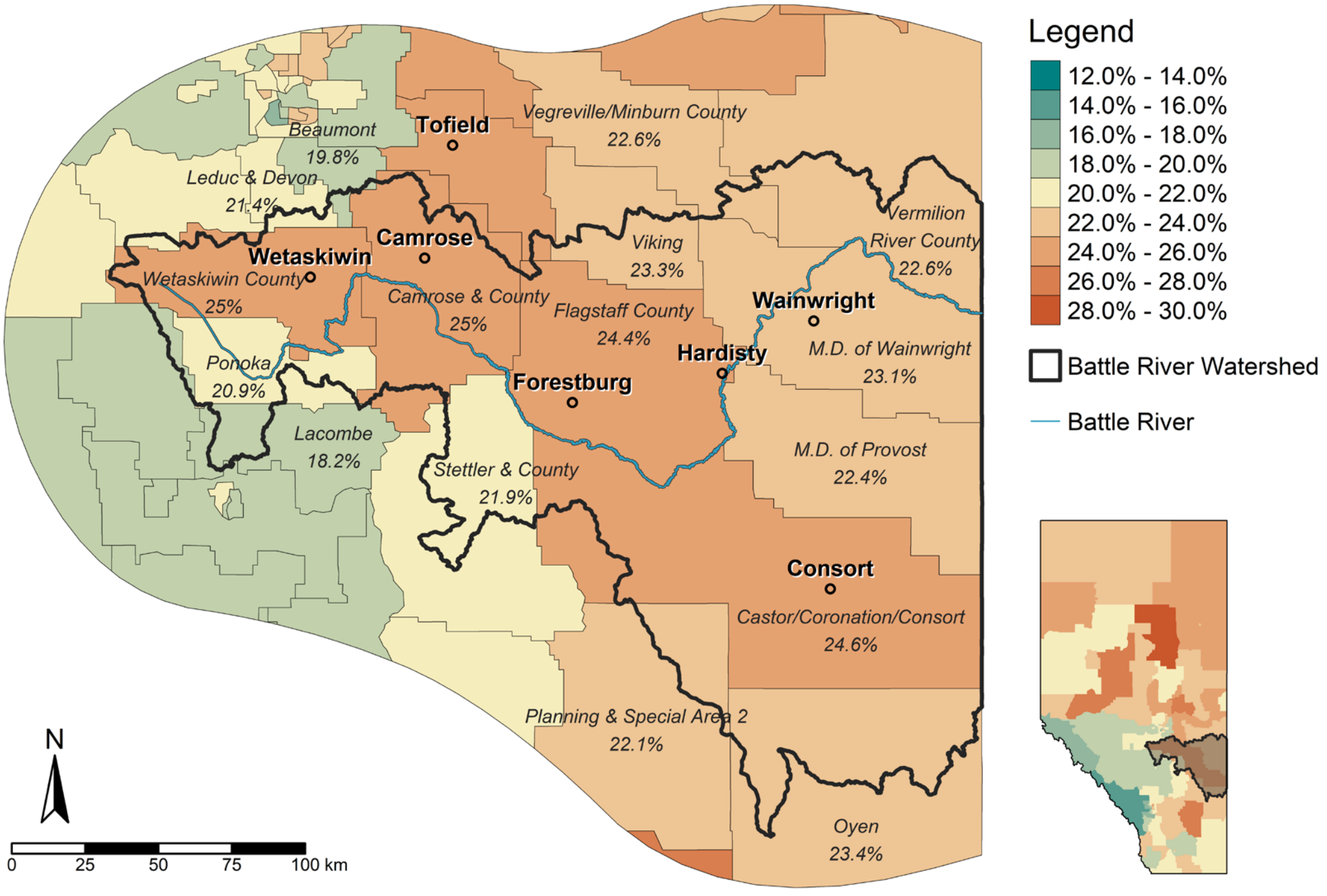
Chronic smoking represents the greatest risk factor for the development of COPD. The Government of Canada (2019a) reports that 80-90% of COPD cases are due to chronic smoking. As of 2017, 22.5% of Central Zone residents were categorized as daily/occasional smokers (Alberta Health 2019a, 4). This is higher than the Alberta rate of 16.7% of daily/occasional smokers (Alberta Health 2019a, 4).

Aging

COPD is a progressive disease, meaning that it worsens over time. In Canada, COPD has a prevalence rate of 14.9% in the 65-69 age group, rising to 24.7% in the 80-84 age group (Public Health Agency of Canada, 2018). In the Central Zone of Alberta, those aged 40-44 have a COPD prevalence rate of 0.52 per

Hypertension Prevalence (2019), Males and Females

% of population with condition (age-standardized)



Map 1.5: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Hypertension).

100,000 population (Alberta Health n.d. a). The rate rises to 5.29 in the 55-59 age group, and 10.53 in the 65-69 age group. The 85+ age group has the highest rate of COPD at 21.96, indicating that COPD is indeed a progressive disease.

Occupational Exposure

Occupational exposure includes exposure to dusts, such as coal and grain dust, and other fumes with outdoor air pollution (Government of Canada 2019a). The American Thoracic Society found that in 2010, ~20% of COPD cases are attributable to occupational exposure (Kraïm-Leleu et al. 2016, 2). COPD is most common in occupations of mining, construction, foundry, welding, steel, textiles, and farming (Kraïm-Leleu et al. 2016, 2).

Occupational exposure is considered an additive effect along with smoking toward the cause of COPD in an individual (Kraïm-Leleu et al. 2016, 2). The Health and Safety Executive (HSE) states that grain dust is a major occupational health risk, with the agriculture industry producing double the amount of asthma cases than the national average, which can progress into COPD.

The problem associated with grain dust is especially relevant for the BRW as agriculture is an essential industry for this area. Farming and growing grain were a major source of income in rural Canada, with the 2016 Census of Agriculture reporting 271,935 farm operators in Canada (Statistics Canada 2017a). Alberta averages 25-30 million tonnes of coal production each year. Coal mining is an occupational exposure risk for developing COPD and chronic bronchitis due to cumulative exposure to coal dust (Santo Tomas 2011). Smoking is a major risk factor toward worsening symptoms: however, COPD can still develop independently of smoking status in coal miners due to environmental exposure to lung contaminants (Santo Tomas 2011).

Hypertension

Hypertension, also known as high blood pressure, is an important risk factor for heart disease and stroke. Healthy lifestyle choices such as regular exercise, abstaining from tobacco use, and a healthy diet can decrease the risk of hypertension. Increased blood pressure can be linked with several environmental factors, including increased stress, poor diet, or unhealthy behaviours including smoking. In addition to cardiac issues, hypertension has negative effects on the brain. Increased pressure can lead to the bursting of blood vessels in the brain, commonly called a hemorrhagic stroke, which can cause decreased cognitive function and impairment of speech and motor skills. Hypertension may also affect the kidneys. The kidneys are responsible for filtering the body's blood many times per day, and the small vessels that filter blood in the kidneys are vulnerable to increases in blood pressure. Hypertension can damage these vessels, which can eventually lead to chronic kidney disease (World Health Organization 2021).

Hypertension rates in the BRW vary from 22-26%. A few regions in the BRW surrounding area, such as Stettler & County, Ponoka, and Lacombe are lower, with rates between 18% and 20% Castor/Coronation/Consort, Flagstaff County, Camrose & County, and Wetaskiwin County have the highest hypertension prevalence rates in the BRW between 24%-26% (Map 1.5). As of 2019, the hypertension prevalence rate in the Central Zone of Alberta is 21.09 per 100,000 population (Alberta Health n.d. g). This rate is slightly higher than the Albertan rate of 20.60, indicating that the BRW and surrounding areas have more cases of hypertension than the Alberta provincial rate (Alberta Health n.d. g).

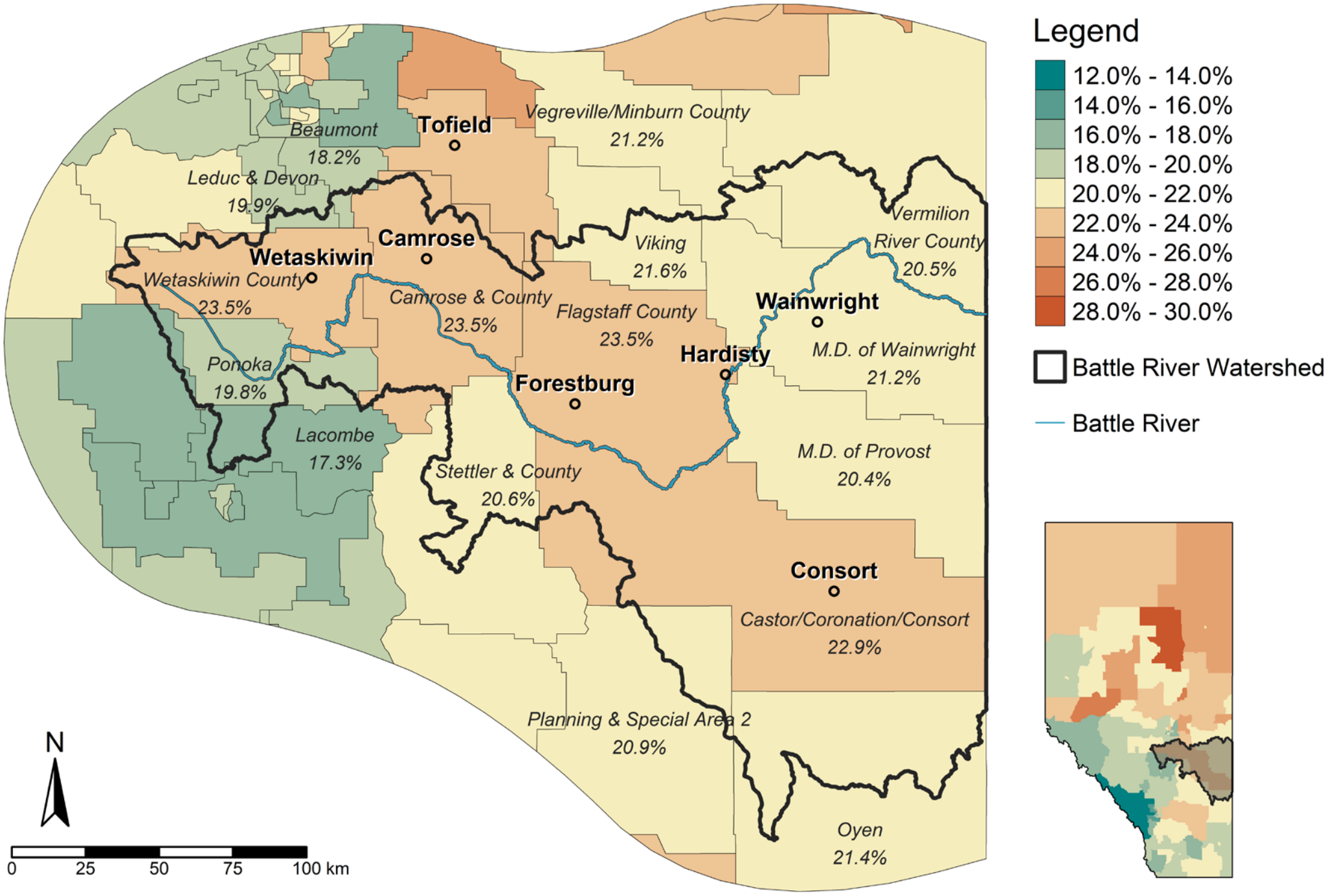
Understanding Hypertension

The World Health Organization (WHO) defines hypertension as a condition in which the blood vessels have persistently raised pressure (2021). Optimal blood pressure is between 90/60 mmHg to 120/80 mmHg. For an individual to be considered hypertensive they must present consistently with a blood pressure of 130/80 mmHg. Hypertension can lead to a variety of complications such as heart attack or stroke, aneurysms, heart failure, and weakened blood vessels in the kidneys. Risk factors for developing hypertension are extensive, including increased age, obesity, inadequate physical activity, use of tobacco or alcohol, and diet.

In the Central Zone of Alberta, the prevalence rate of hypertension rose from 18.0% in 2004 to 21.09% in 2019

Hypertension Prevalence (2019), Females

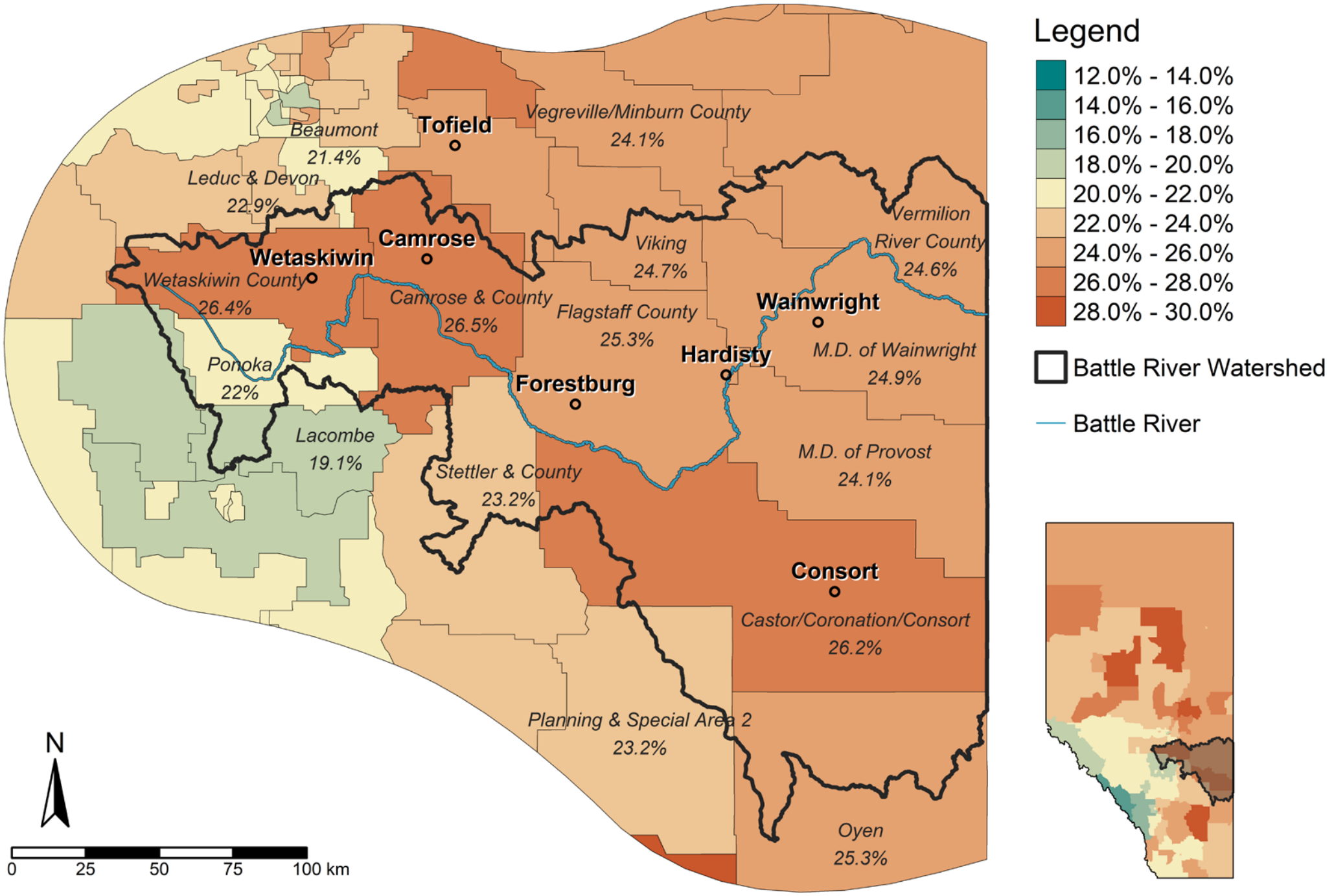
% of population with condition (age-standardized)



Map 1.6: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Hypertension).

Hypertension Prevalence (2019), Males

% of population with condition (age-standardized)



Map 1.7: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Hypertension).

(Alberta Health n.d. g). Several factors account for the increase in hypertension prevalence throughout the years. Changes in diet from one composed of mainly whole foods including fruit, vegetables, meat, poultry, and fish, to one with increasing amounts of high-sodium processed foods is a significant causal factor (Schiffrin et al. 2016, 290). Levels of physical activity are not always met, with only 16.4% of Canadian adults meeting physical activity guidelines stated in Canadian 24-Hour Movement Guidelines (Statistics Canada 2019b). Historically, hypertension was left to the discretion of family physicians ultimately, leading to a lack of screening and diagnosis of hypertension in the general population (Schiffrin et al. 2016, 288).

Risk Factors for Hypertension

Aging

The risk of hypertension increases with age (World Health Organization 2021). In 2019, Central Zone residents in the age group of 20-24 have a hypertension prevalence rate of 1.27 per 100,000 population (Alberta Health n.d. f). The prevalence rate increases to 44.97% in the 60-64 age group, with the age group of 85+ having the highest hypertension prevalence rate at 84.92% (Alberta Health n.d. f).

Inactivity

Inactivity often coincides with being overweight/obese. Lack of physical exercise increases the risk of being overweight, and obesity causes high blood pressure. Eating unhealthy foods and having excessive salt intake is another risk toward the development of hypertension (World Health Organization 2021). In 2017, 33.7% of Central Zone residents were classified as 'overweight', and 28.8% were classified as 'obese' (Alberta Health 2019a, 3).

Sex

There are differences in hypertension prevalence rates based on sex in the BRW. In the BRW, hypertension is higher in the male population, with prevalence rates ranging from 22-28% in most regions. The female population in the BRW has slightly lower hypertension prevalence rates, ranging from 20-24% in most regions. Females aged 25-29 years in the Central Zone of Alberta had a hypertension prevalence rate of 1.75% in 2019, compared to 2.27% in the male population of the same age group (Alberta Health n.d. f). In the Central Zone of Alberta, 70–74 year-old females had a hypertension prevalence rate of 65.01% in 2019, compared to the prevalence rate of 69.36% in males of the same age group (Alberta Health n.d. f). Although there are minor differences in hypertension prevalence based on sex, the general trend is that both males and females have an increased risk of hypertension as they age.

Hypertension Prevalence by Community (2010-2019)

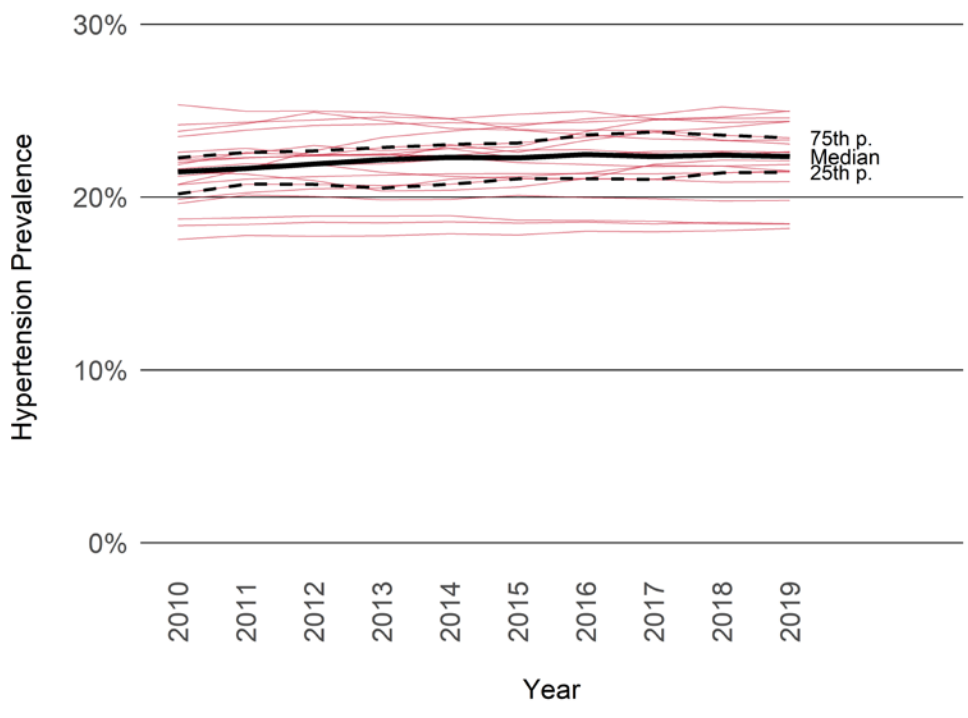


Figure 1.5: Hypertension prevalence for each aggregate local geographic area (ALGA) within the BRW from 2010 to 2019; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Hypertension).

Food, Diet, and Hypertension

In the late 19th century and early 20th century, the typical family diet was very different than what one might see today. There was less access to stores and markets, so families tended to rely on what they could grow, farm, or hunt to eat. This reduced access to food meant that 'boredom eating,' or eating just for pleasure, was a less common phenomenon. According to Dirks (2016, 1), "eating was a matter too routine to give it much thought." Access to processed food was limited due to travel being mostly via human or horse power. Dirks (2016, 55) found that American immigrants living around 1900 commonly consumed the following: fresh beef, eggs, milk, sugar, potatoes, onions, veal, fresh pork and fish, bread, butter, lard, and cabbage. This list is very different from foods that would be seen on a typical North American dinner plate, or television tray. Today, people consume dairy products as 10.6% of their energy, cereal grains as 23.9%, refined sugars as 18.6%, and refined vegetable oils as 17.6%. These foods were not consumed in even close to these quantities in our pre-agricultural past and were certainly not consumed in the same quantities even 100 years ago.

The WHO recommends a diet that is low in fats, sugars, and sodium in combatting hypertension (2021). Excess fat is created through the consumption of processed/deep-fried foods, leading to obesity. Sugars, a type of carbohydrate, will be converted into triglycerides and stored in fat cells. Another facet of a healthy diet is a restriction on sodium intake. Diets that are high in sodium result in an excess of sodium in the bloodstream, leading to an increase in blood pressure. Excess fat, sugar, and salt consumption due to poor diet can also lead to diabetes. High blood pressure is common in patients with type 2 diabetes, as it is linked to impacting insulin resistance (Tsimihodimos et al. 2018, 422).

Hypertension represents a threat not only to the lives of Albertans, but also to the healthcare system. As of 2010, $1.4 billion was being spent on hypertension-attributable costs, with the average spending on an individual with hypertension totaling $5,768 (Weaver et al. 2015, 502). It has been found that education to improve diet and activity, as well as education on reducing alcohol consumption, has had almost no effect (Schiffrin et al. 2016, 290). Instead, public policies for creating healthy communities are required, such as implementing healthy food policies through restricting the marketing of unhealthy food to children. (Schiffrin et al. 2016, 290).

Policy Responses for Chronic Diseases or Conditions

International data show that Canada has comparatively low rates of diabetes, COPD, and hypertension. However, a 2014 report found that 1 in 10 respondents experienced difficulty receiving primary healthcare services (Statistics Canada et al. 2014, 6). The findings of the survey are discussed in a 2014 University of Alberta report on chronic disease management and primary care in Alberta (Chowdhury 2014). According to respondents, the most common difficulties in accessing primary care were: getting an appointment, waiting too long for an appointment, or waiting too long to see a doctor. These barriers to care occurred even more often for those with two or more chronic conditions. Almost 70% of respondents stated that they did not have after-hours access to a physician, not including the Emergency Room (ER), and one in three felt that their last visit to the ER could have been avoided had their regular general practitioner (GP) been available. While 87.3% of the respondents stated that they were willing to see a nurse practitioner (NP) if their GP was not available, only 6.1% actually received care from NPs. This suggests that negative health outcomes for Albertans may not be linked so much to disease prevalence as to bottlenecks in the healthcare system. The findings also suggest that people who do live with chronic disease are more likely to experience barriers to care or to require emergency treatment because of a lack of access to a regular primary care provider (Chowdhury 2014).

Managing and preventing chronic illnesses in Albertans, and Canadians in general, often involves visiting a family doctor, reading the resources that are provided by Alberta Health Services (AHS) or the Canadian Government, or, in worst-case scenarios, seeking treatment at the emergency department. These strategies may not ultimately be the most effective ways to prevent or manage illness. If we want to both reduce and effectively manage chronic illness, we need to look toward multi-sector,

community-based approaches. This section will detail Alberta's existing approach to managing chronic illness, and will also look into community-based approaches aimed at reducing the incidence and prevalence of chronic illnesses in rural communities.

How have governments responded?

In 2008, the Government of Alberta released Vision 2020, a document that aimed to improve the efficiency, accountability, quality, and accessibility of health services in Alberta. This plan sought to increase services for those aged 65 and over and to increase services for improving mental health (Government of Alberta 2008b, 3). The plan specifically set out to achieve high-quality services in rural areas by instituting expanded telehealth services, integrating emergency medical services with specialist/diagnostic and acute care services, and expanding selected rural hospitals (Government of Alberta 2008b, 3). Matching workforce supply to demand for services was also an explicit goal in this strategy.

Other objectives were: increasing team-based care within primary care networks, improving the consistency of care, and changing reimbursement incentives to align with new models of care (Government of Alberta 2008c, 5). Another objective was improving co-ordination and delivery of care while using health resources as effectively as possible. By allowing pharmacists, NPs, and other professionals to assume a larger role in care delivery, the plan sought to ensure that all Albertans would have access to quality health care wherever they live (Government of Alberta 2008c, 3). The report also incorporated a focus on health-system sustainability, through increasing access to preventative care against chronic disease and injury (Government of Alberta 2008c, 7).

In 2010, the Alberta Government released Alberta's 5-Year Health Action Plan (2010-2015) which aimed to have Alberta's healthcare system become the most successful in Canada at treating and preventing illness. The plan sought to achieve this outcome with five strategic tasks:

- improving access and reducing wait times for patients throughout the entire system, including access to specialists,
- providing more choice for continuing care through adding and refurbishing long-term care beds and improving options for home care,
- strengthening primary healthcare through better connecting Albertans to family doctors and other health care providers,
- emphasizing preventative action, and
- building a single health system (Alberta Health and Wellness, and Alberta Health Services 2010, 2).

In 2014, the Alberta Government detailed a new Primary Health Care Strategy and policy design for the primary healthcare system. The strategy was produced with the aid of expert advisory groups, an advisory committee, a strategy working group, and the department of health to respond to demographic changes that affect the healthcare system in Alberta (Government of Alberta 2014b, 1, 5). Fred Horne, Minister of Health at the time, stated that while Alberta is second in the country in terms of spending on healthcare per person, this spending has not translated into health outcomes. Only 51% of Albertans rated their access to health care services as 'easy', 30% of Albertans have at least one of seven chronic health conditions, a percentage that increases drastically among seniors, and the average Albertan's life expectancy at birth ranks fourth in the country (Government of Alberta 2014b, 8). The 2014 Strategy set out to improve these outcomes by increasing the proportion of Albertans who have a consistent primary care team; improving timely access to primary health care; and bringing together clinical and social supports to promote wellness, provide quality care based on a proven course of action, and effectively manage chronic disease (Government of Alberta 2014b, 17). A further goal was enhancing self-management, thus improving patient involvement in treatment and care and providing patients with support to manage their health over the long term.

What is being done?

It is important to consider both the policies specifically targeted at hypertension, diabetes, and COPD, and the policy actions and 'soft' measures that aim to help individuals maintain their physical health, through promoting healthy diets and physical activity and reducing smoking, drinking, and life stress (World Health Organization 2021). Soft measures might include; public health campaigns,

advertising, and community events that influence public opinion and behaviours but are not matters of legislation.

Another reason to consider a broader legislative and policy approach is that there is currently no formal strategy in Alberta detailing the standards, procedures, or principles that must be followed to prevent or mitigate hypertension, diabetes, or COPD in the population (Government of Alberta and Alberta Queen's Printer n.d.). However, the interconnected nature of chronic illness with diet, physical activity, tobacco use, and alcohol consumption means that policies and actions directed toward those factors in personal wellbeing will also play a role in addressing chronic illness. Illnesses such as hypertension, COPD, and diabetes are also often targeted under federal programs from the Public Health Agency of Canada or Indigenous Services Canada. There are also Canada-wide nonprofit agencies dedicated to research, education, and patient support for many chronic illnesses.

Hypertension

When we look beyond legislation, we find a number of guidelines directed toward both the general public and public health officials. To prevent or combat hypertension, the Public Health Agency of Canada suggests that individuals should exercise roughly 30-60 minutes most days a week. (Public Health Agency of Canada 2009a). Along with exercising, Public Health recommends maintaining a healthy body weight according to BMI and waist circumference, and instructs individuals to limit their alcohol consumption to two drinks per day and no more than 14 standard drinks per week for men and nine standard drinks per week for women. The government also recommends that hypertensive patients and normotensive (normal blood pressure) individuals at increased risk of developing hypertension consume a diet that emphasizes fruits, vegetables, low-fat dairy products, whole-grain foods rich in dietary fibre, and protein from plant sources reduced in saturated fat and cholesterol. Stress-management in hypertensive patients can also be considered an intervention that might support other lifestyle changes (Nerenberg 2018, 516).

Diabetes

The Aboriginal Diabetes Initiative (ADI) was initially included in the Canadian Diabetes Initiative, but is now a separate program managed by Indigenous Services Canada (Indigenous Services Canada 2021). Type 2 diabetes affects Indigenous peoples in Canada at significantly higher rates than non-Indigenous people, and the ADI seeks to reduce rates of diabetes among Indigenous peoples by offering screening, treatment, and health promotion services tailored to meet the cultural, political, and social needs of Indigenous communities. (Indigenous Services Canada 2021). Diabetes in Indigenous communities in Canada is related to loss of access to traditional foods, remoteness, and other effects of colonization such as suppression of traditional activities including dancing, games, and hunting. Community-based initiatives supported by the ADI have included all of these activities, with a focus on how traditional activities can be a source of physical health and social wellbeing.

What could be done?

For the chronic illnesses examined here, a significant aid in preventing their onset is maintaining a healthy, physically active lifestyle (Centers for Disease Control and Prevention 2022b), and the policy recommendations from the personal physical health section could also be considered applicable to reducing the rate of chronic diseases in Alberta. A final piece of the puzzle, according to the Chronic Disease Prevention Alliance, is that the Albertan and Canadian governments could implement effective, long-term strategies to reduce household food insecurity in order to promote health and prevent chronic disease, especially in times of crisis such as during the COVID-19 pandemic (Chronic Disease Prevention Alliance of Canada 2020).

Many people with chronic illnesses continue to participate in the workforce (Beatty 2018, 35). For persons living with chronic illnesses, policies aimed towards normalizing and accommodating everyday life experiences would substantially improve quality of life (Langeland 2014). For example, Norway has implemented the 2014 Tripartite Agreement on a More Inclusive Working Life that focuses on ensuring the recruitment of those with disabilities and other vulnerable groups into the workforce, reducing the incidence of sick leave, and reducing the payment of disability benefits without causing hardship to chronically ill employees (Langeland 2014).

This agreement entails, among other things, facilitation grants for businesses that will encourage employers to organize work so that employees can remain working, despite chronic diseases and other health problems.

A 2014 report from the University of Alberta's Institute for Public Economics argues that the province should develop and implement a chronic disease management (CDM) performance index to help the government measure progress on chronic disease management and to help identify barriers to effective management (Chowdhury 2014, 38). Some measurements that could be included in a monitoring index would be: tracking the difficulty accessing after-hours care without going to the ER, ER use in the past two years, same or next day appointments with a family physician, and a measurement indicating long wait times (six days or more) for an appointment with a family physician (Chowdhury 2014, 23).

A long-term action from the report (between three to five years) would be to implement team-based primary care clinics to ensure availability of evening and weekend services for patients with chronic illnesses. The report further recommends fast-tracking training of physician extenders, such as NPs, will benefit Alberta as there is currently a large gap between the demand and supply of primary care providers. This gap could be reduced by opening up additional seats in post-secondary institutions and hospitals.

Recently, there has been a movement to shift Alberta's healthcare system away from the current physician-centric system and towards a system that would prioritize patients (Black, Fadaak, and Leslie 2020). NPs are viewed as important potential instruments in such a move. NPs are educated within the nursing model, with a holistic focus that encompasses health and illness and an emphasis on prevention, wellness, patient education, and the importance of the individual as the primary leader in their own care (Chowdhury 2014, 23). NPs and their patients have interpersonal, interactive relationships, which stresses communication and independent decision-making. This model allows patients to take an active role in managing their chronic disease with clear and specific communication and support from a professional (Chowdhury 2014).

One example of a community-based approach involves utilizing community-based health workers (CBHW), frontline public health workers who are trusted members of the community they serve (Kim et al. 2016, e3). A CBHW model has been shown to be a cost-effective way to address specific health conditions or behaviours for low-income, underserved, racialized, and minority citizens, and many rural communities meet some of these criteria. In addition, the CBHW model supports the transition from a health care system that focuses only on 'sickness care' to one that is also 'prevention-focused' (Kim et al. 2016, e26).

CBHWs are members of their communities, and often share cultural and linguistic backgrounds and life experiences with other residents. This is one reason why they provide tailored, culturally responsive interventions. Multi-sectoral action through CBHW can be a positive alternative in rural communities, or underserved communities, as CBHW have a lived understanding of local barriers to prevention and control of chronic illnesses. Community strategies for reducing chronic disease, for example, may involve encouraging physical activity through increasing opportunities for extracurricular sports, reducing screen time in public services venues like childcare facilities, and increasing the amount of movement-based learning in schools (Meyer et al. 2016, 11), interventions which could be supported by CBHWs connected with the school system and with childcare services.

Finally, community members can work together to create a local environment that supports physical activity. Healthy interventions that go beyond the healthcare system include improving access to outdoor recreational facilities, enhancing infrastructure, supporting bicycling and walking, improving access to public transportation, enhancing personal safety in areas where people are or could be physically active, and enhancing traffic safety in areas where people are or could be physically active (Meyer et al. 2016, 11).

Physical Health

Poor physical health affects the quality and duration of an individual's life and their ability to be engaged and productive members of society. Poor health often contributes to lost economic productivity and increased healthcare costs for diagnosing and treating chronic conditions. These costs affect individuals, communities, and society at large. Good personal physical health stems from appropriate levels of physical activity, adopting a healthy diet, reduced life stress, and limited smoking and drinking habits. Good physical activity improves muscular and cardiorespiratory fitness and bone and functional health, and reduces the risk of hypertension, coronary heart disease, stroke, diabetes, cancers including breast and colon cancer, and depression. Physical activity also reduces the risk of falls resulting in hip or vertebral fractures and is fundamental to energy balance and weight control.

Healthy Alberta Trends Index (HATi)

HATi is a measure of personal physical health and risk factors for poor health based on six factors: life stress, BMI, fruit/vegetable consumption, physical (in)activity, smoking, and high-risk drinking. An individual is scored according to the number of risk factors they have, and then individual data is grouped according to region (provincial zone or health region). Data can also be analyzed by sex and year, but the most recent data collected in Alberta are from 2014. Since the index is focused on individuals, it does not account for sociocultural factors that may be interrelated with physical health, such as Indigenous status or ethnic background. The HATi gives us a good idea of the general physical health of the population. The index also provides a score for the average number of risk behaviours per person, allowing us to draw some conclusions about relative healthiness across different demographics. This is reflected, for example, in Table 1.1. When comparing male to female Albertans, males tend to have higher scores due to engaging in more risk-related behaviours.

Healthy Alberta Trends Index (HATi) by Sex and Zone (2014)

Region	Males	Females	Both
South Zone	2.60	2.06	2.34
Calgary Zone	1.96	1.94	1.95
Central Zone	2.48	2.00	2.25
Edmonton Zone	2.57	1.80	2.20
North Zone	2.52	2.34	2.44
Alberta	2.32	1.95	2.14

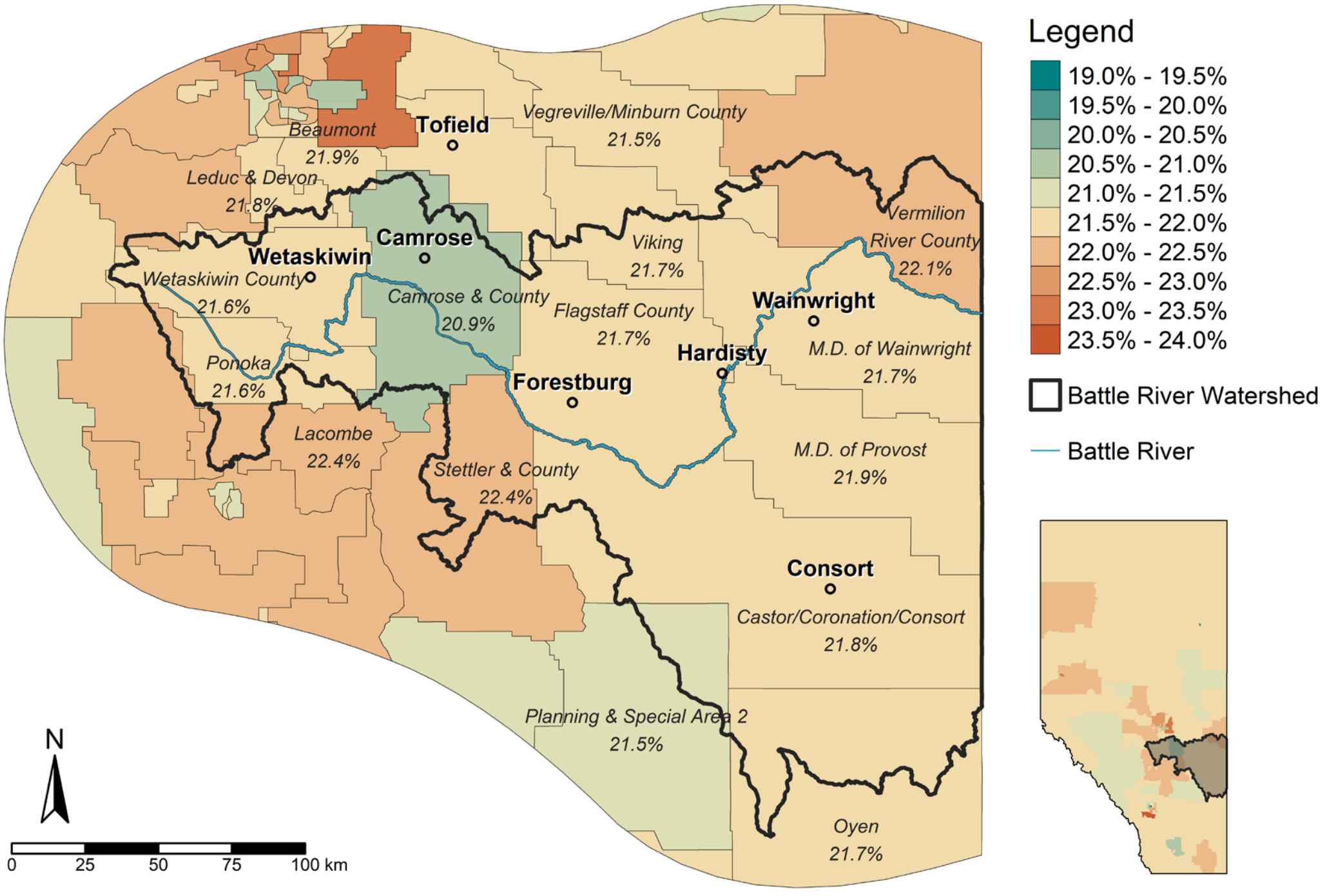
Table 1.1: Healthy Alberta Trends Index (HATi), a measure ranging from 1-6 representing the average number of high-risk behaviours prevalent in the population (*i.e.*, life stress, Body Mass Index, fruit and vegetable consumption, physical inactivity smoking, and high-risk alcohol consumption), by sex and health zone in 2014 (Source: Alberta Health, 2015).

Understanding Healthy Alberta Trends Index (HATi)

The HATi indicated a positive change in the personal wellbeing of Albertans from 2001 to 2014 (Alberta Health n.d. e). In 2001, the HATi for Alberta was 2.37, meaning that on average Albertans engaged regularly in 2.37 out of the 6 "risky behaviours" that are accounted for in the index. By 2014, that

Life Stress (2014)

% of the population that self-rated their level of life stress as 'Extremely' or 'Quite a bit' stressful



Map 1.8: (Source: Statistics Canada. 2014. Canadian Community Health Survey).

number had dropped to 2.14, a change of 5%. The story is the same for the Central Zone In 2001, the Central Zone had a HATi score of 2.62 and by 2014 that score had dropped to 2.25, a change of 14% (Alberta Health n.d. e).

On average, men have a higher number of risky behaviours as measured by the HATi index. In 2001, men in the Central Zone scored 2.9 while women scored 2.33. By 2014 those scores changed to 2.48 and 2.00 respectively (Alberta Health n.d. e). The drop in HATi scores across the board is a good sign of improving regional health. While the data do not directly indicate which risky behaviours are being reduced, it is still promising to see a positive change.

Life Stress

The first indicator measured by the Alberta Healthy Trends index is life stress. The HATi measures the proportion of the population that self-reports their life stress as 'extreme' or 'quite a bit stressful'. In 2001, the Canadian Community Health Survey found that 26.08% of Albertans were self-reporting high levels of stress (Alberta Health n.d. h). At the same time, the Central Zone reported a prevalence rate of 24.48%. In 2014, the scores were 22.47% and 20.70% respectively (Alberta Health n.d. h). This is positive, as it shows that subjective feelings of life stress have reduced over recent years (Map 1.8; Figure 1.6).

The provincial average rate for life stress is 21.8%, indicating that the BRW and surrounding areas have rates similar to the provincial average (Map 1.8).

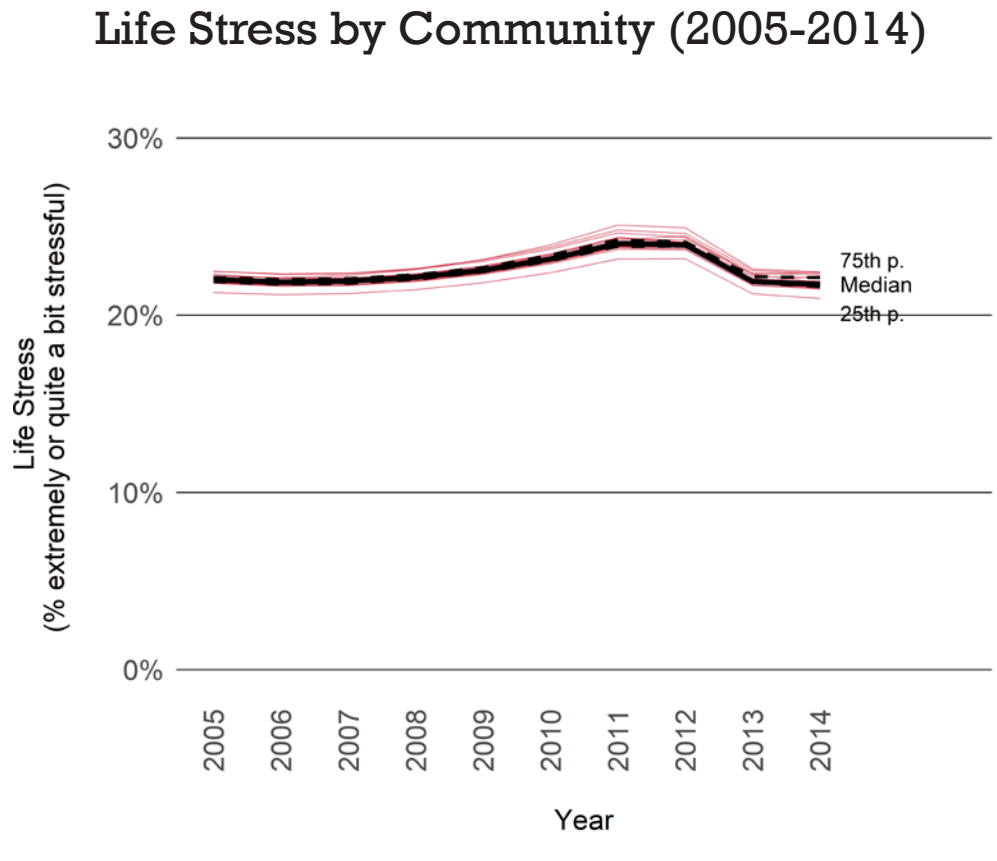
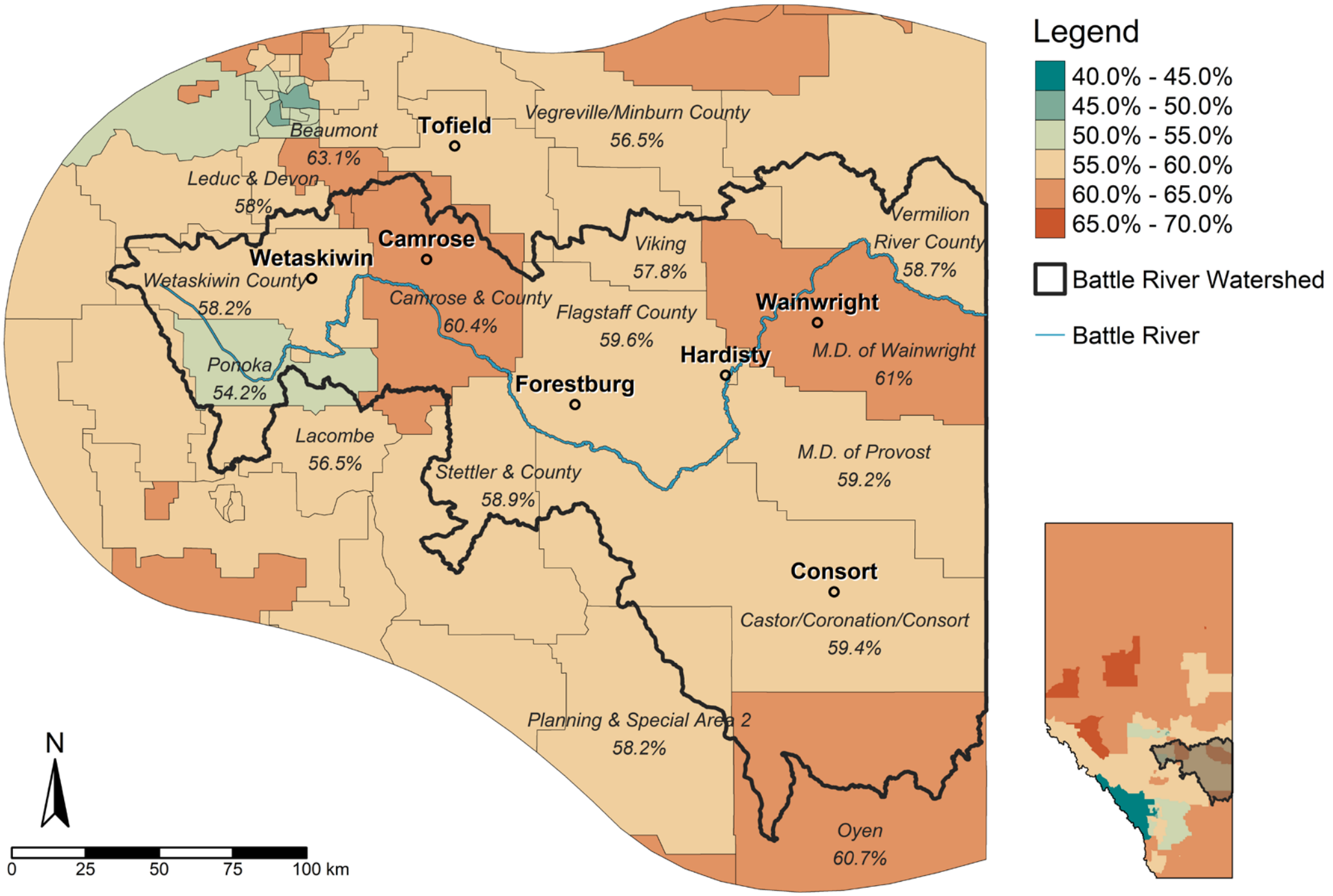


Figure 1.6: Median life stress (proportion reporting their life is extremely or quite a bit stressful) for each LGA within the BRW from 2005 to 2014; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Statistics Canada. 2014. Canadian Community Health Survey).

Overweight (2014)

% of the population that is overweight as defined by having a body mass index (BMI) of 25-30



Map 1.9: (Source: Statistics Canada. 2014. Canadian Community Health Survey).

BMI

BMI is a standardized measure of body fat that is based on height and weight. There are four separate ranges: underweight, normal weight, overweight, and obese (Table 1.2).

In 2001, the Albertan population was split, with 49.73% of Albertans measuring normal or underweight and 50.27% measuring as overweight or obese. In 2001, 41.67% of the Central Zone population was normal or underweight, while 58.33% of the population was overweight or obese. In 2014, the Albertan population saw an increase in BMI as underweight or normal weight went down to 45.16%, and overweight or obese went up to 54.84%. The Central Zone changed very little during this time. In Canada in 2015, 47.1% of the population aged 18-34 years were classified as overweight or obese, rising to 65.5% for the 35–49-year age group. A BMI above 25 is associated with increased health risks and mortality (Map 1.9; Figure 1.7).

Overweight Prevalence by Community (2005-2014)

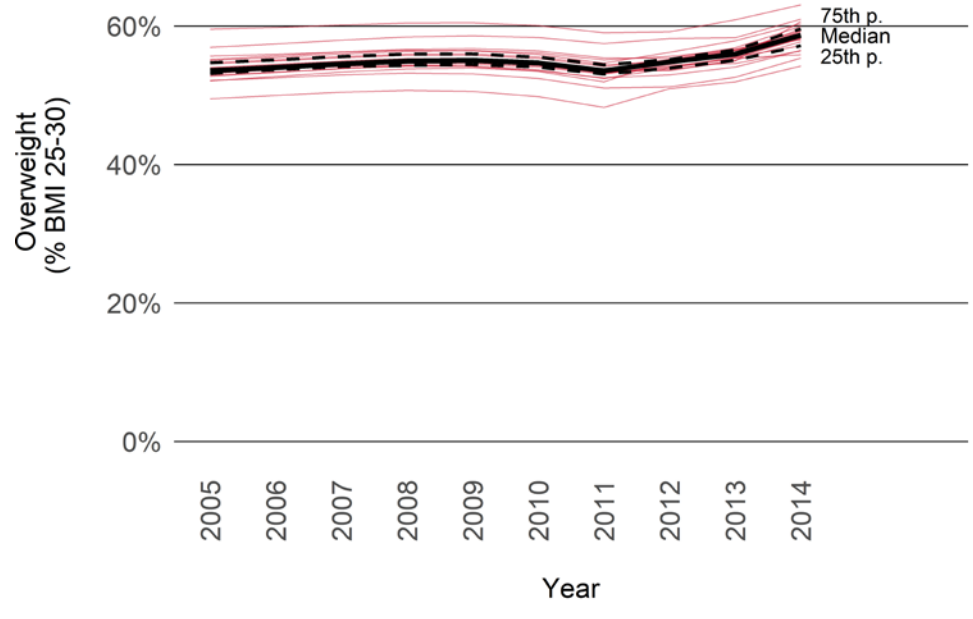
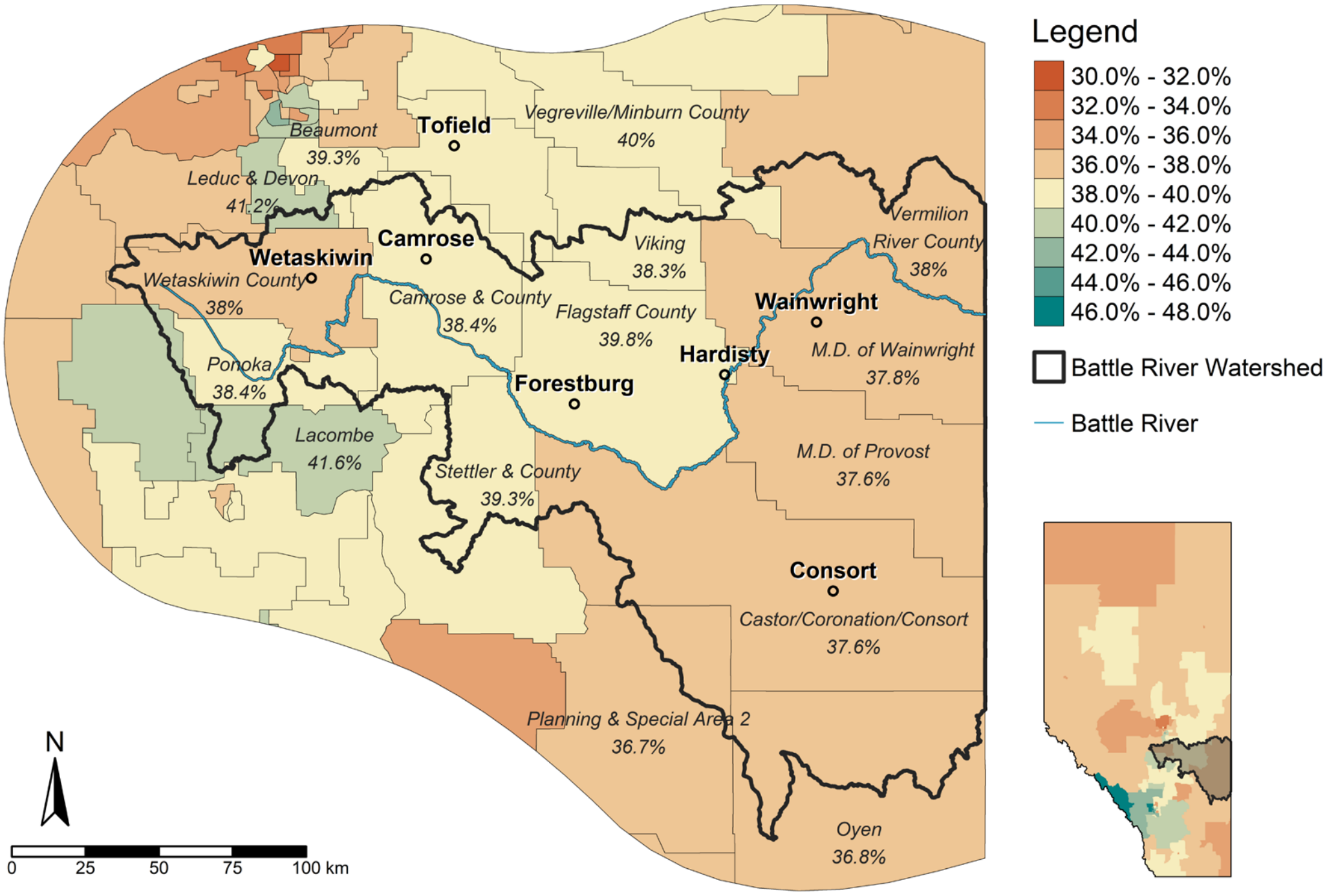


Figure 1.7: Overweight prevalence (proportion with a Body Mass Index 25-30) for each LGA within the BRW from 2005 to 2014; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Statistics Canada. 2014. Canadian Community Health Survey).

Fruit and Veggies (2014)

% of the population that self-reported that they eat 5+ servings of fruits and vegetables per day



Map 1.10: (Source: Statistics Canada. 2014. Canadian Community Health Survey).

Fruit and Vegetable Consumption

The HATi recommends that a minimum of five servings of fruit and vegetables per day is essential to a healthy diet. Fruits and vegetables are a source of vitamins and minerals, as well as antioxidants. Regular consumption of these foods is associated with a lower incidence of cardiovascular disease and obesity (Slavin and Lloyd 2012, 506).

Healthy diets contribute towards good physical health. In 2012, only 38% of Albertans met the recommendation of consuming 5 or more servings of fruits and vegetables per day (Alberta Health Services 2014, 1). In this same time frame, the Central Zone of Alberta was slightly above the provincial average of 39% (Alberta Health Services 2014, 2). The provincial rate of fruit and veggie consumption remains at 38% in 2014, with the BRW regions having similar rates (Alberta Health Services 2014, 1; Figure 1.8).

While the increase in fruit and vegetable consumption is promising, only 38% of Albertans are consuming the recommended number of fruits and vegetables. One explanation for this could be the cost of fresh fruits and vegetables. There has been a steady increase in the cost of some staple fruits and vegetables since 2000. For some families, the high cost and low caloric content of fruits and vegetables may make them luxury items that they cannot afford.

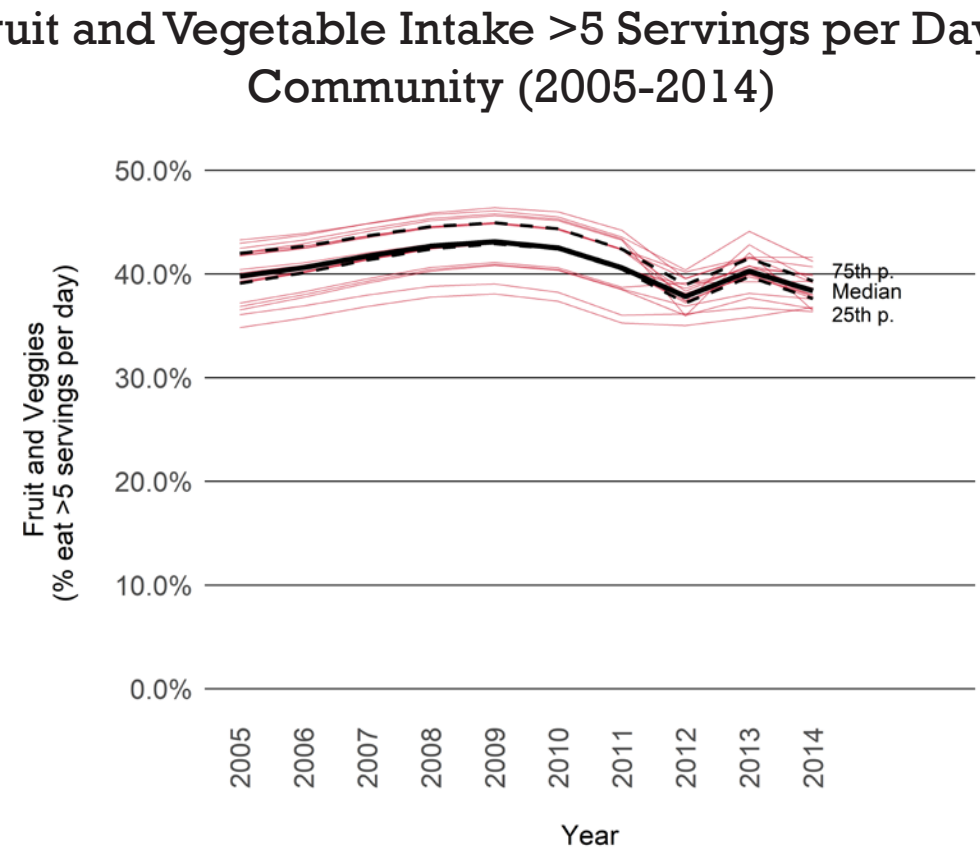
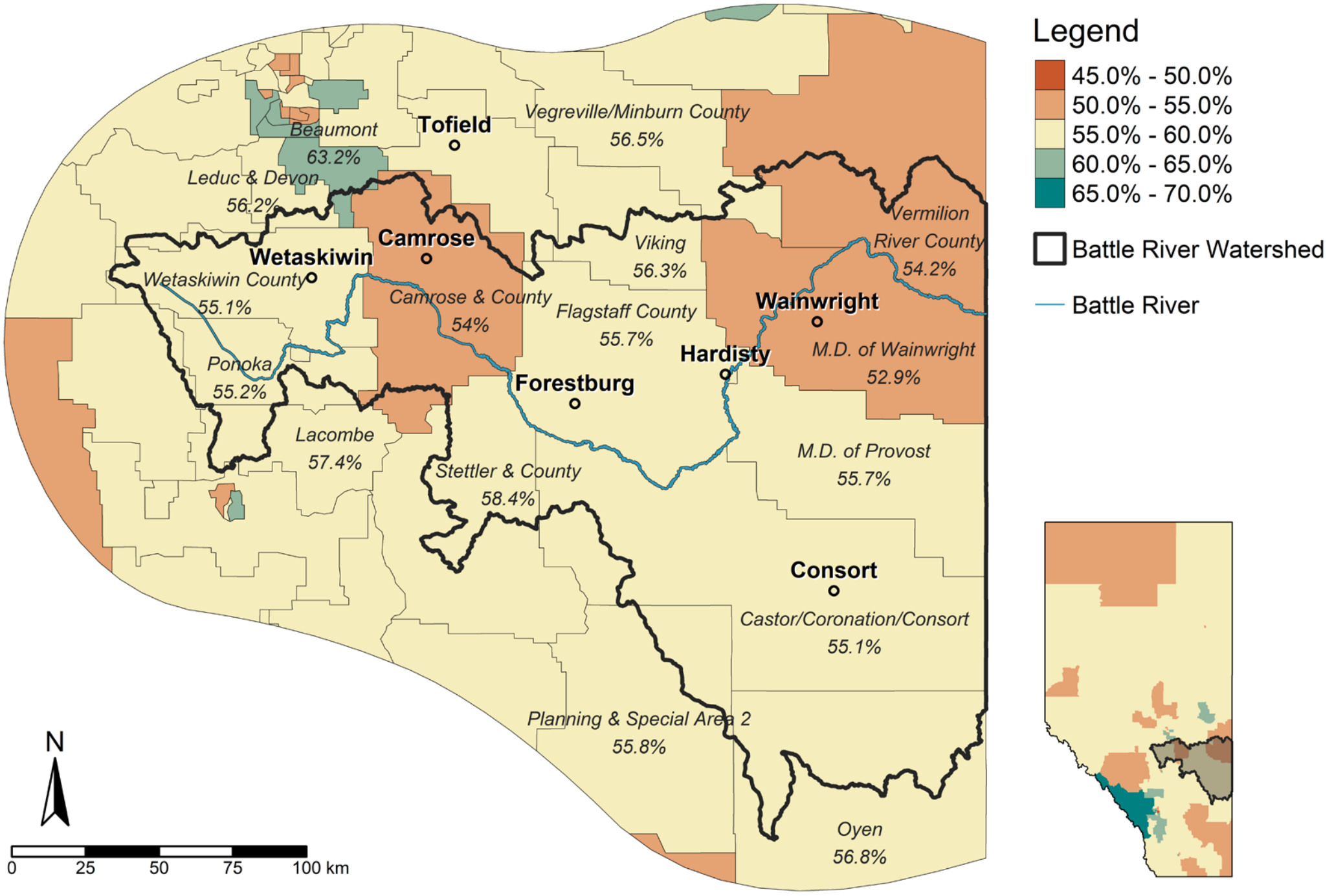


Figure 1.8: Proportion of the population who eat more than 5 servings of fruits or vegetables per day for each LGA within the BRW from 2005 to 2014; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Statistics Canada. 2014. Canadian Community Health Survey).

Physical Activity (2014)

% of the population that self-rated their level of physical activity as 'Active' or 'Moderately active'



Map 1.11: (Source: Statistics Canada. 2014. Canadian Community Health Survey).

Physical Activity

Physical activity and diet are the primary contributors to obesity. According to Rhodes et al. (2017), regular physical activity is an effective preventative strategy against 25 chronic medical conditions. A 2018 Canadian study found that only 18% of Canadian adults meet the recommended 150 minutes of moderate-to-vigorous physical activity per week (ParticipACTION 2018, 3). Fifty-six percent of Canadians believe that busy daily schedules, such as commuting, work, and screen-use, are barriers to becoming physically active (ParticipACTION 2018, 6).

In 2001, 52.19% of the Albertan population reported that they were active or moderately active. In the same period, only 46.52% of the Central Zone reported being active or moderately active. This indicator has improved in recent years with both the Albertan and Central Zone rates rising to around 57%. Most of the areas in the BRW fall within the 55-60% range for physical activity in the 'moderately active or active' scale. In 2017, 26.8% of Central Zone residents were categorized as inactive (Alberta Health 2019a, 4).

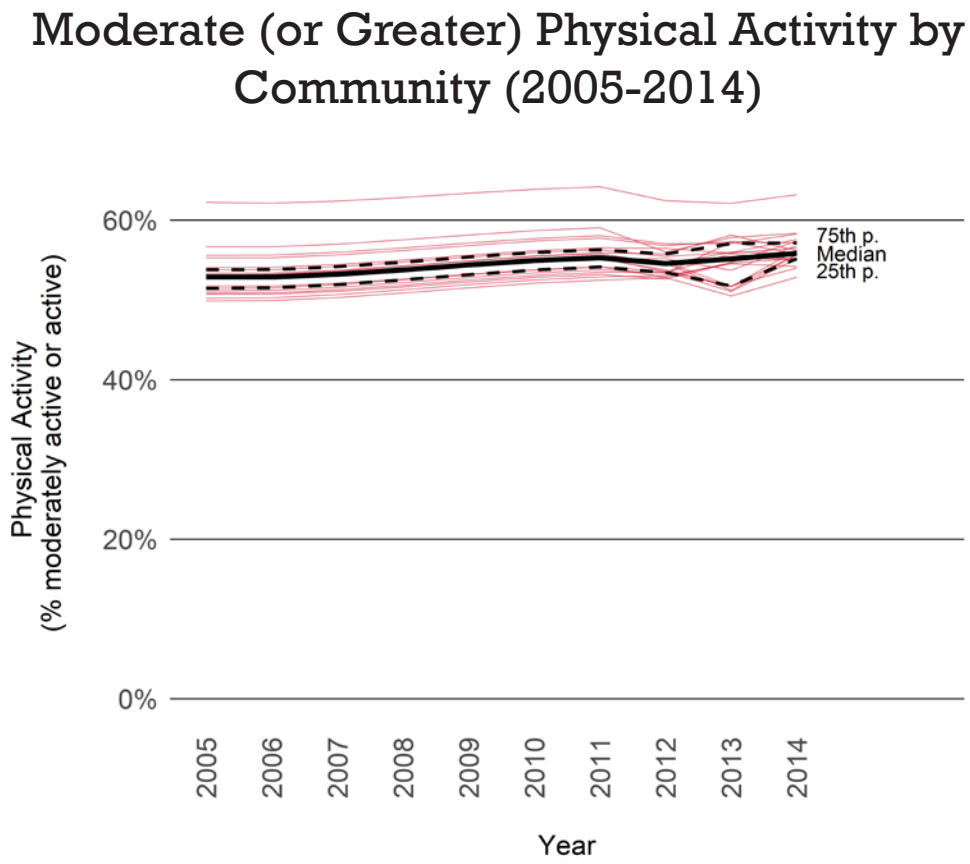
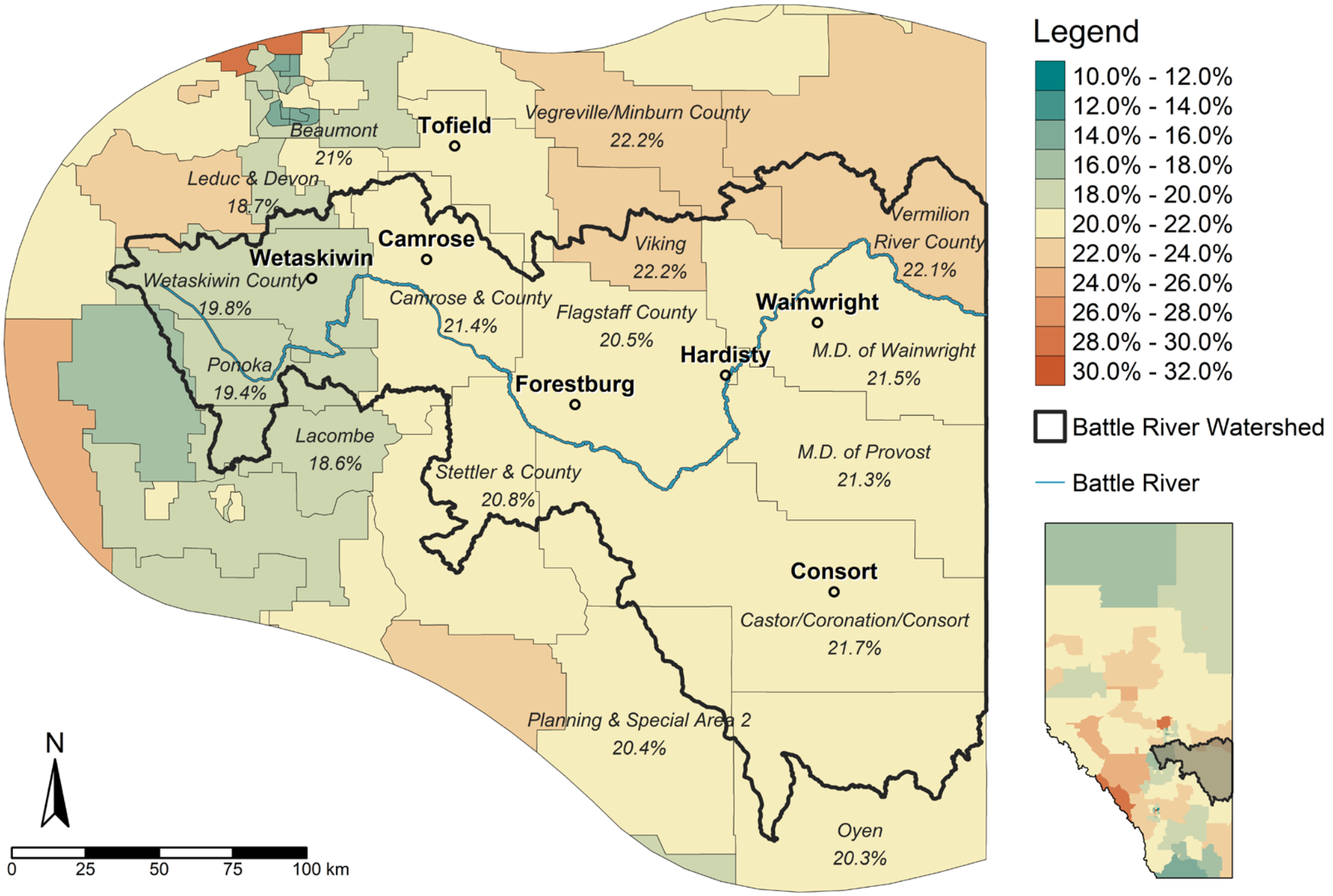


Figure 1.9: Physical activity level (proportion who report being moderately active or active) for each LGA within the BRW from 2005 to 2014; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Statistics Canada. 2014. Canadian Community Health Survey).

Heavy Drinking Prevalence (2014)

% of males who reported having 5 or more drinks, or women who reported having 4 or more drinks, on one occasion, at least once a month in the past year



Map 1.12: (Source: Statistics Canada. 2014. Canadian Community Health Survey).

Drinking

Binge drinking is defined as reporting five or more drinks at least two times per month.

Alcohol is the most common drug used by Canadians, and its use has increased significantly, especially within the female population, since 2013 (Canadian Centre on Substance Use and Addiction 2019, 1). A general survey conducted in 2017 found that 78.2% of Canadians aged 15 and over report drinking alcohol at least once in the past year of 2017 (Canadian Centre on Substance Use and Addiction 2019, 2).

As of 2017, Alberta ranked second highest for prevalence of alcohol consumption at 78.8% of the population (behind Quebec at 84.2%) (Canadian Centre on Substance Use and Addiction 2019, 6). A 2018 survey found that 19.1% of Canadians aged 12 and older reported heavy drinking at least once a month in the past year (Canadian Centre on Substance Use and Addiction 2019, 10).

In Canada, the young adult age group (18-24) makes up the greatest proportion of binge drinkers, with males making up a greater proportion than females; however, the rate of binge drinking in females is still high. At a provincial level, 19% of Albertans aged 12 and over were classified as binge drinkers in 2019 (Statistics Canada 2021c), compared to 18.3% for all Canadians (Statistics Canada 2021d).

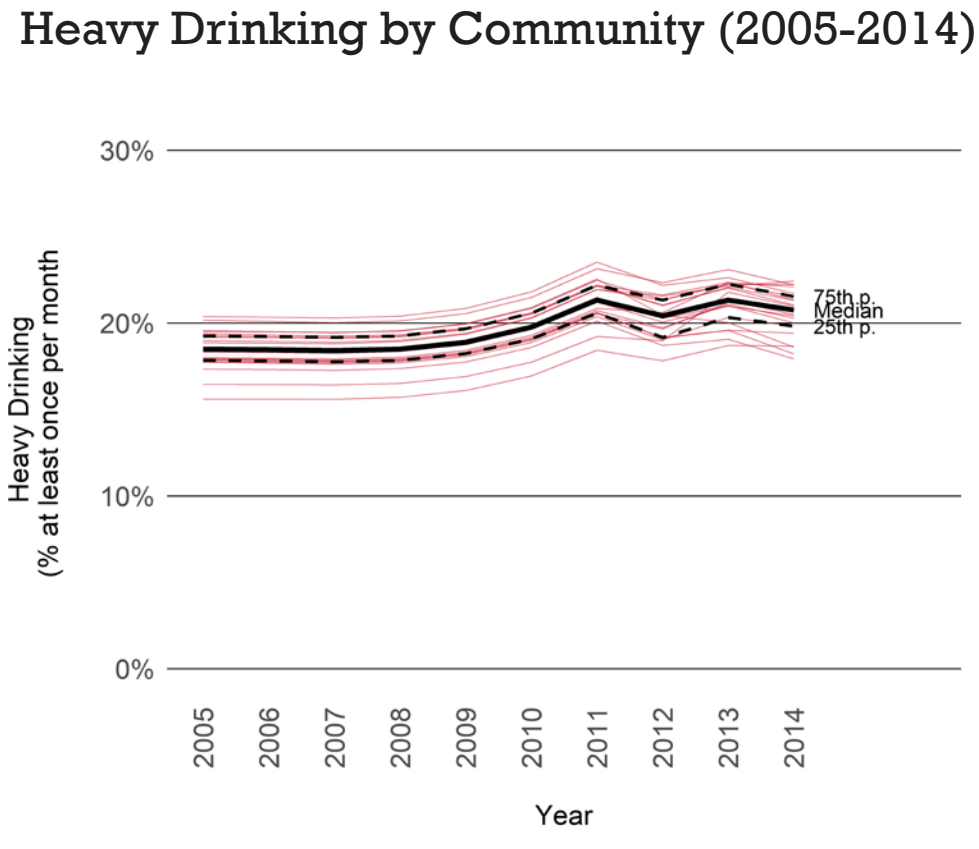
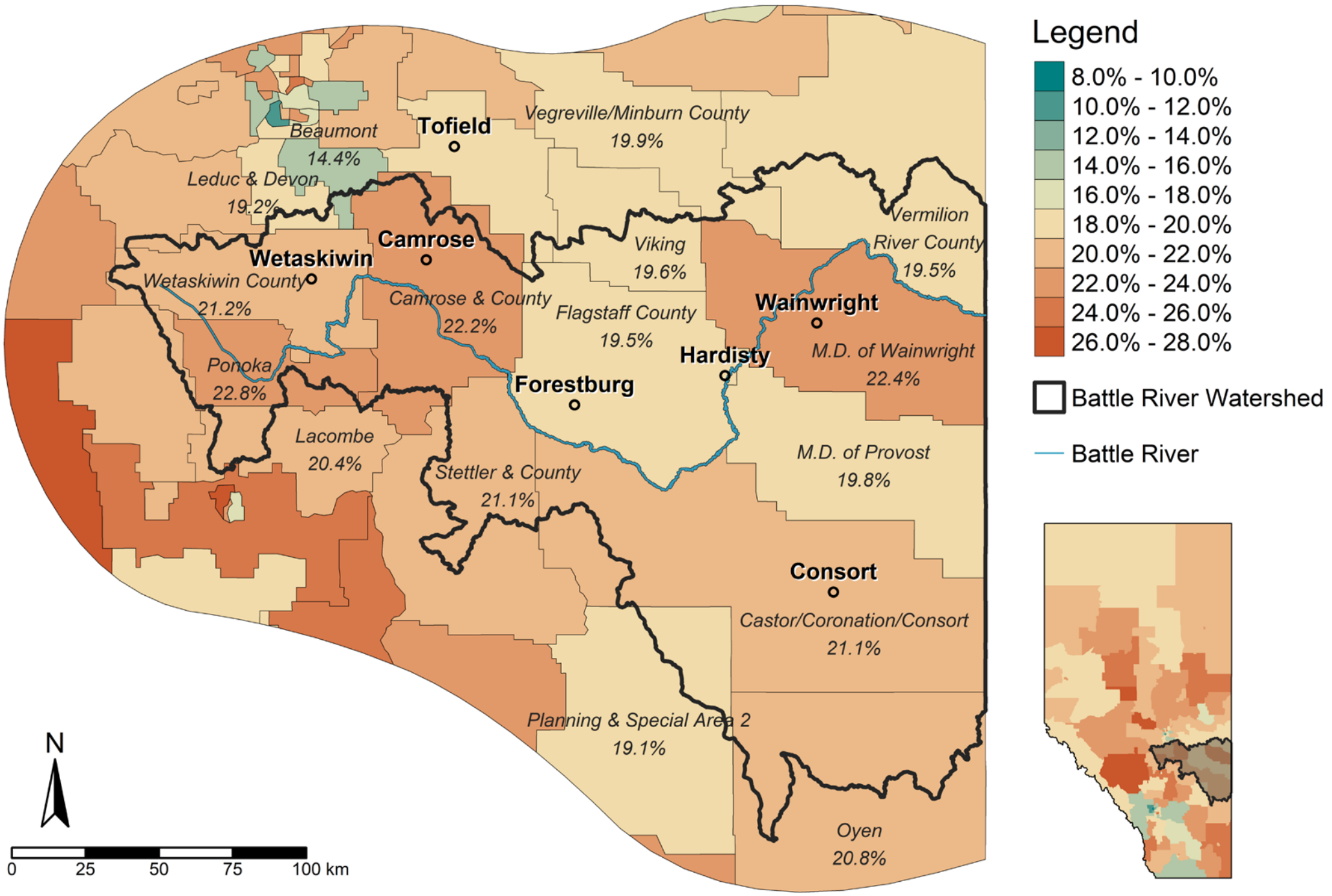


Figure 1.10: Median heavy drinking prevalence (proportion who drink heavily as least once per month) for each LGA within the BRW from 2005 to 2014; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Statistics Canada. 2014. Canadian Community Health Survey).

Occasional or Daily Smoker (2014)

% of the population that self-reported that they smoke occasionally or daily



Map 1.13: (Source: Statistics Canada. 2014. Canadian Community Health Survey).

Smoking

Tobacco use (including chewing tobacco) is the number one cause of preventable death and disability in the world according to AHS (n.d. c). It is known to cause cancer and is linked to illnesses such as diabetes, cardio-vascular disease, and pulmonary disease. A reduction in tobacco use suggests that regu-lations concerning the use and promotion of tobacco have been effective. These regulations include the banning of smoking in all federal workplaces, the banning of promotion and sponsorship of tobacco products, and as of February 7, 2020, the requirement of plain packaging for tobacco products (Tobacco Control Laws 2021).

The decision to start smoking extends beyond peer pressure or a desire to conform to certain societal standards. Statistics Canada (Statistics Canada and Janz 2015) found that youth living in lower income households were more likely to smoke than those living in higher income households. It was also found that individuals who were living in a house-hold with a regular smoker were three times more likely to smoke.

Both the Central Zone and Alberta saw a de-crease in the prevalence of daily smoking between 2001 and 2014. The Central Zone saw a decrease from 25.54% to 17.94% while Alberta saw a decrease from 23.05% to 14.52% (Alberta Health n.d. b). This is pos-itive as a significant portion of the popula-tion no longer smokes daily, but the BRW still exceeds the provincial average.

Occasional or Daily Smoking by Community (2005-2014)

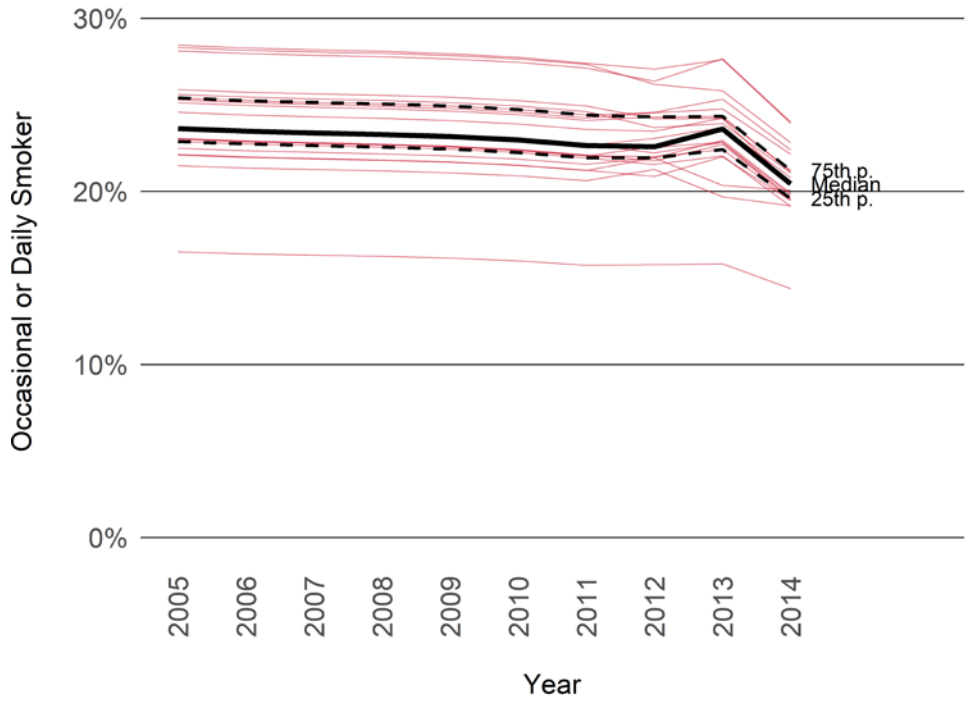


Figure 1.11: Smoking prevalence (proportion who smoke occasionally or daily) for each LGA within the BRW from 2005 to 2014; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Statistics Canada. 2014. Canadian Community Health Survey).

Populations at Risk

Obesity

According to Statistics Canada (2019c), males are more likely than females to be obese. Additionally, obesity is the most common in those aged 45-64 years. Education was also found to be inversely related to the number of obese individuals in a household. Obesity rates are highest in rural regions in the Prairie Provinces (Alberta Health Services n.d. c). In a Canadian meta-analysis of BMI for Indigenous peoples, it was found that the prevalence of overweight and obesity among non-Indigenous adults was 29.7% while it was 36.6% for Indigenous adults (Kolahdooz et al. 2017, 1320).

Lifestyle changes have been dramatic in the Indigenous populations throughout the years. Indigenous populations have a significantly higher prevalence of food insecurity compared to the rest of Alberta, leading to an increased consumption of ultra-processed foods high in calories such as high-fructose corn syrup (Batal and Decelles 2019, 2). Indigenous populations also have a mean annual income of 27% less than the Canadian average, which reduces their access to high-cost healthier foods (Batal and Decelles 2019, 2). Physical activity is also declining in rural and on-reserve Indigenous communities due to lower engagement with traditional activities and increased television and computer use (Kolahdooz et al. 2017, 1323-1324).

Geographic Location

Li et al. (2009, 456) found that rural residents in Alberta are disproportionately affected by smoking. The study also found that men were more likely than women to be smokers, and that middle-aged groups (20-59 years) tended to be smokers more than younger (12-19 years) and older age groups (60+ years). In Alberta, the smoking rate in all age groups (12 years and over) has decreased from 18.4% in 2015 to 15.5% in 2019 (Statistics Canada 2021b). Education and income were also found to be inversely related to smoking prevalence - those with higher levels of education and SES are less likely to consistently smoke.

Binge Drinking

In 2001, the Canadian Community Health Survey indicated that 16.83% of Albertan men and 5.25% of Albertan women engaged in binge drinking. In 2019, that number had risen to 25.3% of males and 14.5% of females in Alberta (Statistics Canada 2021c; Spithoff 2019, E802).

There are many societal and cultural influences on the convergence in consumption levels between men and women, including "greater gender equality, marriage and parenting at an older age, increasing female participation in the workplace and financial independence, changes in drinking environments such as bar design, and more mixed-gender drinking occasions" (Fitzgerald et al. 2016, 1736).

Short-term effects of alcohol include loss of impulse control, impaired attention, concentration and judgment, drowsiness, increased aggression, slowed reaction time, and others. Severe intoxication can result in stupor, coma, respiratory arrest, or death. Long-term effects of frequent binge drinking include damage to the liver, brain, heart, and stomach as well as increased risk of cancers of the liver, breast, throat, and stomach. Other potential long-term effects include but are not limited to hypertension, reduce immune functionality, sexual impotence, and vitamin deficiencies (Health Canada 2021).

Risk Factors and the Healthy Alberta Trends Index (HATi)

Life Stress

Life stress is important to consider as chronic stress can lead to poor health outcomes. Chronic stress is linked to volume reduction of brain structure and physical modifications of neuronal networks (Mariotti 2015). Chronic stress also impacts the immune system, as it overstimulates the hormones that regulate the endocrine (hormone) and immune system, resulting in chronic low-grade inflammation (Mariotti 2015). This state of inflammation can lead to precursors for various illnesses, as well as cardiovascular dysfunction, diabetes, cancer, autoimmune syndromes, and psychological disorders such as depression and anxiety (Mariotti 2015).

The Demography of Stress

In 2019, the age range with the highest perceived stress was 35 to 49 years, closely followed by the 50-64 years age group. Males and females were found to have similar perceived life stress (Statistics Canada 2021a).

Self-perceived stress was classified as "quite a bit/extremely stressful" in 25.3% of a sample residing in the urban core of a municipality, versus 22.5% of the sample residing in rural communities (Romans, Cohen, and Forte 2011, 571). Sense of belonging can mitigate stress, and urban dwellers reported a lower sense of belonging compared to rural dwellers (Romans, Cohen, and Forte 2011, 572).

Sources of stress in Canadian rural areas are often termed 'farm stress.' This includes isolation, worry over crops, government restructuring, having too many responsibilities, and the dangers of agriculture (Brannen, Emberly, and McGrath 2009, 222). Farm stress is amplified by climate change and how this affects crops and overall product yield. Other sources of stress for rural populations include the requirement of traveling long distances to receive treatment, as well as employment stress due to the lack of accessible employment prospects, education, and retraining opportunities (Brannen, Emberly, and McGrath 2009, 222-224).

Obesity

Conditions associated with a high BMI include high cholesterol, type 2 diabetes, stroke, coronary disease, gallbladder disease, sleep apnea, and breathing problems (Centers for Disease Control and Prevention n.d.). An increase in population BMI over recent years indicates that the population is either lacking in physical activity or a healthy diet, though it is more than likely a combination of the two.

The HATi was designed to be a quick and accessible measure of community and provincial health; by selecting those indicators which most closely reflect lifestyle and it does just that. Changes in the HATi between 2001 and 2014 can be attributed to improvements in life stress, physical activity, fruit and vegetable consumption, and smoking rates. Measures of BMI and binge drinking worsened over the 13 year period, and should be addressed immediately in order to encourage the health of the Albertan population.

Body Mass Index and Health Risk

Classification	BMI Category (kg/m^2)	Risk of Developing Health Problems
Underweight	<=18.5	Increased
Normal Weight	18.5-24.9	Least
Overweight	25.0-29.9	Increased
Obese Class I	30.0-34.9	High
Obese Class II	35.0-39.9	Very High
Obese Class III	>=40.0	Extremely High

Table 1.2: Body Mass Index (BMI) classifications and associated health risks (Source: Health Canada, 2003).

Policy Responses for Personal Physical Health

In the past several decades, the provincial government has sought to promote personal wellbeing for Albertans through broadening the scope of government intervention. Personal wellbeing, including personal physical health, is addressed not simply through

changes to the healthcare system or restrictions on behaviour and consumption (for example, on fast-food, alcohol, and tobacco products). Current governments may advocate for a holistic approach to health and wellbeing, which can include community engagement, maintaining fulfilling, engaging, and meaningful work environments, supporting a healthy work-life balance, maintaining healthy relationships, participating in activities that are consistent with one's beliefs and values, and supporting citizens to cultivate an understanding of how one's social, natural, and built environments affect health and wellbeing (Schulte et al. 2015, e38-e39; Stoewen 2017, 862).

A holistic approach to health suggests that personal wellbeing is, in fact, closely connected to interpersonal wellbeing (La Placa, McNaught, and Knight 2013, 118). Interpersonal wellbeing takes the various factors that contribute to an individual's general wellbeing and looks at ways to implement or improve them in an intersectoral way. For example, employers have found that productivity cannot be increased by focusing on physical health alone, because recruitment, retention, and engagement of employees includes consideration of work-life balance, community involvement, and employee development (Schulte et al. 2015, e39).

How have governments responded?

The Government of Alberta began to focus on personal wellbeing in the late 1980s, and in 1990 released the Rainbow Report Volume 1: Our Vision for Health. This report was created to examine health care services and costs in the province (Canadian Museum of History 2010b). The Commission argued in favour of a phased-in budgetary shift to prevention, based on regionalization, that focused on local needs, greater attention to human resource planning, better health data collection, and some private financing to increase choice, competition, and reinforcement of insured services (Canadian Museum of History 2010b). Then-Premier Don Getty did not act on these suggestions at the time, but his successor, Ralph Klein, used the Rainbow Report as the foundation for uniting 128 acute care hospital boards, 25 public health boards, and 40 long-term care boards into 17 health regions in 1994 (Canadian Museum of History 2010b).

In 1991, Alberta established the Premier's Advisory Council on Health and in 1993 the Health Goals for Alberta report was released. This report identified nine population health goals, three of which addressed improving the personal wellbeing of Albertans through reducing illnesses, injuries, and premature death, including a health perspective in public policy and increasing the capacity of Albertans to live in strong, supportive, and healthy families and communities (Alberta Health 1993, 2).

In 2011, the Alberta Health Act came into effect. This Act acknowledges the interconnected nature of health to economics, social factors, culture, physical, and spiritual context, and that decisions made across the health system must be made on the best available evidence and a holistic view of health and wellness (Government of Alberta 2014a, 1-3).

In 2014, Alberta's Health Charter was released to support the Alberta Health Act through making a commitment to provide Albertans with information on the health system and education about healthy living and wellness (Office of Alberta Health Advocates n.d.).

The most recent report, released in 2014 and titled Alberta's Strategic Approach to Wellness, emphazises investment in prevention over and above acute care. The report asserts that "the best cure is not getting sick or injured in the first place," and emphasizes the social, environmental, and personal factors that influence health over an individual's life course (Alberta Health 2014, 6). The report also places special emphasis on healthcare expenditures, in some ways implying that Alberta's healthcare system also needs a "cure" for its own costs, which in 2013/2014 accounted for 45% of provincial expenditures (Alberta Health 2014, 8).

In many ways, the focus of healthcare reform in Alberta has not changed in the 31 years since wellbeing was first identified as a priority by the Rainbow Report. The 2014 Strategic Approach to Wellness builds on the policy direction from the past several decades by highlighting the interconnected nature of health to housing status, income, nutrition, activity, mental wellbeing, and addiction, and emphasizes the need for interventions such

as a poverty reduction strategy, support for early childhood development, homelessness, and the development of family care clinics (Alberta Health 2014, 10). This report sets out a number of wellness goals, including:

- creating communities that support health and wellness,
- enhancing every Albertan's quality of life,
- preventing disease and injury,
- promoting health and wellness, and
- prolonging life expectancy (Alberta Health 2014, 16).

To achieve these outcomes, five strategies were put forward:

- improving the health knowledge, skills, and behaviours of individuals and families,
- building communities that create wellness,
- improving social and economic supports for wellness,
- strengthening primary prevention with primary health care, and
- building healthy public policy (Alberta Health 2014, 17).

What is being done?

Physical Activity

The Physical Activity and Sport Act (2003) promotes physical activity and sport to all Canadians.

Physical activity and sport are recognized as integral parts of Canadian culture and society, and produce benefits in terms of health, social cohesion, linguistic duality, economic activity, cultural diversity, and quality of life. (Government of Canada 2003, 1). This act was structured, written, and designed with the goals of increasing awareness among Canadians of the significant benefits of physical activity and the practice of sport, and encouraging and assisting Canadians to increase their level of physical activity and participation in sports (Government of Canada 2003, 1).

In Alberta, all students in grades 1 to 9 are guaranteed 30 minutes of daily physical activity, in accordance with the Daily Physical Activity initiative. (Government of Alberta n.d. c). The Alberta Sport Participation Support Program is a grant program providing financial assistance to non-profit organizations for the development and operation of projects that specifically seek to include underrepresented groups (including women and girls) in physical activity (Government of Alberta n.d. d).

Healthy Eating

No current provincial or federal legislation deals with the standards, procedures, or principles for promoting a balanced diet. There are places where such legislation could be implemented: for example, the province could consider legislation on mandatory food labelling with nutrition information on food served in restaurants, adopting WHO "Healthy Schools" measures such as regulations on food served in canteens or sold in vending outlets, or developing more substantial regulation of food advertisement and promotion beyond the prohibition of "false, misleading or deceptive [messages] in selling, importing or advertising" as stated in the Food and Drugs Act, Foods and Drug Regulations, the Safe Food for Canadians Act, and the Safe Food for Canadians Regulations (Government of Canada 2019b). There is currently no regulation of trans fatty acid content in foods (Government of Canada 2021b), even though trans fatty acids are widely accepted to be a contributing factor in several chronic diseases including cancer, diabetes, and cardiovascular disease.

However, under the Food and Drugs Act, all food products, with only a few minor exceptions, must display a "nutrition facts table" that provides information on calories (energy content) and thirteen nutrients in a standardized format based on a stated serving size (Alberta Agriculture and Rural Development 2014, 8). Despite the lack of legislation or regulation around food served in canteens or sold in vending outlets, the Government of Alberta has released a healthy vending toolkit to aid schools in making healthy options available to students (Alberta Health Services 2016). As of 2016, the Government of Alberta also endorsed sodium reduction as an essential healthy living measure but so far has only aimed to reduce the consumption of sodium (Vanderlee and L'Abbé 2017, 41).

Many areas of food regulation remain controversial, with both business owners and consumers (and some politicians) arguing that food choices are personal and are also influenced by factors including culture, class, and access that go beyond the individual's desire

to make healthy choices. The regulation of certain ingredients such as sugar, fat, or salt, is actually a complex ethical issue and not merely an issue of health promotion (Véliz et al. 2019, 22). In 2021, both British Columbia and Newfoundland introduced new sales taxes on sweetened carbonated beverages (The Canadian Press 2021; Gushue 2021). It is too soon to say whether or how these taxes will affect consumer behaviour and population health in B.C. and Newfoundland, but these moves suggest growing support within provincial governments for tax-based health incentives around food.

Alcohol and Cannabis

In Alberta, alcohol and cannabis consumption are regulated under the Gaming, Liquor and Cannabis Act. This Act sets the minimum age for obtaining liquor and cannabis, or participating in gambling at 18 years of age (Government of Alberta 2022). The Act also sets out a liquor markup that adds a flat charge to liquor depending on alcohol content. This rate is set by Alberta Gaming, Liquor and Cannabis (AGLC) (Alberta Gaming, Liquor and Cannabis n.d. a), the Government of Alberta's crown commercial enterprise and agency to oversee the gaming, liquor, and cannabis industries in Alberta. The Gaming, Liquor and Cannabis Regulation states how individuals must comply with the requirements for their license or registration (Government of Alberta 2022b). However, this legislation does not restrict the hours or days of sale, nor does it require a government monopoly of retail sales within Alberta, and it also does not place restrictions on the density of sales outlets (Government of Alberta 2022b).

Physical Activity

The Alberta Government, in conjunction with Alberta Education, has implemented a guideline stating that students from grades 1-9 must get at least 30 minutes of exercise a day in school (Government of Alberta n.d. c). AHS also works with organizations, such as WalkABle, to increase adult access to opportunities for physical activity (Alberta Health Services n.d. h).

Through the Alberta Healthy Communities Initiative, AHS is developing a community-participatory approach to assessing community needs for physical activity, which include availability, affordability, and accessibility of a broad range of recreation, active living and sporting, and broader social determinants of health (SDOH) factors including protected parks and green space and clean air and water (Alberta Health Services 2022).

The Alberta Government also provides incentives and services to activity programs, financially supports building and maintaining infrastructure for physical activity, supports volunteer and non-profit societies, and oversees active living and sport opportunities (Government of Alberta 2011a, 14).

Fruit and Vegetable Consumption

In 2015, Health Canada released an updated Canada Food Guide that focuses on promoting healthy eating and overall nutritional wellbeing, and supports improvements to the Canadian food environment (Health Canada 2016). The intended audience for this food guide was health professionals and policy-makers. The food guide states that one should "eat plenty of vegetables and fruits, whole grain foods and protein foods" and recommends choosing "protein foods that come from plants more often" (Health Canada 2019).

In 2012, the Alberta Government released the Alberta Nutrition Guidelines for Children and Youth for childcare facilities, schools, and recreation/community centres (Government of Alberta 2012). These guidelines lay out a rationale for healthy eating grounded in making appropriate choices, rather than prescribing or prohibiting any given food. The guideline focuses on describing a number of foods within the major food groups and encourages consumers to either 'choose more often,' 'choose sometimes,' or 'choose least often,' based on factors including nutritional content and whether the food is processed or unprocessed (Vanderlee and L'Abbé 2017, 25).

Beyond food guides, AHS has sponsored the Healthy Eating Environment Initiative, which includes a Healthy Eating Environment Policy to promote and improve access to healthy foods, as defined by national and provincial nutrition recommendations, in both the workplace and institutional settings (Alberta Health Services n.d. a). Healthy eating environments, according to the Initiative, are settings where nutritious food is accessible, affordable, and therefore easier to consume.

AHS has also created nutrition guidelines for Foods and Beverages in AHS facilities (Alberta Health Services 2019). While these guidelines are not mandatory, they have been implemented in Alberta hospitals (Vanderlee and L'Abbé 2017, 27). Food and nutrition are also interconnected with marketing and influence, and as such, certain products are subject to some of the regulations around truth in advertising. For example, the Lobbyists Act describes restrictions to prevent commercial interests from influencing the development of policies related to environments where there is a potential conflict with improving population nutrition (Vanderlee and L'Abbé 2017, 47).

Contributing Factors to Poor Physical Health

According to the Government of Alberta's 2014 Strategic Approach to Wellness, reducing homelessness, raising incomes, improving nutrition, decreasing rates of mental illness and addiction, and showing compassion to the less fortunate are all social actions that improve health and wellness, prevent disease, and reduce life stress for individuals (Alberta Health 2014, 9).

Mental wellbeing, healthy food, physical activity, stable housing and employment, and social connection are all aspects of the SDOH, the social and environmental factors that influence health and wellbeing beyond individual choices and risk factors. SDOH have been recognized in Canadian health policy since the 1970s, and in Alberta, AHS was founded on a strategic priority to enhance health equity within the province (National Collaborating Centre for Determinants of Health 2013, 3).

AHS defines health equity as being founded on justice, inclusion, accessibility, and accountability, and seeks to create a provincial climate where healthcare embodies these principles by emphasizing health equity (Alberta Health Services 2011).

Alcohol Consumption and Smoking

To discourage problematic alcohol consumption, the Alberta Government developed a provincial Alcohol Strategy in 2010, which promotes action across six policy areas: regulating alcohol availability, controlling alcohol pricing, ensuring safer drinking environments and safer communities, limiting alcohol marketing, advertising and sponsorship, preventing and reducing drinking and driving, and advocating for preventative alcohol policy at the provincial and federal level (Alberta Health Services, Alberta Gaming Liquor and Cannabis Commission, and Alberta Health 2010, 1-2).

For smoking, Alberta Tobacco Legislation prohibits the sale of tobacco to persons under 18, and bans smoking in all workplaces and public spaces including restaurants, bars, patios, and casinos. Smoking is not permitted on the grounds of AHS's property, including hospitals, and AHS's Tobacco and Smoke-Free Environments policy includes provisions by which smokers are offered nicotine replacement therapies during hospital stays (Alberta Health Services n.d. i). AHS also provides education and resources about smoking cessation through their "Prescriptions for Healthy Living" web pages and the "Alberta Quits" platform.

What could be done?

Physical Activity

The WHO guidelines exist as one set of recommendations that the Government of Alberta could draw on to develop and implement policies that promote physical activity in daily life:

At the local level, the Alberta Government could work with municipalities to ensure that walking, cycling, and other forms of active transport are accessible and safe for all, and could also support the extension of such policies for rural communities (World Health Organization 2007).

The Alberta Government could extend its collaboration with the Education Ministry to ensure that schools have safe spaces and facilities for students to spend their free time actively, implement requirements for students in grades 10 through 12 to have access to 30 minutes of exercise per day, and ensure that quality physical education supports children to develop behavior patterns that keep them physically active throughout their lives (World Health Organization 2007). The Alberta Government could ensure that sports and recreation facilities provide accessible and affordable opportunities for all Albertans to play sports and be active, especially in our province's long winter months (Government of Alberta 2019). Additionally, the Alberta

Government could follow the recommendations of EU countries, which have strong preventative policies, such as increasing physical activity in schools and providing opportunities for individuals to participate regularly in at least one organized recreational/sports activity since the alternative would be paying the increased health costs of an ailing population (European Education and Culture Executive Agency n.d.)

Healthy Diets: Fruit and Vegetable Consumption

Only 38% of Albertans reach the recommended 5 servings of fruits or vegetables a day (Alberta Health Services 2014, 1). There are several policy changes that might help us to reach a higher proportion of the population consuming an adequate amount of fresh produce:

- The Alberta Government could ensure that schools have programs available to help children develop the habits of eating a healthy diet, so that they grow into adulthood with healthy skills, knowledge, and preferences (Government of Alberta 2012),
- Alberta could also consider policies targeted towards privately-owned food outlets and quick-service restaurants, such as mandating the implementation of clearly visible labelling on menu boards to allow consumers to interpret the nutrient quality and energy content of foods, and restricting food outlets from giving incentives (such as toys) alongside foods that contain high levels of trans-fats, added sugars, salt, and saturated fats (Vanderlee and L'Abbé 2017, 37),
- There is no current legislation giving municipalities guidance on reviewing or approving fast food development applications, and no policies that ensure support systems are in place to encourage food service outlets to provide and promote healthy foods and to discourage the promotion and availability of unhealthy food. The provincial government could study effective policies in place in other jurisdictions, and move towards implementing similar policies (Vanderlee and L'Abbé 2017).

Tobacco Use

In 2021 Alberta passed the Tobacco, Smoking and Vaping Reduction Regulation, which is provincial legislation aimed at vaping and the increase in youth who are using vapes. This includes restrictions on how and where vaping products can be sold, but could be improved as it does not restrict minors from selling or handling vape products and vape marketing materials at a retail location. This new regulation also limited how vaping products may be displayed or advertised in retail stores, and set out differences between regular retailers where minors may be present and dedicated vape shops where minors are not allowed entry. However, advertising is still allowed, just in a reduced and less appealing way which could be improved by further advertising restrictions (Government of Alberta 2021b).

The regulation also addresses public vaping, including similar restrictions as public tobacco use, by requiring it to be used away from entrances and not in numerous public and private establishments (Government of Alberta 2021b). However, this new legislation could go further by reducing the availability of flavoured vape juices. Several individuals, including doctors and CEOs representing groups ranging from The Lung Association, Alberta Blue Cross, Canadian Cancer Society, and others, argue that the province could improve youth vaping by taking legislation to the next level and restricting flavours.

While the Government of Alberta has yet to decide if flavoured vape offerings increase youth vulnerability to vaping, these individuals and groups insist it does. Primarily, they point to the fact that of the 50,000 youth who vaped in 2019, over 90% used flavoured products (Snyder et al. 2021). Overall, while the new regulation helps, many health and anti-smoking groups believe it could be improved by further government action.

Alcohol Consumption

There are a few jurisdictions around the world that have begun developing policies to limit the negative health and social consequences of alcohol. In Norway, for example, the minimum drinking legal age is 18 for alcoholic beverages with less than 22% alcohol by volume, and 20 for beverages containing more than 22% alcohol by volume. Norway has also adopted policies where only alcoholic beverages with an alcoholic percentage of 4.75% or below can be sold in

non-specialized retail shops and supermarkets. Beverages with higher alcohol content are taxed more heavily and are only sold through a state-owned monopoly (Lovdata 2022).

Mental Health

Mental health policy, planning, and delivery pose some of the most significant challenges for health and human services because they are complex phenomena (Mental Health Commission of Canada 2018, 10). A substantial proportion of the population, in Alberta, and across the globe, faces mental health illnesses that significantly impact their day-to-day lives (Kilbourne et al. 2018, 30). Measuring mental health and tracking data over time helps us understand key social phenomena, including the general health of the population, the effectiveness of current policies, and ways that mental health is interrelated with other indicators of health and wellbeing (Kilbourne et al. 2018, 31).

The Canadian Community Health Survey is used to collect data on self-perceived mental health in Alberta. In 2014, 28% of Albertans rated their self-perceived mental health as poor, fair, or good. In the Central Zone, 27% of the population rated their mental health as poor, fair, or good (Alberta Health n.d. h). Mental illness as a measure of community health is not commonly considered, especially within the context of rural vs. urban influences.

In the early years of psychological research, mental health was defined as an absence of symptoms of poor mental health (Goodman 2018). Freud defined mental health as the capacity "to work and to love" (Goodman 2018). Today, mental health is defined by levels of perceived discomfort, dysfunction, dangerousness, and deviance from cultural norms (Bridley and Daffin 2018).

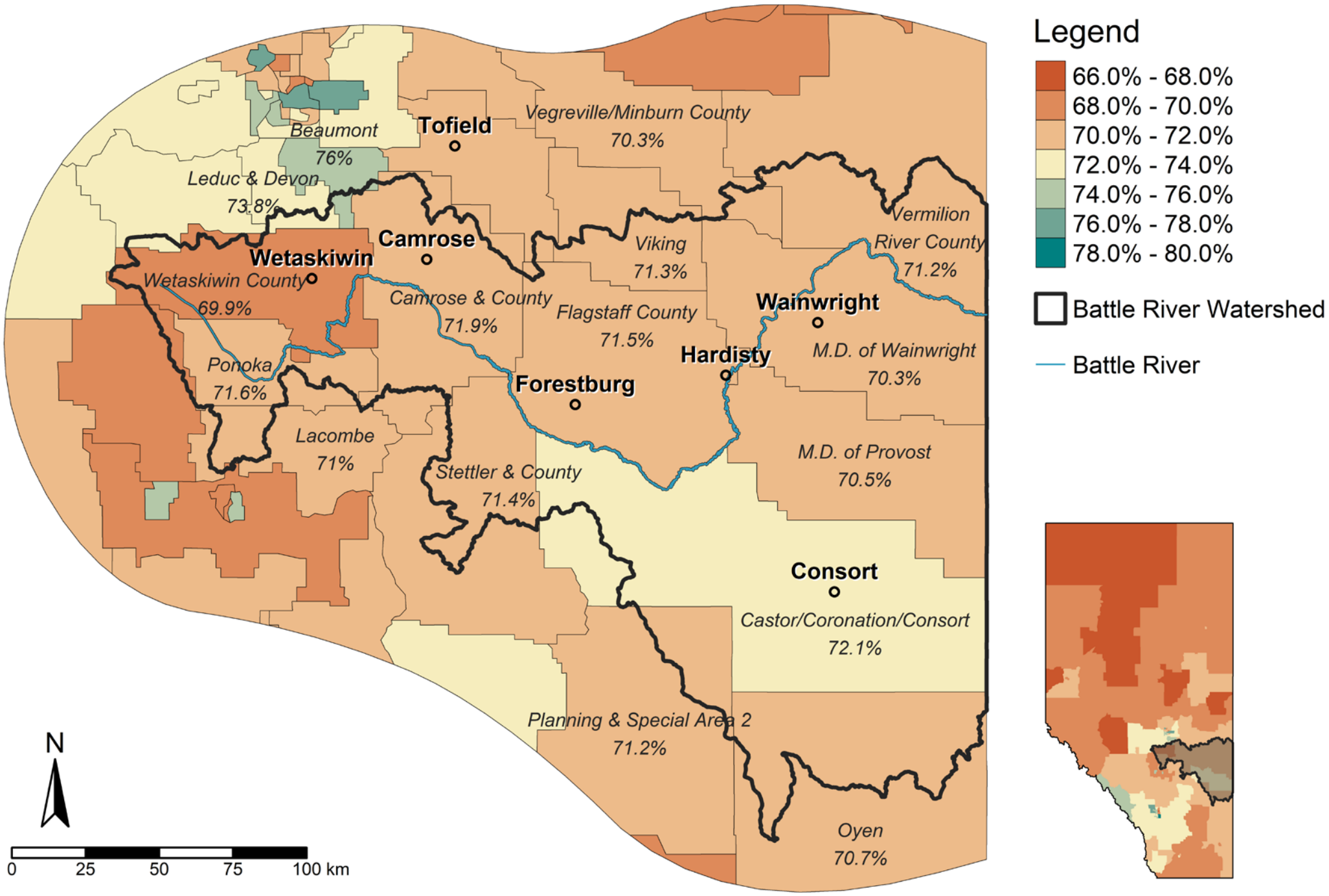
Mental health is a major part of personal wellbeing as it affects daily life. Self-perceived mental health is a subjective score, measured as 'excellent' or 'very good.' In 2014, 27% of the Central Zone population rated their mental health as poor, fair, or good and 73% rated their mental health as excellent or very good (Alberta Health n.d. i). This indicates that the majority of the Central Zone and BRW have promising rates, which are fairly consistent from community to community; most local geographic areas (LGAs) in the BRW are near the provincial average for self-reported mental health.

Self-perceived Mental Health

Self-perceived mental health is a subjective measure of mental health on a scale of poor, fair, good, very good, or excellent. Self-perceived mental health is measured by asking individuals to evaluate their ability to cope with the stresses of life, ability to work productively, and sense of capacity to realize their potential in personal and professional settings (Alberta Health. n.d. i.). A community's self-perceived mental health can be extrapolated from collected individual self-perceived mental health assessments. It should be noted that because this interpretation is via self-report, results may be skewed towards the positive due to social desirability bias, and

Self-Perceived Mental Health (2014)

% of the population that self-rated their mental health as 'Excellent' or 'Very good'



Map 1.14: (Source: Statistics Canada. 2014. Canadian Community Health Survey).

continued stigma associated with revealing experiences of struggle, negative emotions, or psychological distress. As a society, we tend to be ill-equipped to talk openly and without judgment about mental health, and we view poor mental health in an especially negative light. Under these social conditions, in order to maintain a sense of social acceptance and positive self-image, people may be dishonest or omit information when they are given surveys or asked questions by a health professional.

Understanding Self-perceived Mental Health

Figure 1.12 shows that men and women in Alberta's Central Zone tend to indicate "excellent" or "very good" mental health at about the same rates as the whole of Alberta and the whole of Canada.

In general, women tend to report slightly worse self-perceived mental health than men, and this is consistent across regions even where overall rates of self-perceived mental health differ.

Populations at Risk: LGBTQ2+

Transgender people in North America experience harassment and discrimination when seeking social services, employment, health services, or stable housing. According to the Canadian Mental Health Association, lesbian, gay, bisexual, transgender, queer, and two-spirited (LGBTQ2+) people face higher rates of substance use, self-harm, suicide, depression, anxiety, and other disorders

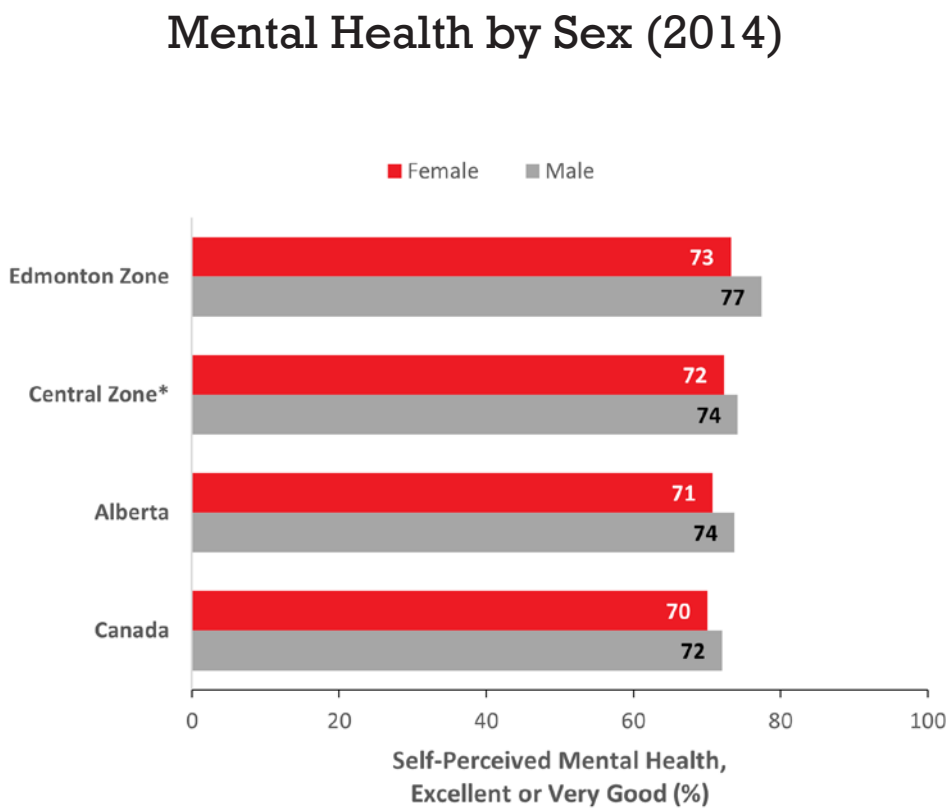


Figure 1.12: Proportion of the population that reported 'Excellent' or 'Very good' mental health by sex in 2014 (Source: Statistics Canada, 2014).

(Canadian Mental Health Association Ontario n.d.). People who identify as a member of this group have double the risk for post-traumatic stress disorder (PTSD) than heterosexual people.

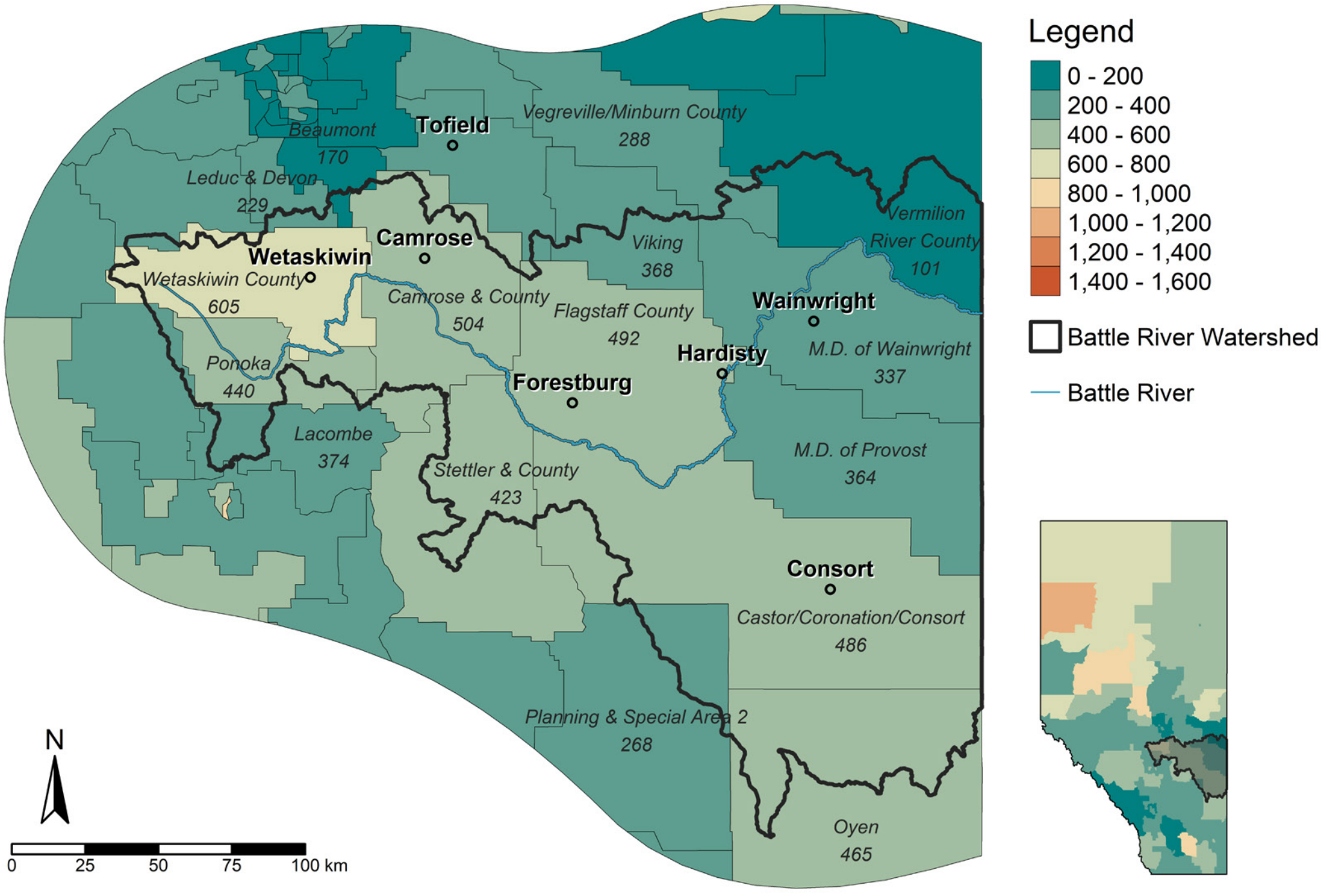
In 2008, hate crimes motivated by sexual orientation were the most violent of all hate crimes (Statistics Canada 2010). A study of transgender people in Ontario found that 20% of individuals had been physically or sexually assaulted due to their identity and 34% were harassed or verbally threatened (Bauer and Scheim 2015, 4).

Indigenous Communities

The Indigenous population of Canada also faces an increased risk for mental illness. In the past, colonialist actions resulted in the exploitation of Indigenous peoples, the creation of residential schools, the degradation of Indigenous cultures, and the loss of traditional territory. The result of these colonialist actions was a loss of Indigenous culture and intergenerational trauma, which is still being felt by Canada's Indigenous peoples.

Depressive Disorders (2019), Males and Females

of emergency department visits per 100,000 population (age-standardized)



Map 1.15: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Addictions and Mental Health – Emergency Visits).

Despite making up only 4.3% of Canada's population, Indigenous youth (15-24 years) have a suicide rate 5-6 times higher than the rest of the Canadian population. Within Indigenous communities, suicide is one of the leading causes of death among children and youth (Giroux et al. 2018, 2). The adult suicide rates in Indigenous communities are twice as high when compared to non-Indigenous communities (Kumar and Tjepkema 2019, 8).

The residential schooling system was a colonialist practice used to erase the language and heritage of Indigenous children in order to assimilate them into Canadian society (Wilk, Maltby, and Cooke 2017, 2). These children suffered many forms of abuse, including psychological, leading to intergenerational trauma and mental health adversities in the Indigenous population today. Residential school attendees and their families experience poor mental health which includes depression and substance misuse (Wilk, Maltby, and Cooke 2017, 5). One study found that in their sample of 127 residential school survivors, only two were free of mental illness (Corrado et al. 2003, 57).

Geographic Location

Rural and remote communities face unique obstacles when it comes to mental health:

- Transportation Barriers: Many rural residents do not have the means to travel long distances to access health services, accompanied with the problem of long wait times,
- Higher Suicide Rates: rural communities in Canada have higher suicide rates compared to urban communities (Friesen 2019, 47). The stigma around mental health in these areas and an increased value on self-reliance influence this trend. People may avoid mental health supports in fear of being recognized in their smaller rural community and being subject to judgement or gossip,
- Supports for LGBTQ2+: Rural communities have fewer supports for LGBTQ2+ individuals and smaller communities may ostracize individuals who so identify,
- Homelessness: Mental health and homelessness are tightly correlated. Camrose reported having a population of 40-60 individuals using homeless shelters, while 6% of households were living in housing conditions below adequate living standards. Homelessness is less visible in rural communities, as many individuals will live in between

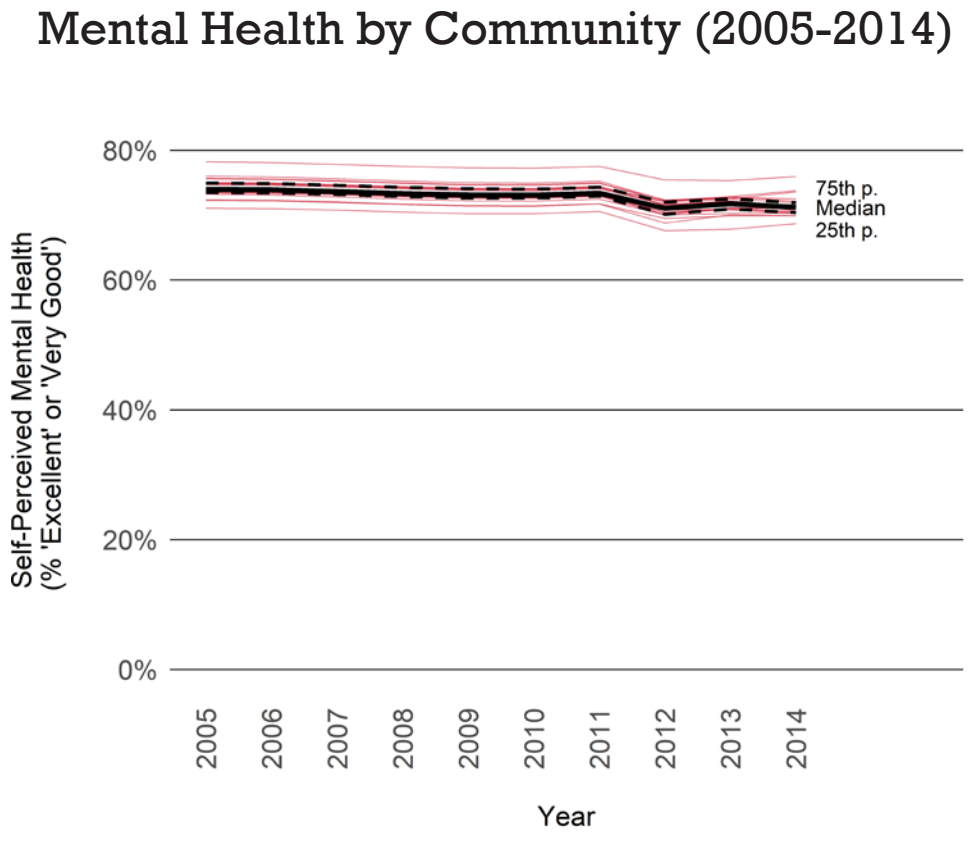
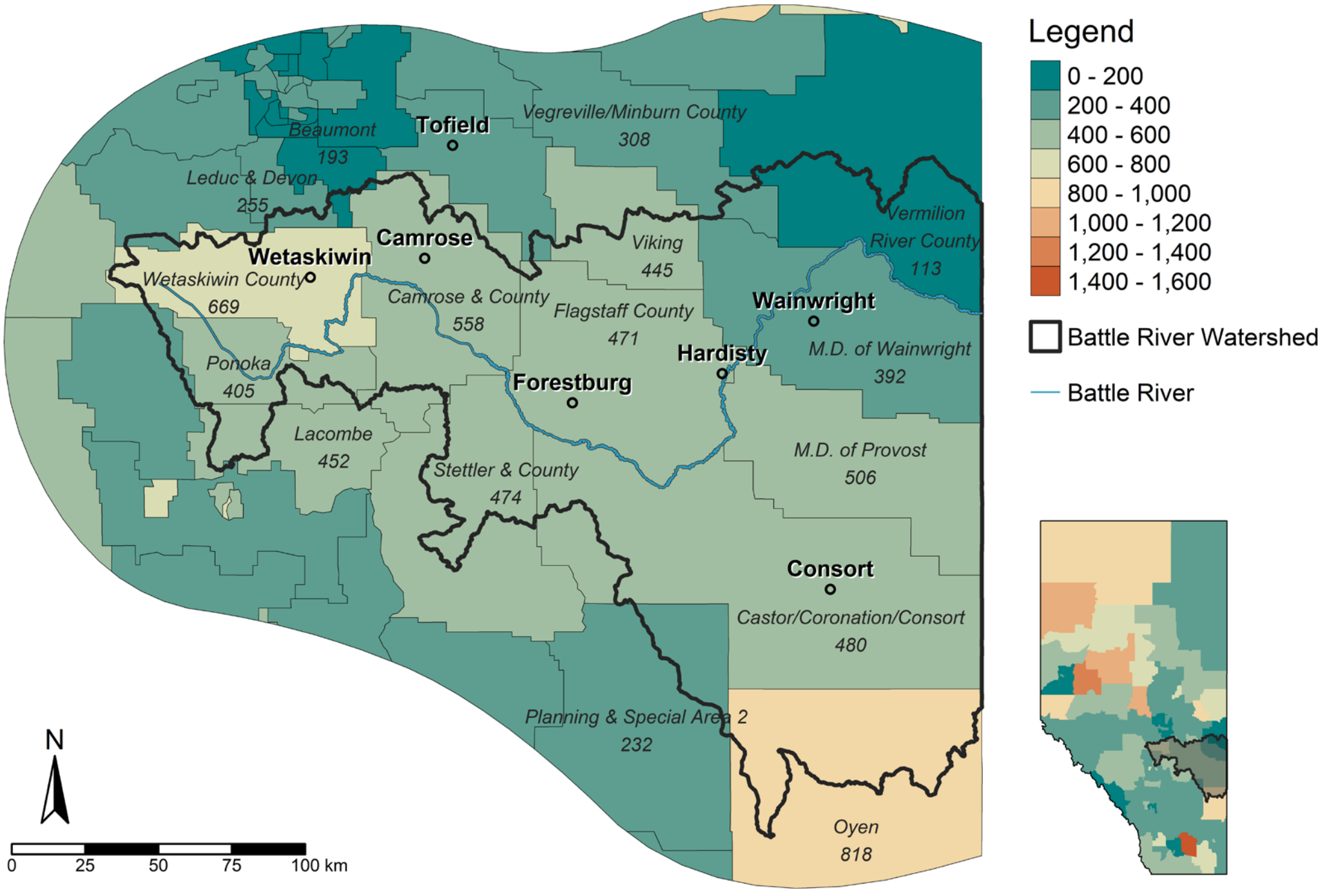


Figure 1.13: Self-perceived mental health (proportion reporting their mental health is excellent or very good) for each LGA within the BRW from 2005 to 2014; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Statistics Canada, 2014).

Depressive Disorders (2019), Females

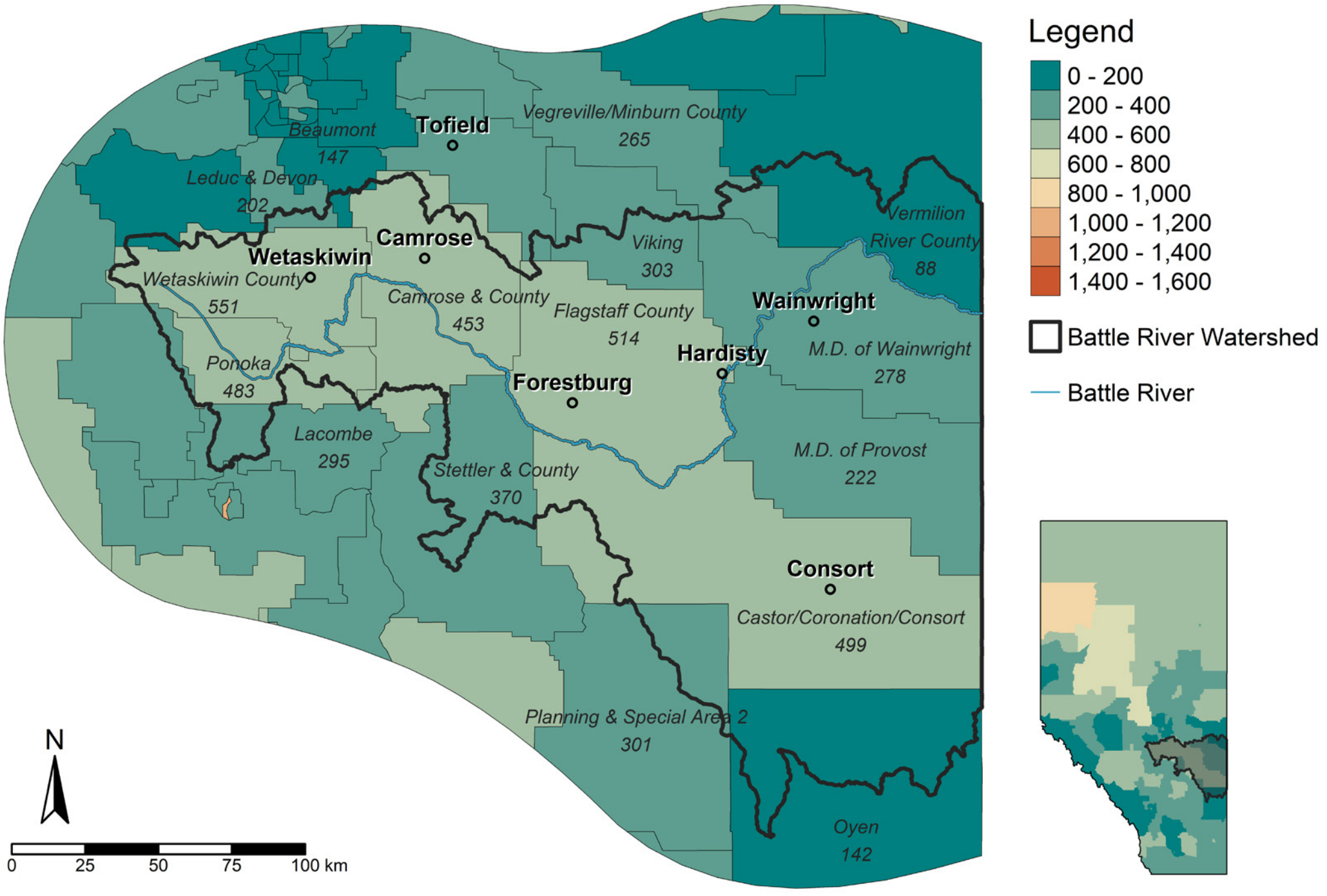
of emergency department visits per 100,000 population (age-standardized)



Map 1.16: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Addictions and Mental Health – Emergency Visits).

Depressive Disorders (2019), Males

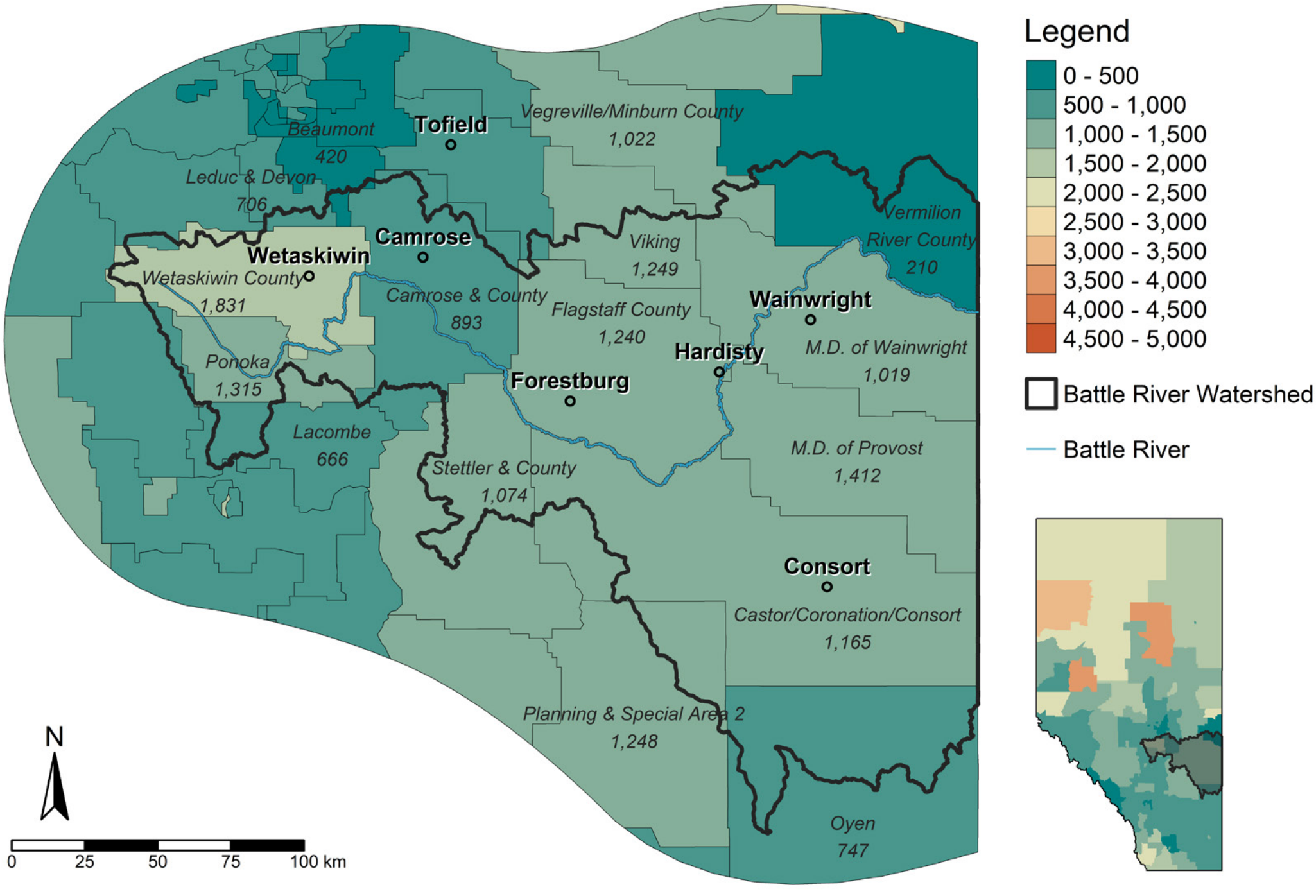
of emergency department visits per 100,000 population (age-standardized)



Map 1.17: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Addictions and Mental Health – Emergency Visits).

Neurotic, Stress-related and Somatoform Disorders (2019), Males and Females

of emergency department visits per 100,000 population



Map 1.18: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Addictions and Mental Health – Emergency Visits).

homes or double up with families in dwellings (Schiff and Turner 2014, 23).

Farmers

A study by Jones-Bitton and the University of Guelph (2016, 2) found that of 1,100 polled Canadian farmers, 45% had high levels of stress and 35% met the criteria for depression. Letvak (2002, 252) introduces the concept of 'farm stress' as a way to describe emotional and physical stress experienced by farmers impacted by the agricultural industry. With concerns over climate change comes the issue of droughts which decrease product output, causing high levels of stress for farmers (Yazd, Wheeler, and Zuo 2019, 9).

•

Percentage of the Population Dealing with Mental Health Conditions

Unlike self-perceived mental health, mental health conditions are diagnosed by a health professional. Data about mental health diagnoses thus present a more verifiable, but not necessarily complete, picture of mental health in a given community. Diagnosable mental health conditions can range from anxiety disorders to clinical depression to schizophrenia and personality disorders.

Mental health conditions are characterized by an impaired capacity to cope with daily life, and require some form of therapeutic intervention, including medication and therapy, to manage. Unfortunately, many cases go undiagnosed either because people struggle through mental illness without seeking professional help, or because appropriate mental health care is unavailable or otherwise not accessible.

A higher prevalence of mental health issues within a population can be tied directly or indirectly to several intersectoral issues and causes including weather (seasonal depression), economy (job loss, highly stressful or exploitative working conditions), or sociocultural environment (levels of racism and other forms of oppression, community bonds, and social isolation or connection, etc.). These intersectoral factors make this measure valuable as a component of identifying the possibility of deeper issues within a community.

Understanding Mental Health Conditions

Depressive Disorders

Depressive disorders are a broad category of mental illness that includes depressive episodes, recurrent depressive disorder, and dysthymia. These are defined by the American Psychology Association (ADA) as such:

- Major depressive episode: "period in which an individual experiences anhedonia or is persistently sad, pessimistic, or otherwise overly negative" (American Psychological Association n.d. e),
- Depressive Disorder: "a mood disorder characterized by persistent sadness and other symptoms of a major depressive episode, but without accompanying episodes of mania or hypomania, or mixed episodes of depressive and manic or hypomanic symptoms" (American Psychological Association n.d. d). It is defined as recurrent when the depressive episode comes after 6 months or longer since the previous episode has resolved (American Psychological Association n.d. k),
- Dysthymia: "any depressed mood that is mild or moderate in severity. Also called minor depression" (American Psychological Association n.d. b).

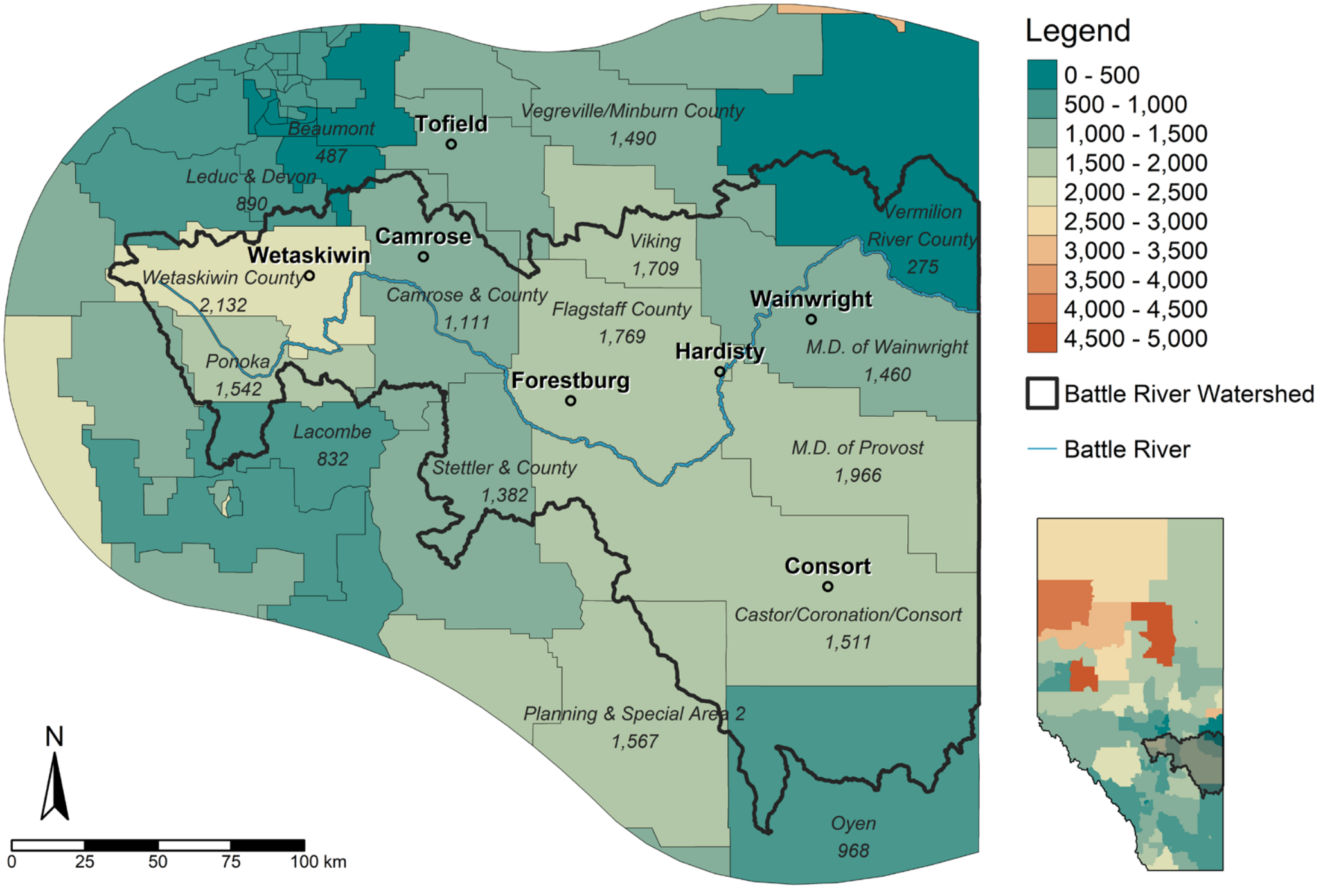
The Alberta average for emergency department visits for depressive disorder is 350.2 per 100,000 population. In the BRW and surrounding areas, many communities fall within the 200-400 and 400-600 per 100,000 population range. Wetaskiwin & County have the highest rate of emergency department visits at 605 per 100,000. Since Maps 1.16 and 1.17 demonstrate emergency department visits, they are only reflective of those hospitalized for their mental illness in relation to depressive disorders. It does not reflect the overall mental health status of the region as not everybody is hospitalized for their depressive disorder.

Neurotic, stress-related and somatoform disorders are a broad category of mental illnesses that include the following:

- Phobic Anxiety Disorders: "anxiety that focuses on or is directed toward objects or situations (*e.g.*, insects, telephone booths, open areas) that represent the real fear but pose little if any actual danger themselves" (American Psychological Association n.d. i),

Neurotic, Stress-related and Somatoform Disorders (2019), Females

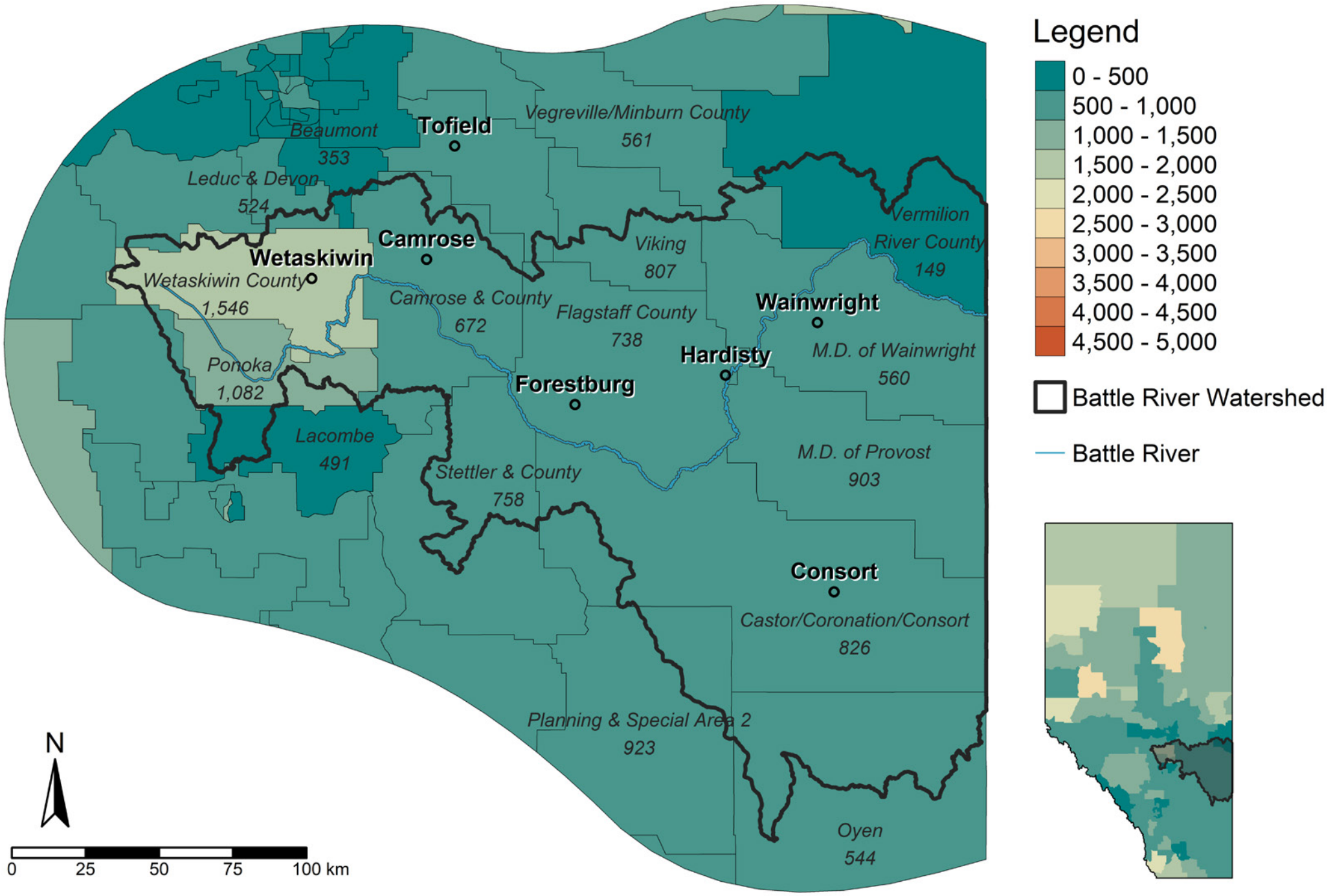
of emergency department visits per 100,000 population



Map 1.19: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Addictions and Mental Health – Emergency Visits).

Neurotic, Stress-related and Somatoform Disorders (2019), Males

of emergency department visits per 100,000 population



Map 1.20: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Addictions and Mental Health – Emergency Visits).

- Other anxiety disorders (panic disorders, generalized anxiety disorders (GAD)): GAD is "excessive anxiety and worry about a range of concerns accompanied by such symptoms as restlessness, fatigue, impaired concentration, irritability, muscle tension, and disturbed sleep" (American Psychological Association n.d. c). A panic disorder accompanies GAD when "characterized by recurrent, unexpected panic attacks that are associated with persistent concern about having another attack, worry about the possible consequences of the attacks, significant change in behavior related to attacks" (American Psychological Association n.d. h)
- Obsessive-Compulsive Disorder (OCD): "a disorder characterized by recurrent intrusive thoughts (obsessions) that prompt the performance of neutralizing rituals (compulsions)" (American Psychological Association n.d. g),
- Reaction to severe stress, and adjustment disorders: PTSD is "a disorder that may result when an individual lives through or witnesses an event in which they believe there is a threat to life or physical integrity and safety and experiences fear, terror, or helplessness" (American Psychological Association n.d. j),
- Dissociative (conversion) Disorders: "any of a group of disorders characterized by a sudden or gradual disruption in the normal integrative functions of consciousness, memory, or perception of the environment" (American Psychological Association n.d. a),
- Somatoform Disorders (*e.g.*, hypochondriacal disorders): "any of a group of disorders marked by physical symptoms suggesting a specific medical condition for which there is no demonstrable biological evidence and for which there is positive evidence that they are linked to psychological factors" (American Psychological Association n.d. l);
- Other neurotic disorders (*e.g.*, neurasthenia): neurasthenia is a "condition marked by fatigue, weakness, insomnia, aches, and pains" (American Psychological Association n.d. f).

The Alberta average is 1,042.3 cases per 100,000 population for emergency department visits in relation to this category. In the BRW and surrounding areas, many regions fall within the 500-1,000 and 1,000-1,500 rate of emergency department visits in relation to neurotic, stress-related and somatoform disorders (Map 1.18 - Map 1.20). Wetaskiwin & County represents the region with the highest number of emergency department visits with a rate of 1,831 cases. Again, it must be noted that these data only represents the number of hospitalized patients in relation to their disorder, and does not represent the overall proportion of residents with a neurotic, stress-related or somatoform disorder.

The Alberta average for emergency department visits for neurotic, stress-related and somatoform disorders for the female population is 1,282 cases per 100,000 population in comparison to 815.2 cases per 100,000 population for the male population. The female population has a higher rate of emergency department visits for neurotic, stress-related, and somatoform disorders in comparison to the male population. Most of the regions in the BRW and surrounding regions fall within the range of 500-100 cases for the male population in comparison to the female population which ranges from 1,000-1,500 and 1,500-2,000 cases per 100,000 population. Again, these data may be biased, as males are often face stigmatization for their mental health and do not report it (Map 1.18-Map 1.20).

Risk Factors for Mental Health Conditions

Discrimination - Acceptance in Community

An important predictor of community mental health is the level of discrimination and racism found in the community. It is no surprise that those experiencing racist acts on an interpersonal level will inevitably have their mental wellbeing negatively affected; however, racism is more than an interpersonal phenomenon. Racism is also socially constructed through systems of education, justice, media, policing, immigration, employment, and government policies (Hyman 2009, 5). Indigenous and racialized group members were also less likely to use mental health services (Hyman 2009, 7).

Social Support

Social support is defined as support volunteered by family and friends, as well as community and religious organizations (Letvak 2002, 251). Receiving social support is a protective factor against mental adversity such as depression (Letvak 2002, 255). Studies find that social supports provide a protective factor against depression in children and adolescents, with parents, teachers, and families being the most significant form of social support for this age-group (Gariépy, Honkaniemi, and Quesnel-Vallée 2016, 285). Social support also provides a protective factor against depression in adults, with spousal support being the most significant type, followed by family, friends, and children (Gariépy, Honkaniemi, and Quesnel-Vallée 2016, 286).

Mental Health Treatment

When we think of mental health treatment, we think of the typical treatment through professional facilities and medication. As important as this is, there are still other important approaches to healing from mental health ailments. Something that needs to be considered in how the community engages with treating mental health are the cultural values of certain groups and how these values influence the way they view health care. According to Arulthas (2018), there are several national Aboriginal mental health strategies in Canada, such as the National Aboriginal Youth Suicide Prevention Strategy (NAYSPS) Program Framework and the First Nations Mental Wellness Continuum Framework. It is important that interventions for crises emphasize cultural safety in order to make mental health services more accessible for Aboriginal people (Arulthas 2018, 22).

Indigenous Mental Health

Having a service provider understand core Aboriginal cultures and values is essential in the aid for mental health of clients, the importance of such stated by one client: in Ontario "living on the reserve is a different way of life ... A lot of people I talked to in the past who were counsellors that hadn't worked for *Mnaamodzawin* or *Noojmowin.* They didn't understand certain things that seems like it's a part of your life when you're on the reserve … it is a different way the whole community deals with things" (Maar et al. 2009, 9).

Sense of Belonging

Sense of belonging has been defined as "the experience of personal involvement in a system or environment so that persons feel themselves to be an integral part of that system or environment" (Hagerty et al. 1996, 236). Combined with self-perceived mental health, sense of belonging provides a snapshot of how people in a community feel about their community, and the relationship between that sense of connection (or lack thereof) and a sense of personal wellbeing. If people feel that they belong to a community and that they are an integral part of the community, that is a positive indicator of the community's mental health environment. It is worth noting that rural communities such as those in the BRW experience a higher sense of belonging than urban areas such as Edmonton.

Risk Factors for Sense of Belonging

Social Engagement

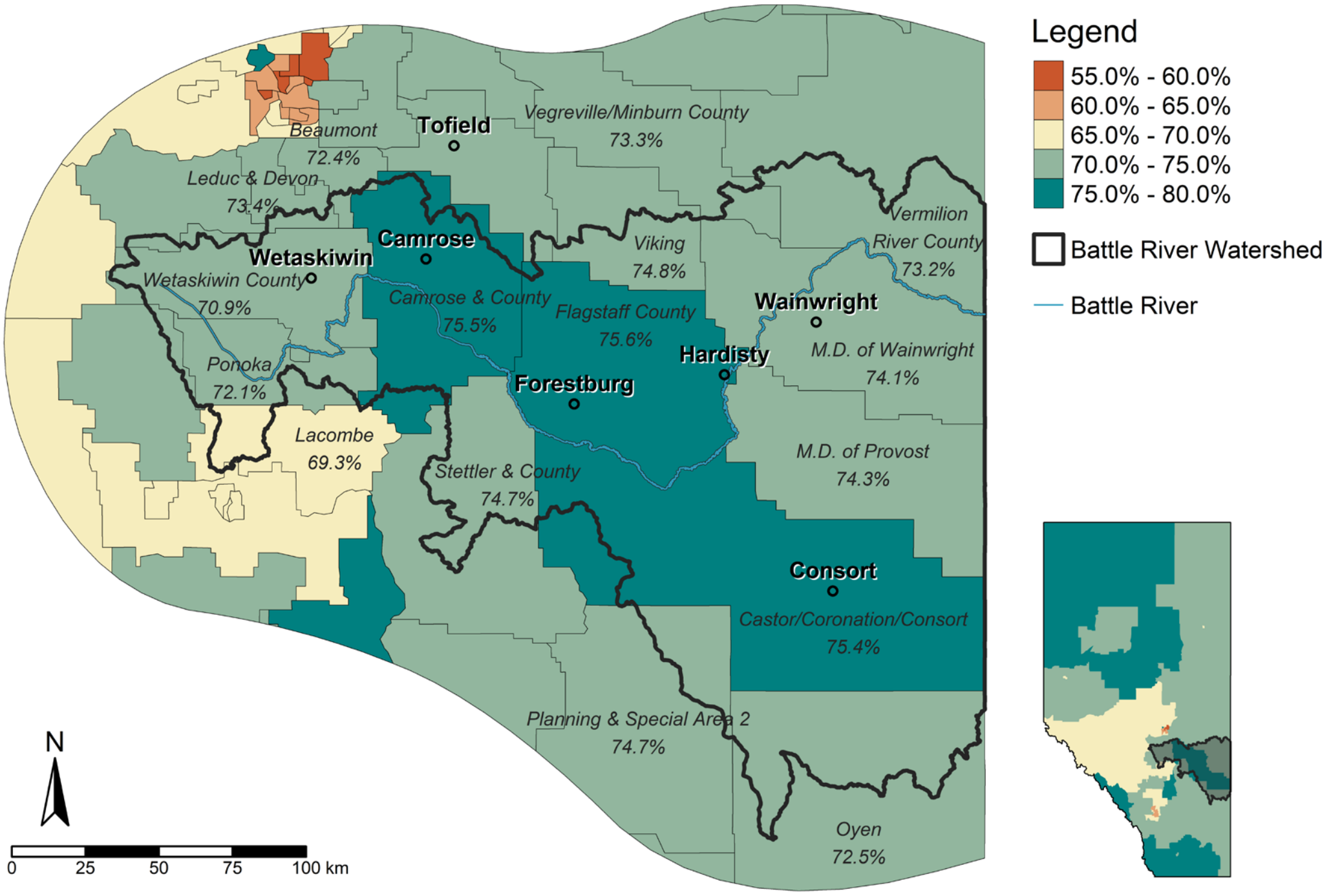
Social engagement is a critical measure of community vitality, defined as the quality of life with regard to the communities that people live in (University of Waterloo n.d. a).

Social engagement involves being a member of group activities, such as cultural, educational, political, religious-affiliations, neighborhood organizations, and so on. Participation in organized groups allows for greater opportunities in developing social connections and generating interest in one's community. Those who participate in more social activities within the community, especially activities that are relationship-based and associated with leisure, report an enhancement in their quality of life (Park et al. 2015, 7).

The social environment in a given year can also be significantly different than the year prior. For example, from 1994 to 2008, the population who reported participating in organizing activities peaked at 65%; however, this has dropped to 51.8% in 2014 (University of Waterloo n.d. c). Recently, the social environment in communities has dropped due to the COVID-19 pandemic. Social gatherings became restricted and opportunities for community involvement became significantly

Sense of Belonging (2014)

% of the population that self-rated their sense of belonging as 'Very strong' or 'Strong'



Map 1.21: (Source: Statistics Canada. 2014. Canadian Community Health Survey).

reduced. Sense of belonging in these years will have dropped significantly, and it may take a few more years to recover.

Social Supports

Social support is defined as people who help others without the gain of financial reward. Psychologists state the importance of social support on quality of life, such that poor social support is linked to depression and loneliness. Social support can come in different forms, such as helping with daily tasks and providing empathy and concern for those in need (University of Waterloo n.d. d).

Social Norms and Values

Social norms and values are indicators of sense of belonging that measures whether the population has experienced discrimination based on their ethnicity or culture. In 1994, 13.3% of the population reported experiencing discrimination in the past 5 years; however, this percentage dropped to 8.0% in 2014 (University of Waterloo n.d. b).

Canada is a multicultural country, with high rates of immigration throughout the country and many different cultural practices found within a community. Statistics Canada conducted a study of 7,003 immigrants who came to Canada between 1980 and 2012 and measured these participants' levels of sense of belonging to Canada. That study found that the majority (93%) of immigrants had a strong sense of belonging to Canada based on two fundamental dimensions of sociocultural and psychological integration: cultural maintenance, defined as the importance of retaining own-group heritage culture, and participation in the receiving society (Hou, Schellenberg, and Berry 2016, 6).

In this context, sense of belonging is defined as a key component of group identity, and for immigrants, a high rate of sense of belonging is "whether they feel accepted, secure, and 'at home' in their adopted country" (Hou, Schellenberg, and Berry 2016, 10).

Age is also an important factor for sense of belonging, particularly for immigrants. Younger people may have an easier time adapting to a new way of life and overcoming challenges such as language barriers.

Discrimination, however, is still prevalent across Canada. Some immigrants report that social inclusion is more difficult in rural communities due to the 'tight-knit' lifestyle from a smaller population size (Patel et al. 2019, 6). Immigrants are often defined as outsiders and find it challenging to be involved in meaningful participation in community

Sense of Belonging by Community (2005-2014)

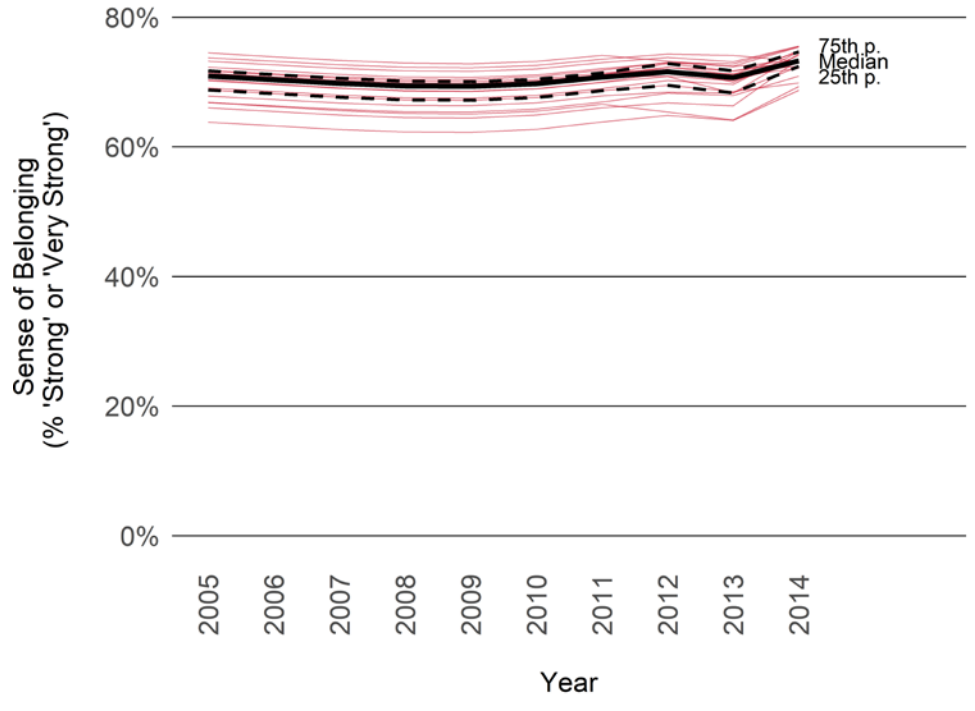


Figure 1.14: Self-perceived sense of belonging (proportion reporting a strong or very strong sense of belonging in their community) for each LGA within the BRW from 2005 to 2014; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Statistics Canada, 2014).

gatherings or social events (Patel et al. 2019, 6). Adolescent immigrants also report that they experience barriers to acceptance in their community and schools (Patel et al. 2019, 6). This highlights the importance of why a strong sense of belonging is necessary as a way to promote a welcoming and inclusive community.

Geographic Location

Rural communities tend to foster a higher sense of belonging than urban areas; for example, sense of belonging in the BRW is significantly higher than the sense of belonging reported in Edmonton. Sense of belonging is often influenced by an area's 'social capital,' a concept that emphasises the role of close relationships and the resources within one's community to form a sense of togetherness (Map 1.21).

Social capital is operationalized based on trust, cooperation, sense of community, and culture and tradition (Rivera et al. 2019, 66). Individuals that come from lower SES are motivated to work together to achieve community prosperity, thus increasing the community's social capital (Rivera et al. 2019, 67).

Culture and traditions are other major factors in building social capital. Sharing cultures and traditions establishes a sense of community by people being able to develop a collective sense of self-esteem and promote a collective feeling of care towards all members (Rivera et al. 2019, 82).

Policy Responses for Mental Health

Connecting communities, schools, workplaces, social services, families, and institutions in order to address, treat, and prevent mental illnesses have become an increasing focus of research into mental health and illness (Caxaj 2016). A number of scholars suggest that promoting and enhancing mental health requires a multi-sector and community-based mental health care approach (Castillo et al. 2019, 1). This section will examine the relevant policies focused on self-perceived mental health, the percentage of the population living with a mental illness, and sense of belonging, with a focus on policies that pay attention to social determinants of mental health and illness.

According to the Canadian Mental Health Association, 20% of Canadians of all ages in a given year will personally experience a mental health problem or illness, and almost one-half (49%) of those who feel they have suffered from depression or anxiety have never gone to see a doctor about their situation (Canadian Mental Health Association n.d.). Of those who have seen a doctor, many report a feeling of not knowing 'which door is the right door', as seeking treatment for mental illness involves navigating a confusing web of programs and services (Government of Alberta 2017, 4).

As has been discussed elsewhere in the atlas, equitable access to health care and education is a barrier faced by many rural communities. Rural communities can also have higher rates of mental illness, including suicide and suicide risk factors, and are more likely to lack access to specialized care (Hirsch and Cukrowicz 2014, 65). Mental health supports in rural communities can be extended through community-based approaches that frame mental health as a public health issue. When mental health is framed as a public health issue, rather than as a private matter, it is easier to coordinate programming to deliver comprehensive resources such as coping skills, mental health literacy, supports, and counselling for mental health resilience, illness prevention, and mental wellness (Caxaj 2016, 36-37).

For rural communities in Alberta, such as the communities of the BRW, it may be beneficial to begin imagining community-based initiatives that work to reverse the stigma associated with mental illnesses while remaining sensitive to cultural context (Hirsch and Cukrowicz 2014, 65). Since half of all lifetime cases of mental illness start by age 14 and 75% start by age 24, the educational system is a primary site at which to begin teaching people about mental wellbeing and the management and prevention of mental illnesses (Hymel et al. 2017, 98). Schools are an essential conduit for reaching children and their families, and for promoting positive social and emotional development, fostering safe and caring environments, and reducing stigma and other risk factors such as bullying (Hymel et al. 2017, 98).

How have governments responded?

In Alberta, mental health and public well-being have been addressed in a focused and specific way. Provincial strategies to address mental health among Albertans seek to reach the population as a whole and to address the specific needs of particular demographics, including Indigenous peoples, people with addictions, and children and youth. The Alberta Government began addressing mental health during the focus group discussions for the development of the Provincial Mental Health Plan in 2003 (Government of Alberta 2008c).

In 2006, the province released the Alberta Aboriginal Mental Health Framework, which took a holistic approach to mental health programs and services for Aboriginal peoples. The province also released the Positive Futures – Optimizing Mental Health for Alberta's Children and Youth: A Framework for Action (2006-2016) in 2006, which sought to improve mental health for children and youth through building the capacity to enhance/increase factors that promote mental health and wellbeing, removing or reducing risks to wellbeing and mental health, and promoting support and treatment (Government of Alberta 2006, 3).

In 2008, the Government created the Children's Mental Health Plan for Alberta: Three Year Action Plan (2008-2011), which sought to describe strategies to build on and enhance collaborative approaches between health services, schools, and communities (Government of Alberta 2008b, 3). Also in 2008, the Safe Communities plan was released, which set out 31 recommendations for crime reduction and prevention that spanned a continuum of prevention, treatment, and enforcement (Government of Alberta 2011c, 1).

In 2008, the Government of Alberta also released A Plan for Alberta: Ending Homelessness in 10 Years, which promised to realize its title by providing more housing options, collecting better information focused on the outcomes of housing strategies, assisting Albertans through enhanced provision of resources geared towards attaining housing, coordinating systems to efficiently work towards shared objectives, and building effective policies to bring down barriers to re-housing (The Alberta Secretariat for Action on Homelessness 2008, 18).

In 2011, AHS released Creating Connection: Alberta's Addiction and Mental Health Action Plan (2011-2016), which addressed the stigmatization of people with mental illnesses through policies aimed to increase awareness and visibility of mental illness. (Government of Alberta 2011b, 8). This plan also sought to improve the capacity of health systems in Alberta to effectively respond to people struggling with mental health (Government of Alberta 2011b, 8). In 2013, the Government of Alberta released Alberta's Social Policy Framework, which aimed to address social challenges and help ensure all Albertans have the opportunity to live with dignity and reach their potential (Government of Alberta 2013, 11).

The need for improvements emerges from the historical tendency on the part of governments and healthcare professionals to treat mental illness with misinformation, give poor directions to patients and their communities, and provide inadequate resources dedicated to addressing mental illness (Shand 2010). As stated in a 2015 review of the Alberta Mental Health system, preventative action is lacking within mental health care in Alberta: most adults with addictions and mental illnesses show signs and symptoms during childhood, but the lack of resources, trained professionals, timely screening, and comprehensive intervention prevent effective treatment of these illnesses (Government of Alberta 2015, 1).

The Canadian Government has been working on mental health for decades, beginning in 1988 with the publication of Mental Health for Canadians: Striking a Balance (Health and Welfare Canada 1988). Since releasing this publication, the federal government has been working with the Mental Health Commission of Canada, the Canadian Institutes of Health Research, the Canadian Depression Research and Intervention Network, National Collaborative for Suicide Prevention, and the Public Health Agency of Canada to address mental health issues (Government of Canada 2016).

Federal mental health strategies often target specific populations of people in the workforce, immigrants, refugees, ethnocultural and racialized groups, and the incarcerated population (Government of Canada 2016).

The federal government also provides funding and grants to organizations and nonprofits, such as the Mental Health Commission of Canada, which work to promote general knowledge of mental health, support people living with mental illnesses, and prevent illness where possible (Government of Canada 2016).

2015 marked the release of the most recent Alberta Mental Health Review Committee strategy. The Committee is tasked with addressing and improving mental health care in Alberta (Government of Alberta 2015, 8). As a result of this report, the Ministry of Mental Health Care reshaped policy goals to improve the current system. New goals include creating an integrated system for diagnosis and treatment through acting in partnership with communities, non-profits, research agencies, and primary healthcare providers; enhancing the role of primary health care to improve access, diagnosis, treatment, and navigation; focusing on prevention and early intervention for children, youth, and families; and updating the Mental Health Act to introduce systemic enhancements and new legislation and standards (Government of Alberta 2017, 9-17).

What is being done?

The Mental Health Act describes the actions the health system and/or legal system can take in certain serious or critical situations to protect and/or treat individuals with a mental disorder (Canadian Mental Health Association - Calgary Region 2010, 6). The Act also describes the rights individuals have to apply for a review, appeal their detention, and state their case if they are unhappy with their treatment under the Act (Canadian Mental Health Association - Calgary Region 2010, 6). This Act does not deal with recommendations regarding the prevention of mental illnesses but instead focuses on apprehension, detention, admission, treatment, and community treatment orders (Canadian Mental Health Association - Calgary Region 2010, 6).

In terms of preventative action and non-legal intervention, the Government of Alberta works with Health Services and Persons with Developmental Disabilities (PDD) to help adults with intellectual/developmental disabilities, mental health concerns/illness, and complex service needs receive the care they need through a coordinated and integrated support system (Alberta Health Services n.d. g). AHS provides free education and resources on their eLearning portal, geared specifically towards learning about the basics of mental health and focusing on support for those working alongside individuals with developmental disabilities (Alberta Health Services n.d. g).

What could be done?

Given the number of people in Alberta and across Canada who experience mental illness and mental health challenges, both the provincial and federal governments need to make mental illness a higher policy priority. Specifically, the Alberta government could acknowledge and act on the chronic underfunding of mental health services in Alberta (Canadian Mental Health Association Alberta 2019, 5). The government could be spending 12-13% of the provincial health budget on mental health, as opposed to the 6% that currently is being spent (Canadian Mental Health Association Alberta 2019, 5). In addition to allocating more funding to mental health, the Health Ministry could begin devoting a more proportional amount of the health budget to action on mental health, in order to shift away from reactively providing programs after an individual experiences the onset of illness.

Another beneficial shift in the policy climate would be adopting a health-equity (parity) lens, placing mental health on the same standing of importance as physical health (Canadian Mental Health Association Alberta 2019, 5). The Alberta Government could also acknowledge and act on the need for cross-ministry investments to promote positive mental health, rather than relying solely on the Health Ministry (Canadian Mental Health Association Alberta 2019, 5). Cross-ministry investment would allow the government and public service to develop a stronger, more integrated picture of the SDOH and how they contribute to mental illness or wellbeing.

SDOH are discussed elsewhere in this chapter, but some of the areas of government oversight that affect mental health are connected to SDOH including equitable access to the justice system, employment, housing, children and family services, and community connection, particularly for seniors and other vulnerable individuals (Shand 2010).

Utilizing a community-based approach may also require tying mental health care to faith-based and culturally-specific healing modalities responsive to local values, building on known rural community strengths such as collective care, informal networks of support, and a connection to the land, and developing initiatives that build a sense of community and engagement (Caxaj 2016, 38). Community-based interventions have the capacity to be culturally customized to fit with the norms and worldviews of unique communities, whether for rural people in general, or perhaps tailored to specific rural subgroups such as farmers, rural women, or veterans and their families (Hirsch and Cukrowicz 2014, 71).

Addressing mental illness may require implementing a youth health strategy. Many mental illnesses first onset in childhood or young adulthood and can be more effectively managed if they are caught early. Other models (*e.g.,* Norway) place mental health on an equal footing with physical health, and include mental health as part of the work aimed at children and young people.

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CHAPTER TWO

PEOPLE AND COMMUNITY

TABLE OF CONTENTS

INTRODUCTION

The People and Community chapter discusses community engagement and wellbeing within the BRW. People and Community encompasses vulnerable populations, inequalities within a community, access to services, and recreational opportunities.

Measuring People and Community

1. Stability and Security

Stability and security is a measure of community wellbeing (CWB) that includes indicators of crime rate and access to community and health services. Stability and security takes into account vulnerable populations at risk for inequalities or experiences of discrimination, as well as barriers of access to food, culture, mobility, and health services. Crime rates can indicate the wellbeing of a community, as reduced safety will lead to a poorer quality of life. Access to community services is integral to the wellbeing of a community, as certain regions may have poor access to healthcare or a lack of special facilities to support one's needs. If a region lacks necessary services or residents cannot easily access them, many citizens, and particularly citizens with lower incomes or reduced mobility, are at greater risk for a poor quality of life.

2. Community Wellbeing

CWB includes many of the social determinants of health (SDOH), including socioeconomic status (SES), race, gender, and culture. A community that rates highly in terms of CWB will be one in which the broadest possible cross-section of residents has equitable access to employment, housing, education, social services, clean air, water, an unpolluted environment, a sense of belonging, security, and social participation. Indigenous communities often report lower-than-average CWB scores due to historic and ongoing racial discrimination, and a lack of resources or facilities in their communities.

3. Civic Engagement

Civic engagement can be used to measure certain public activities that are valued in a democratic culture. These activities often have significance beyond the political sphere, and their presence or absence can indicate community quality of life, individual satisfaction and, again, a sense of belonging, meaning, and social inclusiveness. For example, volunteer activities, from community gardening to coaching recreational sports to fostering rescued animals, give citizens a sense of value and contribute positively to their community. For the communities of the BRW, the extensive and varied ecosystem of the Battle River is a source of pride, wellbeing, and identity. Stewardship activities are a necessary aspect of the health and prosperity of the watershed and its ecosystem. A political measure of civic engagement, voter turnout, is also an important measure of civic engagement, as elections are fundamental to our Canadian political structure.

4. Parks and Recreation

Parks and Recreation is a measure of green space areas and leisure time spent outdoors. Spending time in nature can cover a range of activities and community services, from having access to safe and well-maintained neighbourhood parks to having opportunities to camp, fish, hike, pick berries, or ski. Access to the outdoors is a significant lifestyle variable in Alberta for people of all ages, and across both Indigenous and settler communities. Ensuring that the natural environment is protected not only means that people can continue to enjoy outdoor activities, but also (and perhaps even more importantly), that animal and plant habitat will be preserved, water will remain clean, and human communities can make lasting contributions to the ecosystems in which they exist.

Understanding the Political Context of People and Community

Alberta has enormous natural wealth and has experienced cycles of prosperity and recession. These ups and downs contribute to social instability and fluctuations in supports for social programs. In general, Alberta governments have tended to be socially conservative, and skeptical of programs that address disparities stemming from race, gender, or Indigenous status. At the same time, spending on health care, social services, and education have become the top three sources of government expenditures across Canada. While Alberta does not spend much more per capita on social services and education than it did in 1980-81, by 2016-17, the province was spending more than $2,000 more per person on healthcare costs (Wilkins and Kneebone 2018).

In Alberta, public policy related to people and community reflects larger political trends that sometimes work in opposite directions. One trend is towards decentralization, with greater decision-making authority delegated to lower levels of government, and more

participation from citizens groups, industry, and other organizations deemed to be stakeholders in the policy process. The tendency towards decentralization can be seen in Alberta's Watershed Planning and Advisory Councils (WPACs), introduced in this chapter and discussed in greater detail in the 'Water' chapter. The other trend is toward greater centralization and standardization of policies and services, as can be seen with the development and implementation of AHS. The policy sections in this chapter will pay attention to both of these trends, pointing out each where it is relevant, and paying special attention to policy developments that are relevant for the BRW, rural communities, and Indigenous communities.

Homicide Rate (per 100,000 population) by Census Metropolitan Areas (2020)

Metropolitan Area	Homicides
Calgary, Alberta	39
Edmonton, Alberta	47
Lethbridge, Alberta	2
Toronto, Ontario	105
Winnipeg, Manitoba	41
Victoria, British Columbia	6

Table 2.1: Homicide rate (number of victims per 100,000 population) for select Census Metropolitan Areas in Canada in 2020 (Source: Statistics Canada, 2021).

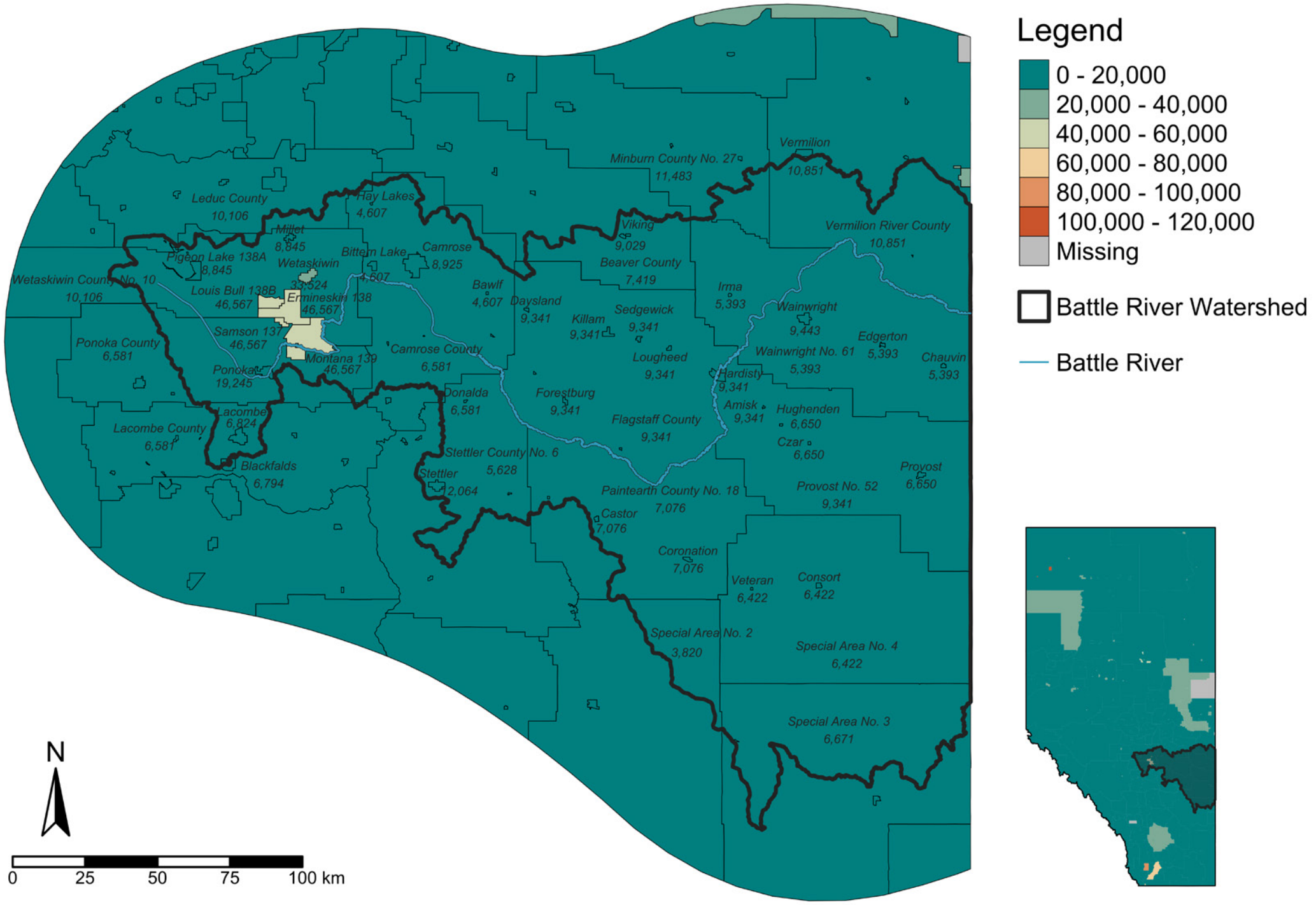
Stability and Security

Crime Rate

According to the CWB Index, "higher levels of crime severity substantially reduce personal and community quality of life" (University of Waterloo n.d. a). In the United States, the Office of Disease Prevention and Health Promotion (ODPHP) lists crime and violence as a key issue in their Healthy People 2020 Social Determinants of Health topic area (Office of Disease Prevention and Health Promotion 2022). The ODPHP notes the effects of crime and violence on both community and individual health and wellbeing, from injuries and premature death to mental distress, reduced engagement with physical activity because of fear of being outside in the neighbourhood, behavioural problems in children extending through adolescence and adulthood, and higher rates of interpersonal violence among people who were exposed to violence as children (Office of Disease Prevention and Health Promotion 2022). People can be exposed to crime and violence

Crime Rate (2019)

of violations per 100,000 population



Map 2.1: (Source: Statistics Canada. 2019. Table 35-10-0183-01 Incident-based crime statistics, by detailed violations, police services in Alberta).

in several different ways: they "may be victimized directly, witness violence or property crimes in their community, or hear about crime and violence from other residents" (Office of Disease Prevention and Health Promotion 2022).

Crime is a complex phenomenon, and includes events which are quite different from each other. A property crime, such as graffiti, is a significantly different type of crime than sexual assault or armed robbery. However, crime of any kind both indicates, and creates, reductions in interpersonal trust and increases unhealthy behaviour at individual and community levels (Willoughby 2012). As seen in Figure 2.1, the BRW experiences variation in its crime rate across communities, and the differences are likely linked to broader structural issues in Alberta and in Canada, including the disproportionate numbers of Indigenous people caught up in the criminal justice system.

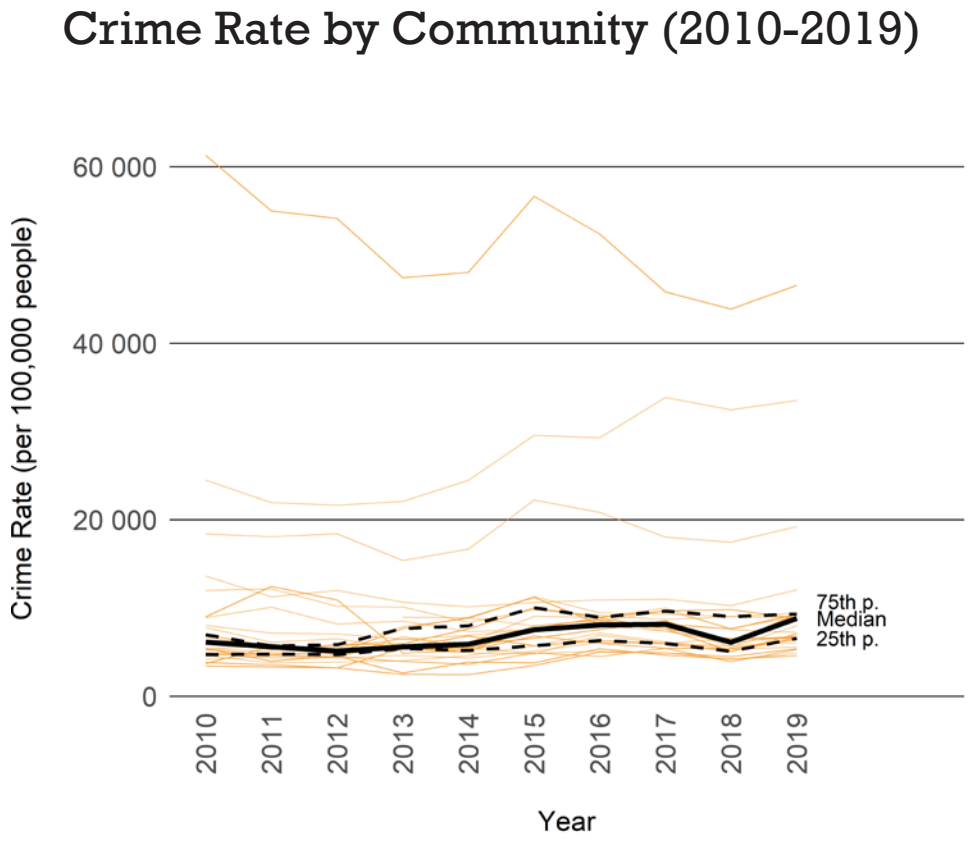


Figure 2.1: Crime rate (per 100,000 population) for each census subdivision (CSD) within the BRW from 2010 to 2019; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Statistics Canada, 2019).

The median crime rate for census subdivisions in the BRW in 2019 was 8,845 incidents per 100,000 population (Figure 2.1). However, crime rates were substantially higher in a number of communities, namely Montana 139, Samson 137, Ermineskin 138, and Louis Bull 138B (46,567 per 100,000 population); Wetaskiwin (33,524 per 100,000 population); and Ponoka (19,245 per 100,000 population) (Map 2.1). For comparison, the crime rate in Edmonton the same year was 9,660 per 100,000 population (Statistics Canada 2021d).

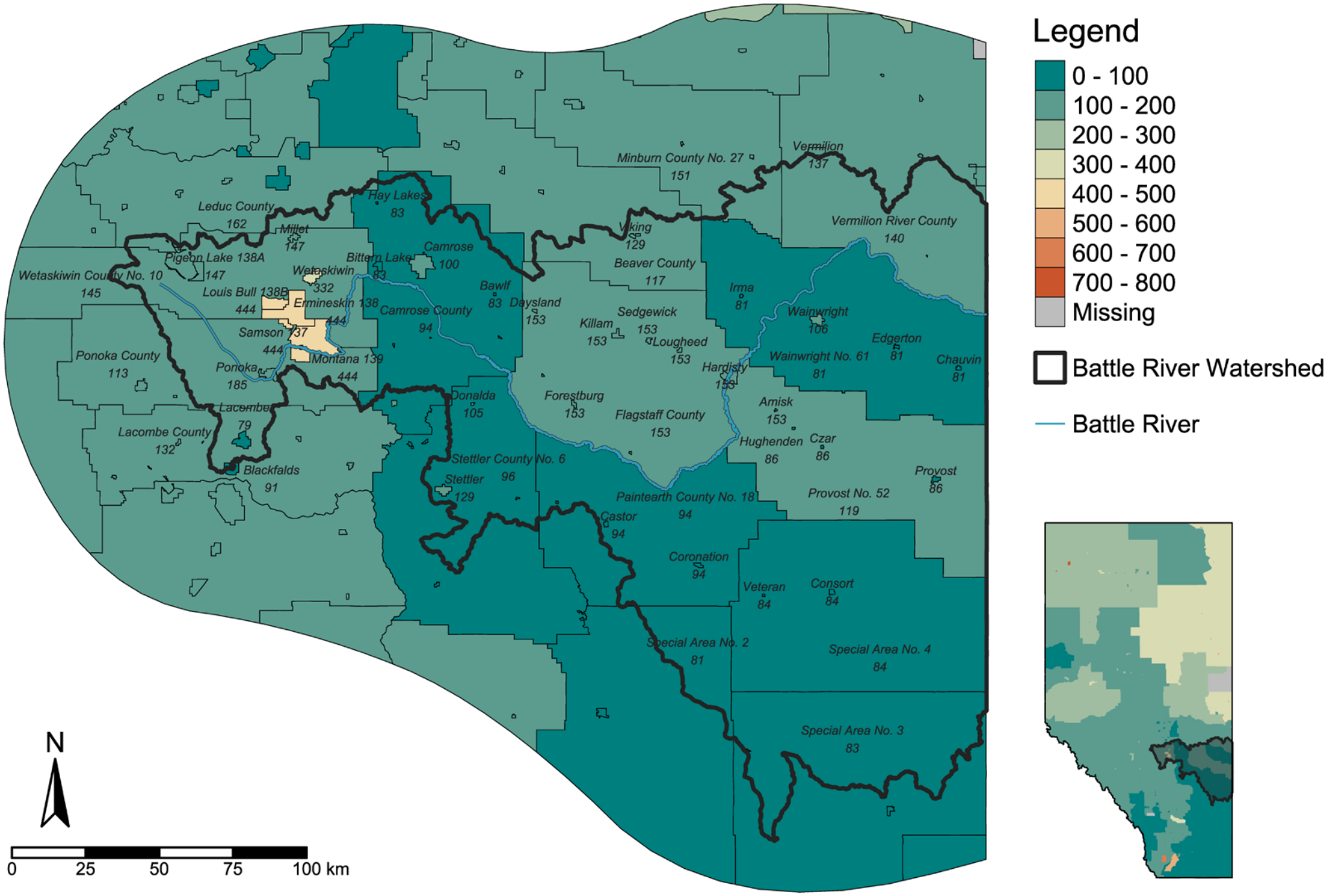
The Crime Severity Index (CSI) tracks the severity of crime by comparing the prevalence of crime within a community, and the seriousness of the crimes committed (University of Waterloo n.d. a). A higher CSI score indicates more severe crime in a region. In the BRW and surrounding areas, the CSI rating falls within a range of 0-100 and 100-200 depending on the region. A small region south of Wetaskiwin has a significantly higher score, falling within the range of 400-500 (Map 2.2). In 2019, the Alberta average for the CSI rating was 120.14 (Statistics Canada 2022d).

Understanding Crime Rates

In Canada, crime is defined as "acts or omissions prohibited by law and punishable by sanctions" (Spencer and Mohr 2015). Certain types of crime, especially violent crime, have geographical and sociodemographic biases, explaining the variation of crime in certain regions. For example, in 2019 the Northwest Territories had the highest rate of violent crime in Canada with 11,060 violent crimes per 100,000 population (Statistics Canada 2021d).

Crime Severity Index (2019)

Measure of the severity level of police-reported crime; higher values indicate greater number and/or seriousness of crimes



Map 2.2: (Source: Statistics Canada. 2019. Table 35-10-0190-01 Crime severity index and weighted clearance rates, police services in Alberta).

In 2019, Alberta had 1,461 violent crimes per 100,000 population, with Ontario as the lowest ranking province in violent crime at 942 cases per 100,000 population (Statistics Canada 2021d).

There are numerous reports of racial biases in the enforcement of criminal justice. For example, a study of 10,000 arrests in Toronto found that black people were 50% more likely to be taken to a police station following arrest than caucasians (The John Howard Society of Canada 2017). Indigenous peoples are also over-represented in correctional institutions. Indigenous peoples make up around 6% of Alberta's population; however, they represent 39% of the jail population (The John Howard Society of Canada 2017). In 2017, 38% of people convicted of homicide in Canada were Indigenous (Beattie, David, and Roy 2018, 14).

Crime Severity Index by Community (2010-2019)

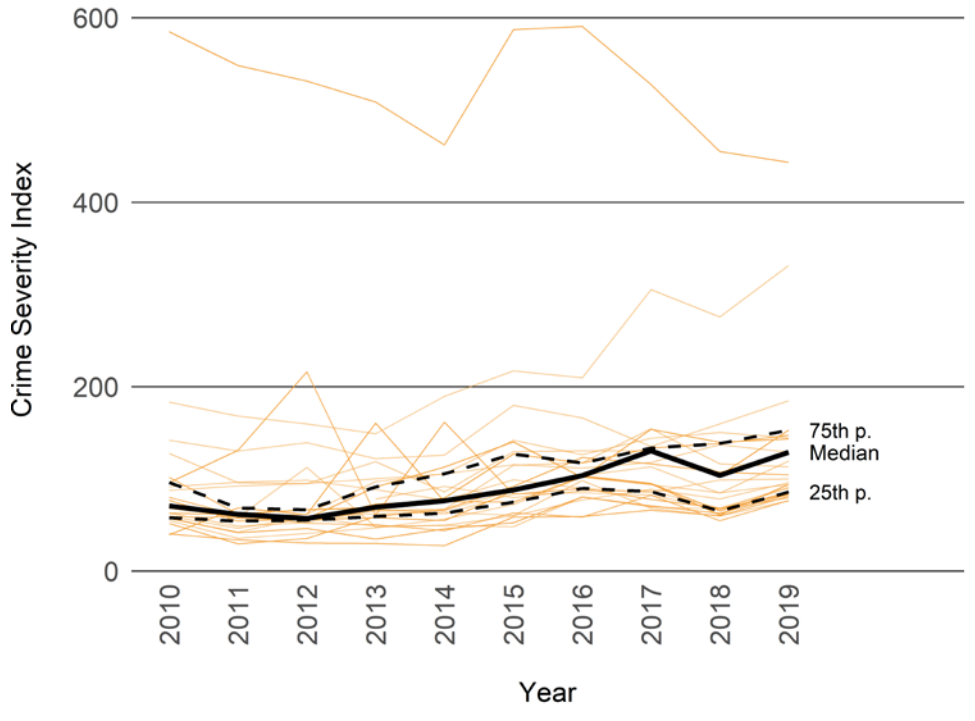


Figure 2.2: Crime severity index (a weighted measure that accounts for the frequency and severity of crimes) for each census subdivision (CSD) within the BRW from 2010 to 2019; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Statistics Canada, 2019).

Risk Factors for Crime Rate

Urban vs. Rural Crime

The overall perception of Canadians is that rural residents are more satisfied with their personal safety and believe that crime is proportionally lower in their neighbourhood (Perreault 2019, 4). However, rural residents actually experience more crime than urban residents in Canada (Statistics Canada 2019b, 1). In 2017, rural police reported: "23% of violent crimes, 17% of property crimes, 27% of Criminal Code traffic offense, 23% of other Criminal Code offences, and 21% of drug offences" (Perreault 2019, 5). The rural crime rate of Criminal Code violations (excluding traffic) was 23% higher than the urban rate; when considering all federal violations and traffic offences, the rural crime rate was 30% higher than the urban rate in 2017 (Perreault 2019, 5). Rural crime is especially prevalent in the Prairie Provinces, including Alberta (Perreault 2019, 6).

Violent Crime

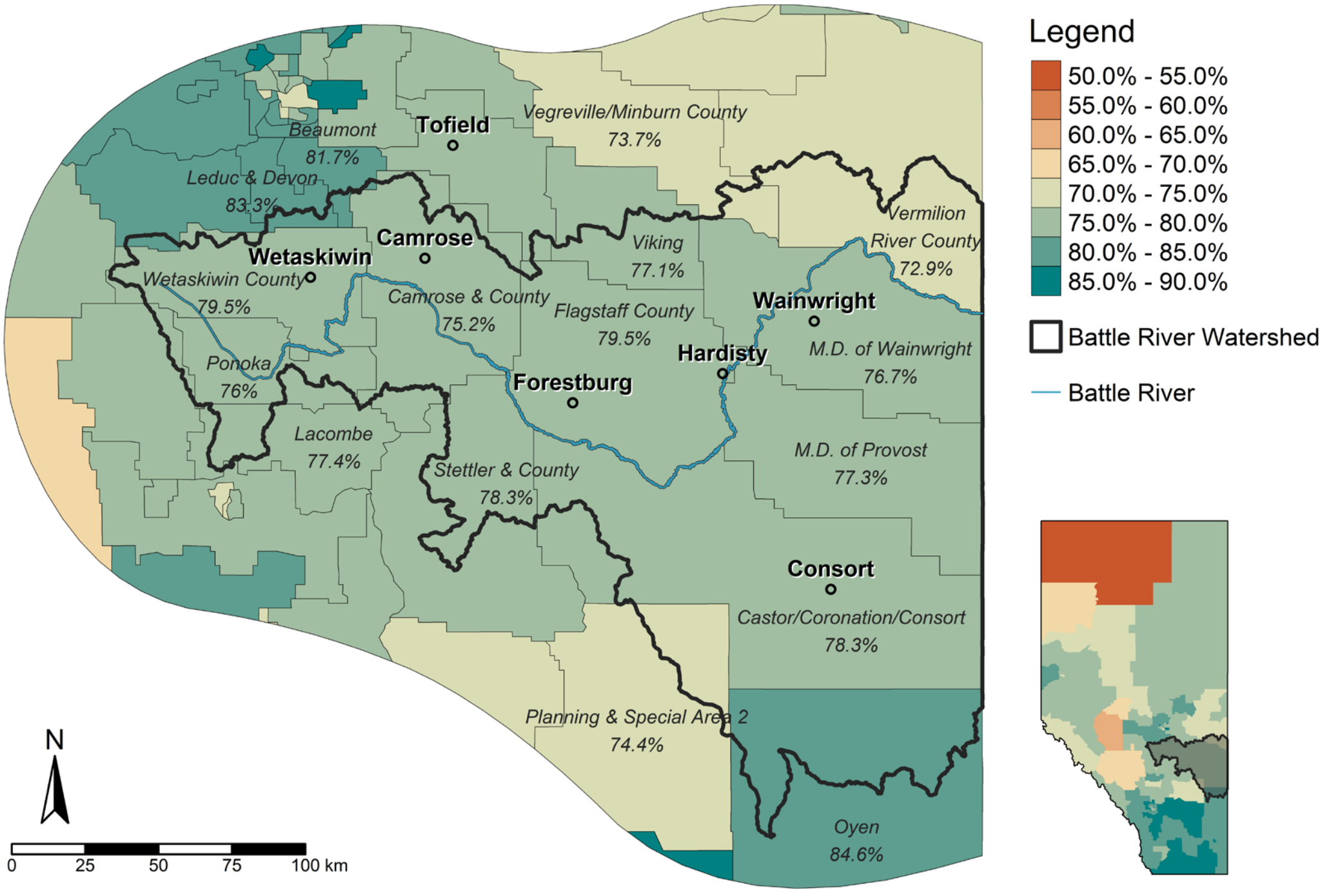
Violent crime is more common in rural areas, with physical assault being twice as common in rural communities (Perreault 2019, 14). Both homicide rates and violent offences such as firearm offences and aggravated assault were higher in rural areas (Statistics Canada 2019b, 3).

This trend may exist due to several factors, such as (but not exclusive to) the following:

- Geographic Location: Some rural communities face isolation and have barriers in accessing services or neighbours, and limited access to personal and public transportation, internet, telephone, etc. (Jeffrey 2019, 5),
- SES: Low SES women in rural communities in Alberta have reported challenges in leaving abusive relationships due to their inability to access affordable housing and having insufficient incomes (Barton et al. 2015, 8),

Access to Family Doctor (2014)

% of the population who have a regular family doctor



Map 2.3: (Source: Statistics Canada. 2014. Canadian Community Health Survey).

- Firearms: Rural communities often have strong traditions and community values related to firearms, thus contributing to greater access and use/threat of firearms in violent crime cases (Jeffrey 2019, 5).

Property Crime

Property crime is the primary form of crime in both rural and urban areas, with rural property crimes only 6% higher than urban areas in 2017 (Perreault 2019, 17). Although the rate is not significantly higher, there are still significant differences in the nature of property crimes between these two regional areas.

Mischief is defined up as the willful destruction or damaging of property (Government of Canada 1985, 453), and is the most common type of property crime in rural regions. Break-ins and thefts are of great concern in rural areas, especially within Alberta. In 2017, there were 978 reported break and enter incidents per 100,000 population in rural Alberta, a rate that is 48% higher than in urban Alberta (Perreault 2019, 18).

There is a strong relationship between crime and SES. Property crimes are often commited by individuals who have recently moved, have lower levels of educational attainment, poor quality and older housing, and higher unemployment (Kitchen 2007, 67). Public Safety Canada lists risk factors for criminalization that coincides with the previously mentioned study, such as poverty, unemployment, and low literacy (Public Safety Canada 2015).

Access to Community and Health Services

The term community services covers a wide range of social and physical supports within a community, from family physicians to income and employment support, disability support, and even internet provision. Community services play an integral role in interpersonal relationships and social bonds within a community. Investments that promote education, literacy, and employment services are investments into the mental health, labour potential, and economic growth of a community. Especially in rural areas, access to reliable internet helps residents to access education and may support social connectivity. Healthcare in Canada is an essential service, and our universal healthcare is widely regarded as a global achievement. There is strong international evidence that accessible, effective primary healthcare (a family physician or a professional such as a nurse practitioner) is linked with improved community and individual health (Shi 2012, 7). However, not all communities have consistent or comprehensive access to primary healthcare, and this can especially be a problem for rural communities.

Understanding Access to Community and Health Services

Community services play an integral role in the cultivation of crucial interpersonal relationships within a community. Opportunities to better the community through education and literacy are investments in mental health, labour potential, and growth of a community. Health care in Canada is also an essential service, however, not all communities have consistent access to healthcare. In 2015, 19.5% of Albertans reported not having a regular health care provider (Statistics Canada 2020d, 4). Males and those aged 18-34 years-old were most likely to be without a health care provider (Statistics Canada 2020d, 4). In 2019, 14.9% of Albertans reported that they did not have a regular health care provider (Statistics Canada 2020d, 4).

Tables 2.2 and 2.3 show two components of access to community and health services. Both internet access and access to a family doctor are important for health, wellbeing, and connection. The BRW lags significantly behind Alberta's fastest, and average internet speeds (Table 2.2). The percentage of population with access to a family doctor, on the other hand, is on par with the average rate of access in Alberta (Table 2.3).

Risk Factors for Access to Community and Health Services

Internet

Internet is an essential service that allows one to access information and contacts for health and community services. Internet speed varies throughout the BRW. On average, the internet speed in the BRW is 10.85 Mbps (Table 2.2). A few regions in the BRW are below this average, such as Forestburg and surrounding areas. The average internet speed in Alberta is 20.91 Mbps, which is approximately double the BRW's average (Table 2.2).

Family Doctors

Having a family doctor is a critical health service that should be obtainable to any resident in a community. In most regions in the BRW, 75-80% of residents have a regular family doctor (Map 2.3). This means that around 20% of BRW residents still do not have access to a family doctor, which is a significant proportion of the population. In 2014, 77.5% of Alberta residents had a regular family doctor, similar to the rates in the BRW (Table 2.3). It is important to note that this is not representative of specialist doctors in the region, and it is likely that the BRW has a smaller percentage of residents that have access to these specialist physicians.

Transportation Barrier

Transportation barriers disproportionately affect older adults that live in rural areas, and those of lower SES (Jazowski et al. 2021, 1). Rural residents must often travel out of their town to reach specialists that are primarily located in larger urban centers. For example, cancer patients in rural communities must travel long distances to either the Cross-Cancer Institute in Edmonton, or the Tom Baker Cancer Facility in Calgary. This transportation barrier contributes to the decreased likelihood of receiving or adhering with recommended treatment and specialist care, as well as non-adherence of treatment and surveillance with cancer treatment plans (Jazowski et al. 2021, 1). Albertan weather and road conditions makes this more difficult during the harsh winters. Those of low SES in rural areas may lack sufficient transportation methods to travel for appointments or treatments. Some people are also reluctant to access these healthcare services as there is stress associated with leaving behind families and support networks for extended periods of time.

One of the biggest concerns highlighted in transportation issues is dissatisfaction with the dispatch of Emergency Medical Services (EMS) (Rural Health Services Review Committee 2015, 16). Ambulances can have a hard time finding rural addresses, thereby increasing response time in a time of urgent need (Rural Health Services Review Committee 2015, 16).

Internet Speed (2020)

Region	Min	Max	Population Weighted Mean
Battle River Watershed (36 CSDs)	1.51	20.86	10.85
Alberta (233 CSDs)	1.06	34.94	20.91

Table 2.2: Median internet download speed (megabits per second, Mbps) for Census Subdivisions (CSDs) in Alberta and the BRW (Source: Government of Alberta, 2020).

About 40% of First Nations people in Alberta live in First Nations communities or on reserves (Kulhawy-Wibe et al. 2018, 3). This can pose a physical barrier to healthcare access due to geographic isolation (Kulhawy-Wibe et al. 2018, 3). Many healthcare services are concentrated in urban or more developed areas which requires Indigenous peoples to travel long distances to access specialists (Nguyen et al. 2020, 4).

Limited Healthcare Supply

Despite having a high number of physicians per capita, rural communities continue to face physician shortages. (Government of

Alberta n.d. n). The number of physicians practicing in rural Alberta in 2020 was 752, accounting for 6.7% of physicians in Alberta, which is a decrease of 4% since 2019 (Government of Alberta n.d. n). Many physicians that practice in rural areas are also closer to retirement (Friesen 2019, 48). This issue of physician shortages is especially apparent in Indigenous communities and reserves (National Collaborating Centre for Indigenous Health 2019, 4).

Continuing care is in high demand as Alberta's population is aging and seniors are becoming a large segment of rural communities (Brassolotto et al. 2019, 160). Challenges in the rural continuing care workforce include the recruitment and retention of care workers, staffing levels in facilities, and changes in staff roles and responsibilities over time (Brassolotto et al. 2019, 166). The shortage of staff means there are not enough staff to monitor residents, address their basic needs, or provide psychosocial care (Brassolotto et al. 2019, 166). Especially for seniors, staying in their home community is important in maintaining support from nearby family and friends; however, this is an issue when seniors are forced to move from their homes to different communities that have the access and beds for continuing care (Brassolotto et al. 2019, 167; Strain et al. 2011, v-vi).

Quality Healthcare, Social Climate Barriers

Social barriers to healthcare are identified as "difficulty getting accurate diagnoses, lack of trust in health care providers, physicians' perceived lack of interest in patients, difficulty scheduling an appointment, and/or long waiting times at such appointments" (Goins et al. 2005, 209). Rural residents were 1.7 times more likely to report avoiding the community's health care professional compared to the residents living in urban regions (Spleen et al. 2014, 83). Documented barriers to access included: "stigma, lack of privacy, lack of culturally appropriate interventions, and acceptance of poor health" (Spleen et al. 2014, 84). Vulnerable populations, such as religious groups, the lesbian, gay, bisexual, transgender, queer, and two-spirit (LGBTQ2+) community, and Indigenous peoples, often have a more pronounced lack of access to quality health care.

Language barriers between Indigenous peoples and health care providers are a common barrier to accessing healthcare in Indigenous communities (Cameron et al. 2014, E9). Indigenous culture understands health in a holistic approach, meaning that healthcare is conceptualized as a balance between "mind, body, spirit, and emotion" (National Collaborating Centre for Indigenous Health 2019, 8). This understanding of health is

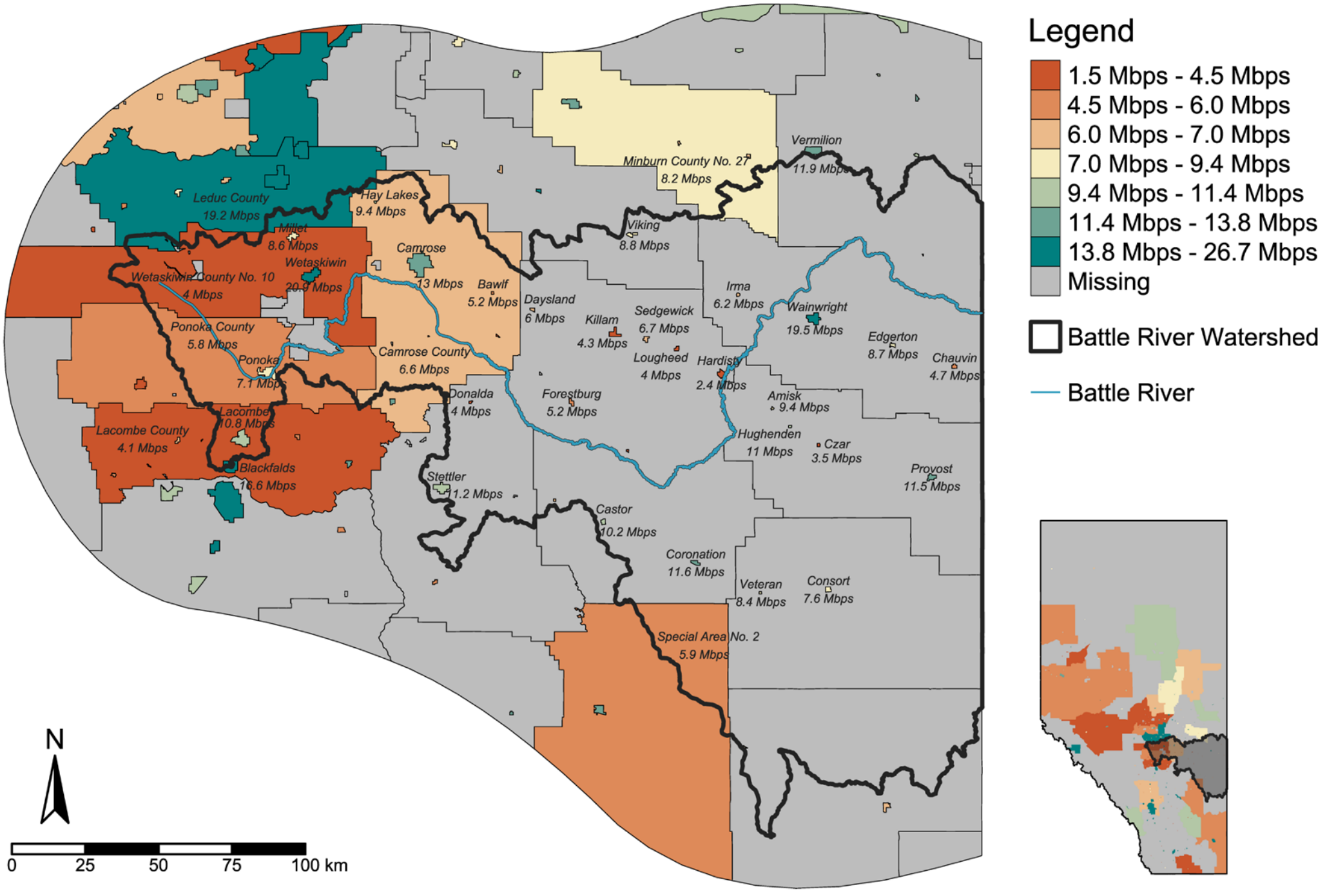
Access to a Family Doctor (2014 and 2016)

Region	Access to a Family Doctor
Camrose and County	75.2%
Wetaskiwin	79.5%
Lacombe	77.4%
Alberta	80.1%
Canada	85.1%

Table 2.3: Percent of the population with access to a family doctor for select countries and communities in 2014 (Source: Statistics Canada. Table 13-10-0451-01 Health indicators, annual estimates, 2003 - 2014.
Alberta Health, Analytics and Performance Reporting Branch. 2014. Interactive Health Data Application: Canadian Community Health Survey (CCHS) Indicators).

Median Download Speed (2016-2020)

Download speed in megabits per second (Mbps)



Map 2.4: (Source: Government of Alberta, Alberta Regional Dashboard. 2020. Median Download Speed. Compiled from M-Lab Network Diagnostic Tool (NDT) data).

often not emphasized in Western healthcare, which may lead to misunderstanding and mistrust of health care providers (National Collaborating Centre for Indigenous Health 2019). Historical events such as the segregation and mistreatment of Indigenous peoples in 'Indian hospitals' for tuberculosis treatment, have also led to a reluctance to seek medical help due to emotional stress and elevated anxiety (National Collaborating Centre for Indigenous Health 2019, 2).

Another group that faces healthcare access is the LGBTQ2+ community. Many individuals of this community find it difficult to share their sexual identities with their clinicians. Furthermore, research has shown a lack of appropriate illness-related education (Hafeez et al. 2017, 5). With LGBTQ2+ youth reporting higher rates of mental health difficulties, the lack of mental health services and facilities in rural areas also poses a significant challenge (Hafeez et al., 2017).

Healthcare Initiatives

There are initiatives in place to improve access to care in rural communities, which the Government of Alberta claims to be a priority. Some of these incentives include:

- The Rural Remote Northern Program (2007): provides direct financial incentives to physicians who live in underserviced communities,
- The Rural Health Professions Action Plan (1991): works with communities to enhance the attraction and retention of health professionals for rural practice,
- The Rural Medical Education Programs (2020): support medical students and residents experience with rural health care, and
- The Physician Locum Service Program (2020): ensures that communities with four or fewer physicians have access to medical coverage if a physician is unable to provide services.

Policy Responses for Stability and Security

For the past 15 years, the Government of Alberta has been developing policies in the areas of Criminal Justice and Community and Health Services that seek to address two things: (1) the need to modernize these two systems in the face of Alberta's changing demographics, and (2) an increasing recognition of the role that poverty, addiction, and mental health issues play in community safety and wellbeing, which includes crime.

Alberta's 2007 Keeping Communities Safe report set out 31 recommendations for crime reduction that spanned a continuum of prevention, treatment, and enforcement. The report was developed from the findings of a task force which was sent to select communities across Alberta to understand the impacts of crime on communities and the efficacy of the criminal justice system in addressing and preventing crime (Alberta's Crime Reduction and Safe Communities Task Force 2007). The report set out five priority areas for reducing crime:

- improved access to treatment for drug and alcohol addictions,
- reinforcing existing laws and introducing new crime-related legislation aimed at repeat offenders, addressing issues in high-crime areas, and ensuring that the courts can process offenders more quickly,
- improved support for families, children, and youth,
- increasing numbers of police to better reflect Alberta's growing population, and
- a renewed focus on community safety (Alberta's Crime Reduction and Safe Communities Task Force 2007, 42).

Alberta's Ministry of Community and Social Services "exists to support the social inclusion of Albertans" and "funds a range of programs and services for Albertans in the areas of disability supports; prevention of family and sexual violence; CWB and resilience; employment services; housing stability and homeless supports; and financial stability" (Government of Alberta 2020b, 8). Community and social services are on the front lines of poverty reduction, through supporting people to access housing, employment, and income support. The root causes of much of the province's crime lie in addiction and poverty.

How have governments responded?

Crime Rate

The Keeping Communities Safe task force (2007) found multiple themes that reoccurred across communities. In particular, the report listed a significant problem with repeat

offenders, meaning a person who commits a crime, is caught, charged, and released, only to commit the same crime again.

The high number of repeat offenders indicated that the justice system did not meaningfully interrupt the cycles that create repeat offenders, including poverty and addictions. Moreover, the system is fractured, as police, the courts, social workers, mental health workers, and community agencies work independently instead of sharing the same objectives (Alberta's Crime Reduction and Safe Communities Task Force 2007, 40). Underlying issues, including addictions and mental illness, are given "band-aid" treatment (Alberta's Crime Reduction and Safe Communities Task Force 2007, 40).

In 2010, the Government of Alberta released the Law Enforcement Framework. The Framework incorporates recommendations from several other policy initiatives, including the MLA Review of Special Constables, the Roundtable on the Future of Policing, and the Crime Reduction and Safe Communities Task Force (Government of Alberta 2010b, 3).

The Law Enforcement Framework is designed to reflect and respond to emerging challenges in the Alberta justice system, and to position Alberta law enforcement as a modern, flexible, and professional force that is well-positioned to meet the policing and public security needs of Albertans (Government of Alberta 2010b, 2). The Framework presents nine strategies that will guide the Alberta Government as it makes future decisions about policing, including:

- Having a capable, flexible, and responsive operational police as the foundation,
- Utilizing the full continuum of law enforcement delivery to provide flexibility in policing approaches throughout the province,
- Alberta Law Enforcement Response Teams (ALERT) will act as the instrument to execute and improve the delivery of "integrated, specialized policing services,"
- Alberta law enforcement will be led by intelligence,
- Having clear, strong standards and performance indicators to guide and assess law enforcement in Alberta,
- Balancing traditional law enforcement activities with prevention initiatives led by communities to achieve the long term goal of decreasing crime,
- Ensuring that all provincial municipalities will have meaningful input into the needs of local policing,
- Ensuring the police public complaint process will be responsive and timely, which will enhance oversight of Alberta police officers and police services, and lastly,
- Creating a framework that focuses on transparency, equity, and sustainability for the distribution of local policing costs (Government of Alberta 2010b, 3-5).

The Alberta Government's current approach to crime reduction is discussed on their Crime prevention web page. This site describes an approach that aligns with the above findings and strategies, which emphasize the social roots of crime and crime prevention (Government of Alberta n.d. e). Part of taking a social approach to crime involves understanding and describing an individual's risk factors and protective factors.

Risk factors for becoming involved with crime either as a victim or an offender include unemployment, low levels of education, and drug and alcohol addictions, while protective factors include having strong social networks and living in communities with accessible and effective social services (Government of Alberta n.d. e).

In 2022, Edmonton Police Services (EPS) have announced the Young People Strategy: 2021-2024, for changing the way EPS officers and policies interact with youth aged 10-24. Young people in this age group make up approximately 18% of Edmonton's total population, but commit 26% of property crimes and 31% of violent crimes. The new strategy aims to divert youth out of the criminal justice system as much as possible, through the creation of new youth-specific offender management programs, new protocols for officers dealing with young people that take youth behaviour and development into account, and through reference to the social factors of wellbeing including race, gender, housing status, trauma, and mental health (Edmonton Police Service 2021).

Community and Health Services

The contemporary approach to community and health services in Alberta marks a shift from a programmatic response to a systems-level response (Strathcona County 2017, 2). In other words, government programs and services are shifting away from a model of service provision where individuals receive services in a top-down and isolated manner, and are attempting to shift towards systems that work with complexity.

The hope for an integrated, systems-level approach is twofold. In the first instance, such an approach will be better able to maintain care for people with complex needs. For example, mental health care can be better coordinated with housing supports, instead of each of these needs being treated separately and as though they do not interact. In the second, people accessing services are assumed, in a systemic model, to be active participants in their care and service provision, and not passive consumers (Strathcona County 2017).

What is being done?

Crime Rate

Several pieces of legislation exist in Canada, and in Alberta, that define criminal activity and specify punishment for offences. In certain cases, legislation will describe the special rights of specific types of offenders, such as youth. The two most important pieces of legislation are:

The Federal Criminal Code, which codifies most criminal offences and procedures in Canada (Government of Canada 1985). The Criminal Code was passed in 1892, and amendments to the Code have been made almost yearly to keep abreast of technological, social, and economic changes in society (Pringle 2020).

The Criminal Code contains most of the criminal offences that have been enacted by Parliament; however, some other criminal offences have been incorporated into other federal statues (Pringle 2020). The Code not only defines types of conduct that constitute criminal offences but also establishes the kind of degree and punishment that may be imposed when an individual is convicted of an offence and the procedures to be followed throughout the criminal process (Pringle 2020).

The Federal Youth Criminal Justice Act (2002), which states:

- that society has a responsibility to address the developmental challenges and needs of young persons, that communities and families should work in partnership to prevent youth crime by addressing its underlying causes,
- that a demand exists to respond to the needs of young persons and provide guidance and support,
- that accurate information about youth crime, the youth justice system and effective measures should be publicly available,
- that young persons have unique guarantees of their rights and freedoms, including those set out in the United Nations Convention on the Rights of the Child,
- that the youth justice system should take into account the interest of victims and ensure accountability through meaningful consequences, rehabilitation, and reintegration, and lastly,
- that the youth justice system should reserve its most serious interventions for the most serious crime and reduce the over-reliance on incarceration (Government of Canada 2002, 1).

This legislation is supplemented by provincial legislation, including:

- Alberta's Criminal Notoriety Act, which was put in place in 2006 to prevent criminals from financially exploiting the notoriety of their crimes (Government of Alberta 2010a),
- Alberta's Victims of Crime and Public Safety Act (2020), and
- Victims of Crime (Strengthening Public Safety) Amendment Act, which came into force on June 26, 2020.

These three Acts expand the scope of the provincial Victims of Crime Fund to include public safety initiatives which aim to deter crime and reduce victimization. The initiatives include ALERT, the Rural Alberta Provincial Integrated Defence (RAPID) Force, drug treatment courts, and provisions to hire more crown prosecutors (Government of Alberta n.d. p).

Access to Community Services: Health Care

AHS was launched in 2008, transforming twelve separate health authorities into one province-wide system (Alberta Health

Services n.d. a). The transition sought to reduce economic inefficiencies, competition between regions, and wait times for medical procedures, as well as to ensure that all Albertans could receive the same standard of care.

The new system of province-wide governance replaced the previous system of regional governance, which in the 1990s replaced a system where individual hospital boards and health service providers negotiated directly with the Ministry of Health (Born, Sullivan, and Bear 2013). Some services which had formerly been the responsibility of municipalities, such as ambulance service, became the responsibility of AHS and were coordinated at the provincial level (Alberta Health Services n.d. a).

The cost of healthcare in Alberta is above the national average and climbing, a situation that three decades of regionalization and increasing centralization sought to fix (Hussey 2017; Ernst & Young LLP 2019). Current spending is worrisome on two fronts: high healthcare costs mean that the province cannot afford to fund other priorities, and reforms to healthcare to reduce costs always risk a reduction in the quality and accessibility of services (Hussey 2017). However, the reasons for rising costs are not necessarily obvious or easy to fix through budget measures.

One of the significant drivers of healthcare costs in the last 25 years has actually been an exponential rise in the prices of pharmaceuticals, meaning that Canadian governments are paying more for prescription medication. Over the same period of time, costs for hospital care, medical care, and preventative care have only risen slightly, and are actually, in the case of hospital care, lower than they were in 1996 (Hussey 2017).

Housing

Alberta has a mandate to provide safe and affordable homes for Albertans through the 2017 Provincial Affordable Housing Strategy (Government of Alberta 2017b). In order to be eligible for affordable housing, applicants must have an income below local income limits as determined by the market for that community, must have assets below a certain threshold of value ($25,000), and be a Canadian citizen or permanent resident. Once deemed eligible, applicants are given priority based on a need which is determined by income, assets, number of dependants, and current housing condition (Government of Alberta n.d. a).

The provincial Affordable Housing Strategy is intended to ensure that Albertans who live in government-supported housing have the stability they need to build better lives for themselves and the people they love (Government of Alberta 2017b, 1). This strategy set out an investment of $1.2 billion over five years to build more affordable housing and to support the construction of an estimated 4,100 new and updated affordable housing units (Government of Alberta 2017b, 3). Alberta has since released a new plan, Stronger Foundations, which aims to provide low income Albertans with more affordable housing options (Alberta Seniors and Housing 2021). It is a 10-year plan which aims to achieve goals such as neighbourhood revitalization, incentives for innovation, housing stability, and financial sustainability (Alberta Seniors and Housing 2021, 14).

Non-market housing in Alberta is a community service "comprised of a complex mix of owners and funding structures between non-profit organizations, private businesses and the federal, provincial, and municipal governments" (Alberta Urban Municipalities Association n.d. a).

Governing the system in Alberta is the Alberta Housing Act (updated in April 2022), which exists for "the efficient provision of a basic level of housing accommodation for persons who because of financial, social, or other circumstances require assistance to obtain or maintain housing accommodation" (Government of Alberta 2022a, 3).

The Act establishes housing management bodies, including the Alberta Social Housing Corporation, and includes regulations pertaining to Alberta Mortgage and Housing Corporation loans, Housing Accommodation Tenancies, loan insurance, the Lodge Assistance program, management body operation and administration, the rent supplement, and social housing accommodation (Government of Alberta 2022a). Also outlined in this act are protection from liability, fees, standard lodge rates, ministerial

regulations, and Lieutenant Governor in Council regulations (Government of Alberta 2022a, 2).

In addition to the Housing Act, the Supportive Living Accommodation Licensing Act applies to buildings or units in buildings that are intended for permanent residential living where an operator also provides or arranges for services in order to assist residents to live as independently as possible (Government of Alberta 2015, 2). This Act addresses licensing requirements, gives the ability to designate a director, sets out the complaint processes and powers of inspection, and gives the director the ability to cancel licenses or make stop orders (Government of Alberta 2015, 4-8).

Employment Services

The Government of Alberta enacted the Income and Employment Supports Act in 2019 to authorize programs for Albertans needing "food, shelter, personal items, medical and other benefits essential to their health and wellbeing" (Government of Alberta 2021c, 5). This legislation also provides the authority for training programs and other measures to help Albertans gain independence and self-sufficiency (Government of Alberta 2021c, 5). Covered in the Act are income support and health and training benefits, temporary employment and job creation programs, child and adult support services, and confidentiality of information (Government of Alberta 2021c, 1-3).

The Public Service Employee Relations Act (Government of Alberta 2022d) outlines employers' rights and responsibilities, acknowledges the existence and activities of trade unions, and employees in labour relations affecting Alberta public sector employees. The Employment Standards Code further recognizes that a mutually effective relationship between employees and employers is critical for Albertans to thrive, and that employees and employers are best able to manage their affairs when statutory rights and responsibilities are established and understood (Government of Alberta 2021a, 8).

Throughout the province, there are numerous online and offline resources for job-seekers, which include municipal employment services based in Calgary and Edmonton, and job fairs across Alberta. Employment services can also be accessed through Alberta Supports and Alberta Works Centres located in communities around the province, which offer job postings, a job search library, job training information, employment counselling and resume building, internet access, computers, and photocopiers for job searches, and job-interview and job-search workshops (Government of Alberta n.d. j).

The Government of Alberta also provides an employment and training services directory, which includes information on programs to help individuals find and keep jobs, get training, and adapt to a changing labour market (Government of Alberta n.d. j). Finally, the Government of Alberta provides a number of employment supports for those looking for work or facing layoffs, including Career Week Workforce Partnerships, support for Albertans affected by coal phase-out, and programs tailored to women's economic security, to name a few (Government of Alberta n.d. l).

Education and Literacy

The current Education Act came into force on September 1, 2019 (Government of Alberta 2022b, 184). This Act sets out the goals, roles, and responsibilities for education in Alberta, from Early Childhood Services (ECS) through the K-12 system. The Act identifies the roles and responsibilities of the Education Ministry, school boards, charter schools, private schools, teachers, parents, and students. The Education Act lists the rights of access to education for resident students and independent students, compulsory education, school attendance, responsibilities to students, special considerations for international students, tuition fees for non-public education, Francophone education, and enrolment in a Francophone school (Government of Alberta 2022b, 1).

The Act also specifies opportunities for learning beyond the traditional public school classroom, including flexible learning, charter schools, and private schools. It also discusses dispute resolution, including the responsibilities of students, parents, teachers, and the School Board and School Trustee, bullying awareness and non-discrimination, student discipline, student advisory councils, the Complex Education Needs Tribunal, and the Attendance Board (Government of Alberta 2022b, 1-3). The Education Act also lays out school board powers and elections, the school authority structure, finances and property,

education professions and occupations, and consequential amendments and repeals (Government of Alberta 2022b, 3-11).

Other Community Services

Community services traditionally include income and employment support, housing support, family violence prevention, and support for people with disabilities. The last part of this section will look at two areas of community service that are increasingly gaining importance in calculations of social wellbeing: food and culture.

Access to Food

In 2016, farmers' market and direct farm purchases exceeded $1 billion (Government of Alberta n.d. m). In 2016, 92% of households in Alberta had purchased food from local suppliers in supermarkets while 80% had bought local food at farmers' markets. Furthermore, the number of Albertans who spent over $1,000 per year at farmers' markets doubled from 2008 to 2016 (Government of Alberta n.d. m).

Bill 7, Supporting Alberta's Local Food Sector Act, was passed on May 30, 2018, signalling the importance and value of local food providers to the provincial economy and to Albertans' quality of life. The Act recognizes that Alberta producers, processors and other participants in the province's supply chain are instrumental to meeting consumer demand for fresh and healthy local food and beverages that are grown, harvested or made in Alberta, and that the success of the local food sector is supported by increased consumer awareness and effective assurance systems (Government of Alberta 2018b, 4).

The purpose of Bill 7 is to encourage sustainable development of a province-wide local food sector, and to regulate agricultural products that are produced or processed in the province. There are specific provisions for goods marketed and sold as organic products within the province (Government of Alberta 2018b, 3). The Act also identifies Alberta Local Food Week as taking place on the preceding week before the third weekend in August (Government of Alberta 2018b, 4).

Culture

In 1987, Alberta passed the Alberta Cultural Heritage Amendment Act, which maintains that it is essential to recognize and share knowledge and traditions from the many ethnocultural groups who live in the province. The Act also recognizes that the cultural heritage of Alberta is enhanced by the freedom of ethnocultural groups to express their cultures and traditions, and by all Albertans being able interact with people of diverse heritage (Government of Alberta 1987, 283).

The Ministry of Culture and Status of Women replaced the former Ministry of Culture, Multiculturalism and Status of Women in 2021, and was created with the intention to "improve Albertans' quality of life through support of cultural development, historical preservation and increased gender equality" (Auditor General of Alberta 2021, 57; Government of Alberta n.d. i). This ministry is responsible for developing and sustaining a vibrant cultural sector, which includes creative and cultural industries, recreation and sport, artists and the arts community, and the voluntary sector. It is also responsible for improving gender equality in the provincial government's legislation, policies, and programs. (Government of Alberta n.d. i). The objectives and projects of this Ministry include:

- community facility enhancement supports for building or upgrading recreational, cultural, and/or other related public-use community facilities (Government of Alberta n.d. c),
- initiatives which aim to reinforce the leadership and capacity of community organizations and to support publicly beneficial community-piloted objectives (Government of Alberta n.d. d),
- Cultural Heritage supports for conserving, managing, and promoting Alberta's historic sites and places, and Indigenous and Francophone cultures (Government of Alberta n.d. f),
- Culture and Status of Women grants, opportunities for project funding in several sectors, including heritage, recreation, sport, arts, community, culture, and diversity and inclusion (Government of Alberta n.d. g).

The Government of Alberta also provides cultural services through Heritage Conservation and Protection programs, which include:

- heritage markers,
- a heritage database of over 10,000 historic places,
- heritage awards,

- access to conservation advisors, and,
- a special Heritage Resource Impact Assessment for proposed developments (Government of Alberta n.d. h).

Opportunities for intersectoral action

Crime Rate

Until recently, there has been a lack of dedicated study to rural crime as an independent phenomenon (Hollis and Hankhouse 2019, 178). This is beginning to change, and more intensive study may help us to better understand the specific dimensions of rural crime and crime prevention. Statistics accounting for crime tend to show that smaller communities have higher rates of crime than urban areas. This is primarily because there are fewer people in smaller communities, and so crime appears to be proportionally higher - a break-in and enter in a town of 6,000 people will often be perceived as a higher crime rate than 100 break-ins in a city of 100,000 (Hodgkinson 2022, 294). However, crime in rural communities and small towns can have a disproportionate effect on public perception, precisely because small municipalities tend to be places where people know many of the other people in their community and events tend to affect the whole community.

A recent study in North Battleford, Saskatchewan found that crime prevention strategies adapted and implemented by local residents and municipal employees can have beneficial effects both on crime rate and on community development (Hodgkinson 2022, 294). Strategies implemented by local people, rather than imposed on the community, have the benefit of empowering the community to investigate the circumstances (*e.g.*, environmental, social) that allow for crime in the community.

Rather than turning crime over to law enforcement services or the provincial government, a community based model can have far-reaching effects on CWB, including improving infrastructure and facilitating dialogue and partnership between members of the community who might otherwise not communicate (*e.g.*, shelter managers, shelter residents, business owners).

Access to community services: Health Care

There are many concerns about the provision of care in rural areas, but some of the common issues include attracting and retaining primary care providers (*e.g.*, physicians and nurse practitioners), underutilization and neglect of existing rural healthcare infrastructure in favour of transporting patients to larger central locations, and availability of long term care (Rural Health Services Review Committee 2015, 31-33).

Having local input and control is of particular importance to rural communities, and local residents express the desire for healthcare decision-making to reflect local priorities where possible, particularly over basic day-to-day decisions and routine maintenance issues (Rural Health Services Review Committee 2015, 20). Having local control where it is feasible can contribute to community development as local people have the responsibility and authority to solve problems and make the system work in their community.

In order for local communities to regain authority over day-to-day operations, the Rural Health Services Final Review report recommends that AHS restructure its chain of command to empower local site managers of healthcare facilities, and institute greater autonomy for health regions while maintaining the capacity to enforce uniform standards of care (Rural Health Services Review Committee 2015, 33).

Housing

Municipal governments can play a key role in affordable housing through regulatory actions such as loosening restrictions on building affordable housing, including rental apartments in cities, especially on public land around transit stations, and implementing inclusionary zoning to build more affordable units in new developments (Swail 2019).

A municipal government can also invest financial resources to create incentives and partnerships that will lead to the development of dedicated non-market housing (Alberta Urban Municipalities Association n.d. b). The latter entails the municipality donating land to organizations, such as Habitat for Humanity, that can build affordable housing units, creating grants for homeowners to create secondary suites, having grants for developers to create rental housing, or contributing to mortgage down payments (Alberta Urban

Municipalities Association n.d. b). Municipal action can supplement organizational action and create substantial change for low-income individuals, whether from providing more affordable housing or helping with payments.

Employment Services

Employment issues in rural areas can be complex. Some small communities in Alberta become 'boom towns' with the advent of new resource developments, seeing a more-or-less transitory influx of new residents attracted by high-paying jobs. These boom economies may or may not last, and they contrast, in many regions of the province, with existing economies based in agriculture.

Many small and rural communities are attempting to support more diverse, longer-term local employment, particularly through encouraging tourism and entrepreneurialism (Infrastructure Canada 2019). Municipalities and organizations provide employee services, such as training and employment and career services to help individuals find employment and training opportunities. These programs are offered through community organizations, non-profit agencies, private schools, businesses, and employer organizations (Government of Alberta n.d. k). Sometimes this can happen in partnership with local, post-secondary institutions such as Olds College, which offers a variety of programs from trades training to agricultural certification to tourism and hospitality industry diplomas – including a Brewmaster and Brewery Operations diploma (Olds College n.d.).

Education and Literacy

Schools, libraries, community centres, and colleges are cornerstones of literacy and education for rural regions. Many of the libraries in the Central Region now belong to the Parkland Regional Library System, which affords libraries access to programs like Alberta-wide book borrowing (Parkland Regional Library System n.d. a). The dissolution and amalgamation of rural municipalities has, however, also resulted in the closure of some local libraries, including the Galahad Library (Flagstaff County n.d.). Libraries within the regional library system continue to offer services and education to all residents, from learn-to-garden programs to early childhood education support to film festival screenings (Parkland Regional Library System n.d. b).

A number of educational programs and supports may also be based in larger municipal centres within a rural region. For example, in the BRW, Camrose is home to the Camrose Adult Learning Council, a community organization offering GED (*i.e.,* high school diploma-equivalent) and English Language Learning (ELL) courses (Camrose Adult Learning Council n.d.). Also based in Camrose, the Augustana Campus of the University of Alberta offers a number of courses through their Extended Education professional development workshops and certificate programs, as well as degree programs and pre-professional study for healthcare students (University of Alberta Augustana Campus n.d.).

These programs and organizations, and others like them, ensure that education and literacy support is available in local communities. Many programs specifically cater to the needs and interests of rural residents, whether this means a focus on programs that are tailored to a workforce based in agriculture, programs to support new immigrants, or programs to support seniors in communities with aging populations.

What could be done?

Crime Rate

While several different types of crime contribute to the overall crime rate, many rural citizens face high rates of theft and other property crimes. In the Prairies, the rural crime rate was about 36-42% higher than in urban centres in 2017 (Perreault 2019, 3). One perceived factor to high rural crime rates is that police response times are lengthy and, therefore, ineffective at stopping crimes in progress (Nelson 2020).

The root causes of rural crime are complex, but mental illness and addiction figure prominently among them (Harkness and White 2021). Rural communities in Alberta have seen ongoing reductions in funding for hospitals and social agencies, and they do not typically have locally-based mental health and drug courts (Simes 2019). In the absence of alternatives, addressing rural crime focuses on punishment and criminalizing behaviour that might be better treated in the healthcare system. This leaves the Royal Canadian Mounted Police (RCMP) and municipal police forces stuck in a cycle of incarcerating repeat

offenders over and over again. The Chief of EPS, Dale McPhee, has stated: "the right direction [to helping with rural crime] is getting to the root of the problem by addressing mental health concerns, helping people who are high-risk, and addressing individuals who are vulnerable to addictions," (Simes 2019).

New RCMP Rural Crime Reduction Units are tasked with suppressing, apprehending, and helping to rehabilitate repeat offenders, a strategy that appears to be showing results. These units have helped reduce crime by 9.8% from 2017-18 (Simes 2019). Other programs, such as the Integrated Habitual Offender Management Initiative, leverage support from social and health agencies to address the root causes of crime (Royal Canadian Mounted Police 2019, 17).

Studying what makes Canada and Canadian jurisdictions similar to, or different from, comparable jurisdictions from around the world may be another place to gain insight into reducing our crime rates and improving the effectiveness of our justice system at both deterring crime and rehabilitating offenders.

For example, Norway's homicide rate is around 0.5 murders per 100,000 population and the country maintains about 188 police officers per 100,000 population (Nikel 2022). In comparison, Edmonton has about 183 officers per 100,000 population, and Calgary has 168 officers per 100,000 population (Statistics Canada 2018a, 22). Despite the similar numbers of police officers per 100,000 capita, Calgary's homicide rate was 1.34 and Edmonton's was 2.60 per 100,000 population, both significantly higher than Norway's (Statistics Canada 2021c).

The recidivism rate is one way to assess our system's strength by looking at the likelihood that a previously convicted person will re-offend and be re-convicted. Ideally, the proper collection and analysis of recidivism statistics could help inform our opinions about how well our correctional system rehabilitates prisoners and keeps the public safe (Ahsan 2019). Norway also keeps track of their recidivism rate, which stands at about 20%, but in Canada, we have unreliable and uneven data for recidivism (Ahsan 2019; Denny 2016, 23).

Access to Community Services

Across the country, there are barriers to social necessities, including literacy and education, housing, food, culture, and employment. Canadian communities have long histories of organizing to provide services that help individuals gain access to necessities (Marchildon 2012). For example, communities all across Alberta often donate and run food banks that help feed Albertans in need. However, many studies show that food banks are limited in their effectiveness at addressing hunger and the root causes of food insecurity (Bazerghi, McKay, and Dunn 2016, 732).

Food access is correlated with both income and employment, as most households that are food insecure have lower incomes, are more likely to rent rather than own their own place of residence, and are more likely to be recipients of social assistance, workers' compensation, and employment insurance in comparison with food secure households (Tarasuk, St-Germain, and Loopstra 2020, 848). Food Banks Canada, a national leadership body behind food banks across the country, advocates that social policy reforms should work towards ensuring that all households have sufficient incomes to meet the necessary costs of living (Tarasuk, St-Germain, and Loopstra 2020, 848).

While food banks have an important role to play in providing immediate relief for those experiencing acute food deprivation, they are limited in their capacity to improve overall food security outcomes due to the limited provision of nutrient-dense foods, including dairy, vegetables, and fruits. Because food banks are often unable to meet the nutritional requirements of those in need, they may end up contributing to poor health outcomes (Bazerghi, McKay, and Dunn 2016, 738). People who might be in need of food bank services contend with stigma, fear, and embarrassment associated with the service (Garthwaite 2016, 278). Food-insecure households do not report using food banks because food banks are seen as a strategy of "last resort" (Tarasuk, St-Germain, and Loopstra 2020, 843). Instead, Canadians are more likely to ask friends for food, miss bill payments and rent/mortgage payments, or pawn/sell possessions (Tarasuk, St-Germain, and Loopstra 2020, 846).

Community organizations can play a major role in advocating for such social policy, and community organizations can also provide training opportunities for individuals in need of employment and secure access to income. These training opportunities could be provided through community leaders or non-profit community-based organizations that provide high-quality training, credentialing, and job-replacement services. There may also be a role for community colleges in recruiting low-income, disadvantaged, or out of-work populations to equip them with skills and credentials that prepare them for careers. Community-based organizations can also establish partnerships with local employers, thus identifying employment and employer needs within a community, addressing local labour shortages, and diversifying workforces.

Community Wellbeing

Community Wellbeing Index

The Community Wellbeing Index (CWB Index) is a measure of socioeconomic wellbeing for communities in Canada. The CWB Index:

- produces a reliable and systematic summary measure of the socio-economic well-being of Canadian communities,
- identifies differences of well-being among Inuit and First Nations communities in comparison with non-Indigenous communities,
- allows well-being to be tracked over time, and
- promotes a diverse array of research concerning the aspects of well-being through compatibility with other community-level data (Government of Canada 2019).

The CWB Index is calculated using Census data, covering the years from 1981 to 2006 and 2016, and the National Household Survey from 2011 (Government of Canada 2019). Because Indigenous communities in Canada experience worse socioeconomic outcomes than the non-Indigenous population does, the Index also separates out specific data that reflects trends in First Nations and Inuit communities (Government of Canada 2019).

The CWB uses four indicators of SES as defined by the Canadian Government: education, labour force activity, income, and housing (Government of Canada 2019). Education is based on the proportion of people in a community with a high school diploma or a university degree. Labour force activity functions as a measure of the proportion of the people in the community who are members of the work force, and how many of those members have jobs and how many are unemployed. Income is calculated based on the total income per person among residents. Housing is based on the proportion of people in the community who have adequate living conditions, defined as housing that is not overcrowded or in disrepair (Government of Canada and Indigenous Services Canada 2019, 2).

Based on these indicators, communities are indexed on a scale of 1-100. All communities, including First Nations, Inuit, and Non-Indigenous communities, have seen a steady increase in scores on the Index since 1981, but the disparities between Indigenous and non-Indigenous groups are still pronounced (Government of Canada and Indigenous Services Canada 2019, 4).

Understanding Community Wellbeing Index

In the BRW, the CWB Index is 80. A small region south of Wetaskiwin is significantly lower with a score ranging between 40-50 (Map 2.5). This may be due to high levels of crime and a high CSI score, as highlighted in previous sections. The Alberta average for CWB is 79.6 (Figure 2.4).

Risk Factors for Community Wellbeing

Educational Attainment

Educational attainment is one of the four key measures for CWB. In 2016, the Federal Census revealed that 25.2% of Albertans aged 25-64 had a high school diploma as their highest level of education, while 28.2% of Albertans the same age had a bachelor's degree or higher (Statistics Canada 2017c, Figure 1.2). The CWB does not take into account other forms of education such as trade certifications or apprenticeships. Nearly 30% of the BRW population aged 25-64 years had a high school diploma as their highest education and 13.8% had a post-secondary degree or higher in 2016 (Statistics Canada 2017a).

These data demonstrate that while high-school completion appears to be slightly better in the BRW than in the rest of the province, post-secondary education is not as common.

Economic Barriers

The rural residents who are more likely to enrol in post-secondary education are those that come from higher income families and higher levels of parental education (Friesen and Purc-Stephenson 2016, 139). Rural residents that come from low-income households often face barriers of having more obligations outside of school and lack of financial support or motivation from parents (Friesen and Purc-Stephenson 2016). Rural students also need to account for moving costs, such as paying rent and necessities such as food and utilities, on top of tuition fees (Zarifa, Hango, and Milian 2018, 275).

Social Barriers

The idea of making money immediately after high-school education is more enticing as opposed to continuing education and relying on familial support (Friesen and Purc-Stephenson 2016, 139). Economic opportunities can be more favorable and more easily attainable than pursuing post-secondary education (Morton et al. 2018, 169-170).

Rural schools may also not provide enough exposure for post-secondary opportunities. Rural students can have lower levels of awareness and exposure towards post-secondary opportunities (Friesen and Purc-Stephenson 2016, 140). Many rural schools lack resources that engage students in higher educational attainment, such as advanced placement (AP) classes (Morton et al. 2018, 162).

Work-Force Appeal in the BRW

The agricultural sector in Central Alberta provides employment for many rural residents. In 2016, 32.8% of male and 12.4% of female BRW residents were participants in agricultural work (Statistics Canada 2017e).

Work in the trades, such as employment in the oil and gas field, is also common in Central Alberta. In 2016, 15.7% of the BRW population aged 25-64 years had an apprenticeship or trades certificate or diploma (Statistics Canada 2017a). It is also not necessary to hold a certificate or diploma for all positions in the trades field.

Labour Force Activity

The BRW had a labour force participation rate of 70% and an employment rate of 63.8% in 2016 (Statistics Canada 2017d). In 2016, Canada had a participation rate of 65.7% and an employment rate of 61.1%. Alberta had a participation rate of 72.5% and an employment rate of 66.6% (Statistics Canada 2021b).

A 2010 study conducted by Watrecon Consulting found that 23.6% of the Battle River Basin's workforce was employed in the agriculture or another resource-based industry, 17.2% was involved in a service-based industry, 11.5% was in the healthcare and social services industry, and another 12.3% were involved in retail (Watrecon Consulting 2010, 8-9). These four industries account for 64.6% of all employment in the BRW.

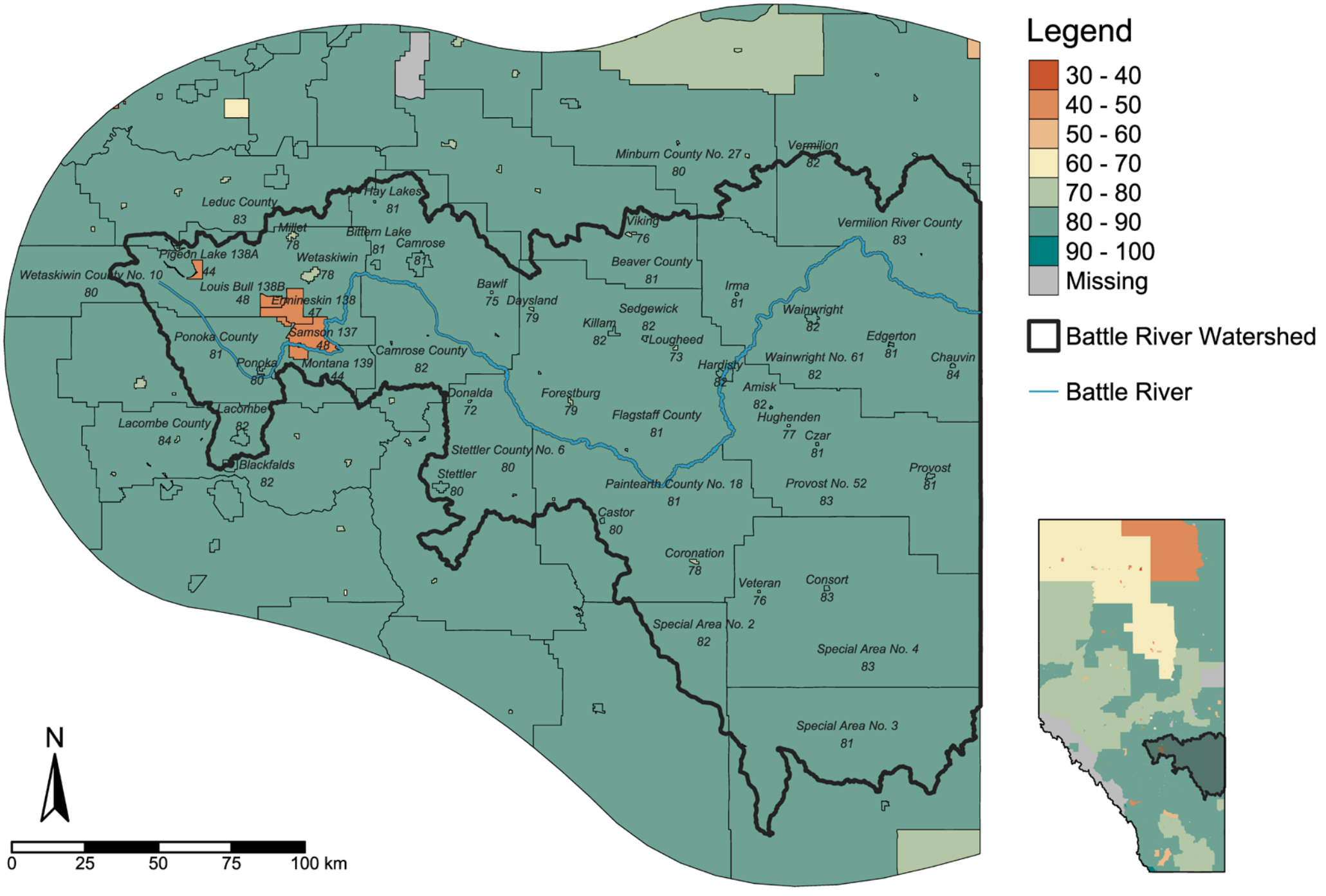
Income

Income is an essential SDOH, as it facilitates access to housing, food, clothing, transportation, and communication technologies. In 2018, the BRW had a median family income of $91,363.40 per year, compared to the Albertan average of $104,597 and the Canadian average of $87,930 (Government of Alberta 2019a; Statistics Canada 2021a).

The Market Basket Measure (MBM) is a method of taking into account the costs associated with a basic standard of living, such as

Community Wellbeing Index (2016)

Measure of the severity level of police-reported crime; higher values indicate greater number and/or seriousness of crimes



Map 2.5 (Source: Crown-Indigenous Relations and Northern Affairs Canada. 2016. Community Well-Being Index).

food, clothing, footwear, shelter, and other expenses for a reference family of four that includes two adults and two children. In 2018, the MBM for rural Alberta was $45,047 (Statistics Canada 2022c), barely below the median income of the lower 50% of BRW residents' incomes. (Statistics Canada 2022b). This means that, statistically speaking, one in four families of four will be below the MBM in the BRW.

The Consumer Price Index (CPI) is an indicator of changes in the prices of goods and services experienced by consumers. From 2000 to 2018, the CPI rose by 150% in Alberta. In the same time frame, the median income of an Albertan family rose by 184%. This is a good sign for Albertans as it indicates that goods and services are becoming cheaper relative to income (Statistics Canada 2020a). However, this trend may not persist as inflation surges in 2022.

Housing

In 2016, Alberta had a home ownership rate of 72.4%. Lacombe, Camrose, and Wetaskiwin each had ownership rates of 76.8%, 66.2% and 63.8% respectively (Statistics Canada 2019a). In 2011, the Red Deer-North Zone, is within the BRW, had an average value of dwelling that was 25.7% less than the Albertan average. Eight-point-five percent of homeowners had homes in need of major repairs in the Red Deer-North Zone compared to 7% in the rest of Alberta (Government of Alberta 2017a, 9). This can pose substantial issues for a population of homeowners, as there is a trend of household expenses rising faster than salary and wage increases globally (Wetzstein 2017, 3160).

Historically, Canadian governments would provide housing for lower income earners and reduced the demand pressures on lower priced homes; however, the current role of government funding and intervention is reduced to providing homes to low-income residences (Moos et al. 2018, 9). Current Canadian housing market forces benefit high-income earners in rich, central locations (Moos et al. 2018, 9).

Indigenous Community Wellbeing

Indigenous communities in the BRW score 40% lower on the CWB than non-Indigenous communities. In 2016, the average CWB index score for Indigenous communities was 58.4 (on a 100-point-scale) and 61.3 for Inuit communities (Government of Canada and Indigenous Services Canada 2019, 4). The average CWB score for non-Indigenous communities was 77.5 in 2016 (Government of Canada and Indigenous Services Canada 2019, 13). Housing and income represented the largest gaps between CWB scores for Indigenous and non-Indigenous communities (Government of Canada and Indigenous Services Canada 2019, 5).

Reserves

There are 138 reserves for 49 First Nations in Alberta. Approximately 61% of Alberta's First Nations people lived on reserves in 2018 (Wildcat 2022). Today, reserves make up just over 1% of Alberta's land mass, and Indigenous people are no longer free to hunt, farm, or fish wherever they want on their territories.

In the 1870s, the Indian Act (1876) controlled reserve life and agricultural practices of Indigenous peoples. Reserves were not suitable for sufficient farming and had insufficient resources for protection against natural disasters (Vowel 2016, 208).

The quality of life on reserves is often problematic. For example, there are currently 51 long-term drinking water advisories in effect in 32 Indigenous communities/reservations, meaning that the water is unsafe and does not meet drinking water quality standards (Government of Canada and Indigenous Services Canada 2022). Based on the 2016 census, 19.4% of Indigenous peoples in Canada live in dwellings that are in need of major repairs (Statistics Canada 2017b, 1). It is important to realize that Indigenous peoples living on-reserve often do not have the opportunity to own their home; instead, it belongs to the federal government and is under government control (Vowel 2016, 147).

Educational Attainment

There are significant gaps in the educational attainment status for Indigenous peoples when compared to non-Indigenous peoples. About 9.8% of Indigenous peoples in Canada hold a university degree, compared to 26.5% of non-Indigenous peoples (Statistics Canada

2013, 4-5). Around 32% of Indigenous peoples aged 35-44 do not have a high school diploma, compared to 11.3% of non-Indigenous peoples in Canada (Statistics Canada 2018b). Only 57% of federal funding for First Nation students is allocated to First Nations schools, and First Nations schools receive no funding for library books, librarians' salaries, construction or maintenance costs of school libraries, information and communication technologies, or sports and recreation (Vowel 2016, 277). Curricula typically do not address the colonial past and its treatment of Indigenous people, nor do they address culturally relevant and traditional aspects of Indigenous culture, language, or governance.

Policy Responses to Community Wellbeing

CWB is a concept that attempts to describe "where human needs are met, where individuals and groups can act meaningfully to pursue their goals, and where they can be satisfied with their way of life" (Armitage et al. 2012, 3). CWB can be thought of as having seven dimensions: social, economic, environmental, physical, political, health, and attachment to place (McCrea, Walton, and Leonard 2014, 274).

Each of these dimensions is responsive to time and change, and the capacity of a community to respond to change in a way that maintains wellbeing relates to the concept of community resilience. These dimensions are to some extent subjective and particular as they reflect the values and norms of those people who make up the community. In order to accurately measure CWB, we must take into account the subjective elements of community experience, and not assume that the presence, absence, or quantity of any particular element can entirely predict CWB (McCrea, Walton, and Leonard 2014, 271; Sirgy et al. 2010).

We measure CWB to inform and benefit decision-makers and communities (Miles et al. 2008, 73-74). Measuring wellbeing in a community can help us understand quality of life and areas for improvement that are specific to a given place, and can provide us with critical information for decision-making regarding sustainable development in regional communities (Miles et al. 2008, 77). Rural communities strive to build wellbeing and resilience within their local areas through strategic plans established by community organizations and authorities (McCrea, Walton, and Leonard 2014, 270). At the same time, governments and other organizations are also seeking to measure wellbeing and resilience to develop baselines with which to evaluate progress and the impact of their activities and programs (McCrea, Walton, and Leonard 2014, 270).

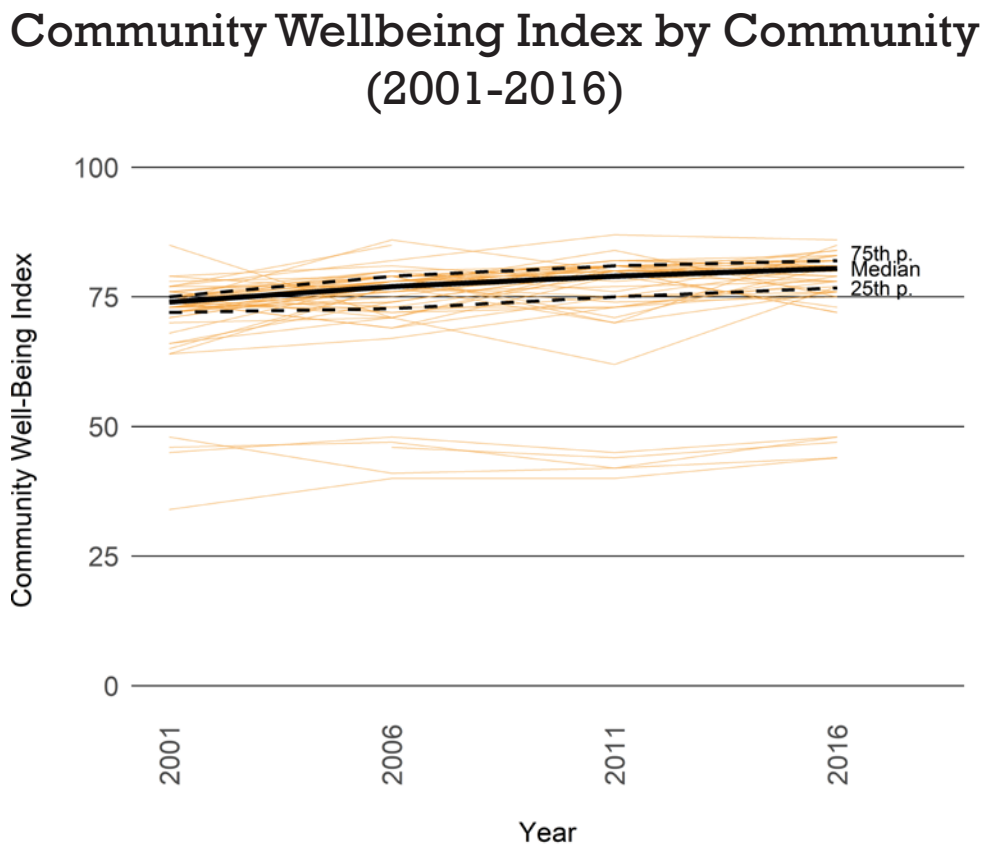


Figure 2.3: Community Well-Being Index for each census subdivision (CSD) within the BRW from 2001 to 2016; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Crown-Indigenous Relations and Northern Affairs Canada, 2016).

The CWB Index is a federal initiative that utilizes census data to assess socioeconomic wellbeing for specific communities over time. There are specific provisions for assessing wellbeing for Indigenous communities. The goals of the CWB support human development over purely economic measures of growth like GDP, focusing instead on educational attainment, labour force activity, income, and housing. The CWB also focuses at the community level, meaning that the data is assessed by census population centres, rather than at the provincial or national level. This community-level data have the capability to show, for example, where there are meaningful differences between neighbouring communities, and what those differences are.

From 1981 to 2016, wellbeing scores for all provinces and territories have tended to increase. Within this general increase, there remain significant differences between the wellbeing of Indigenous and non-Indigenous communities. While Indigenous wellbeing overall appears to have increased significantly in some regions of the country (*i.e.,* British Columbia, Manitoba), the Prairie Provinces in particular, report large gaps in wellbeing between Indigenous and non-Indigenous communities, and these gaps have remained large over time (Government of Canada and Indigenous Services Canada 2019, 11).

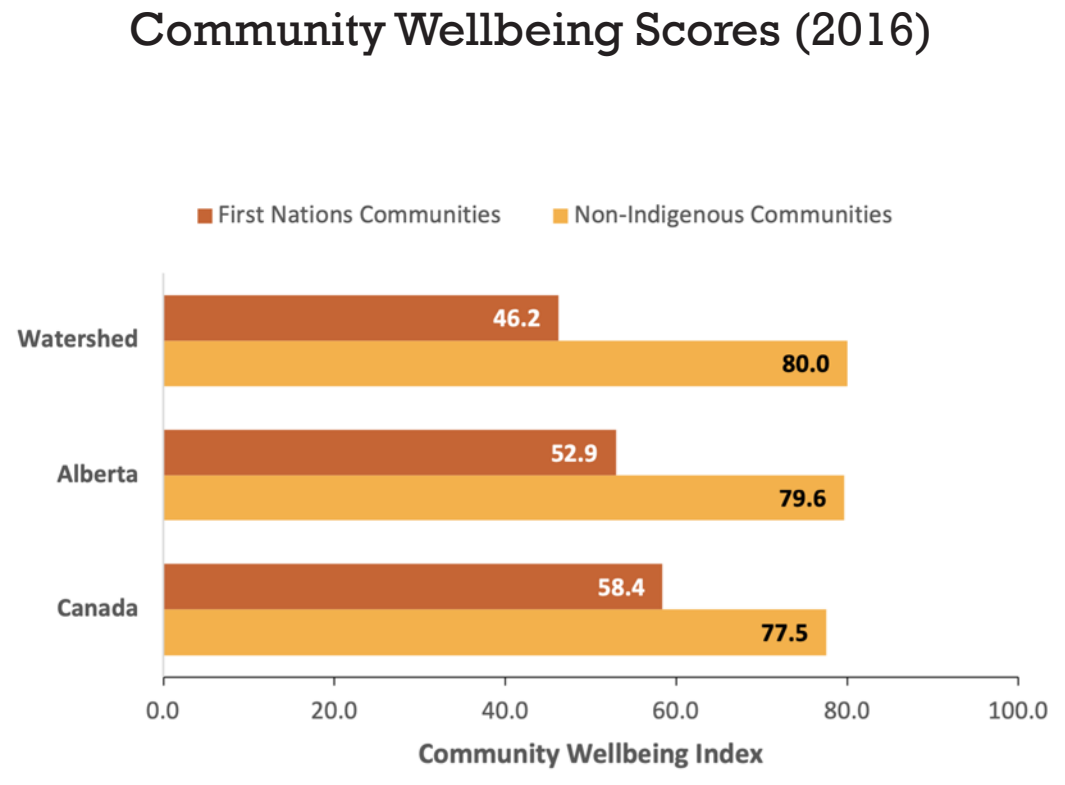


Figure 2.4: Comparison of average Community Well-Being Index scores for Indigenous and non-Indigenous communities in the BRW, Alberta, and Canada (Source: Crown-Indigenous Relations and Northern Affairs Canada, 2016).

How have governments responded?

In 2012, the Alberta Government published the Speak. Share. Thrive. Social Policy Framework. Speak. Share. Thrive. was the result of intensive public engagement conducted between June and November 2012 (Government of Alberta 2013, 7). The document addresses several areas of social policy of pressing interest in Alberta, including the province's changing economy, limited paid vacation days and holiday time as compared to other provinces, and high cost of living. Also examined are Alberta's poverty and economic disparity rates, the prevalence of mental illnesses in Alberta, and several indices related to demographic change including the province's aging population and changing family compositions. Finally, the report discusses indices related to physical health and the sustainability of the healthcare system including levels of obesity and chronic illness in Albertans, levels of disability, level of activity and participation in sport and recreation, and the $31 billion spent on health, education and social services in 2012-2013 that accounted for 75% of total budgeted expenses (Government of Alberta 2012, 3).

In 2013, the Alberta Government published The Alberta's Social Policy Framework. This framework builds from the information gathered in the Speak. Share. Thrive. engagement process, and stated three main goals:

- clarifying the objectives to be achieved in social policy,
- the path to achieving these objectives, and
- the roles and responsibilities of different actors and participants (Government of Alberta 2013, 3).

Because social policy goals cut across different areas of governance, there is a need to coordinate activities within and between government departments, to harmonize work between government and other stakeholders, and to ensure that there is policy alignment and consistency. The government also understands its role to be one of influencing and guiding the ongoing work of improving the lives of Albertans, providing direction through planning and decision making, connecting stakeholders and facilitating dialogue, and supporting the creation of a local and province-wide culture that shares the goals and vision of the social policy framework (Government of Alberta 2013, 16).

In order to achieve this improved CWB, the social policy framework notes the need to orient social policy practices, delivery systems, and institutional cultures towards the principles and outcomes of the framework. Collaboration is a major focus of the framework, which emphasizes creating alignment across policy domains, encouraging innovation that achieves agreed-upon outcomes, working together to achieve positive social outcomes, developing broad coalitions to resolve challenges, and sharing a common language and a common vision for the future (Government of Alberta 2013, 18). Specific areas of transformation include:

- results-based budgeting,
- common service access,
- early childhood development,
- primary healthcare initiatives,
- partnering with First Nations, Métis, and Inuit communities,
- a poverty reduction strategy,
- safe communities, and
- a 10-year plan to end homelessness (Government of Alberta 2013, 19).

What is being done?

Alberta presents an interesting case for studying inequality, because historically the province had many of the economic ingredients conventionally assumed to reduce inequality - competitive economic growth, high labour market participation and median wage, and low unemployment and poverty rates - yet also increasing inequality.

Jones (2015, 67) finds that economic growth in the province has tended to benefit top earners, and has not had the effect of increasing social mobility or improving economic outcomes for the lowest-income Albertans. Inequality is not only an effect of income but also an effect of wealth, such as property and other assets. Lower income Albertans have almost no wealth, which exacerbates inequality. There is nothing to indicate that the province is likely to change its economic strategy, but unfortunately that strategy appears to be compatible both with robust economic performance and high rates of economic inequality and social insecurity. In 2015, Alberta had the least effective income redistribution mechanisms of any province, and the lowest rates of social assistance in the country (Jones 2015, 68).

What could be done?

Similar to the CWB, the Canadian Index of Wellbeing (CIW) is an index designed to measure multiple domains of wellbeing, but unlike the CWB, it does not have an explicit community focus and does not treat Indigenous wellbeing as an area of special consideration. However, recommendations from research using the CIW can inform policy on CWB in general. Policy recommendations from the CIW tend to focus on national-level initiatives, such as a universal basic income (University of Waterloo n.d. b). While a universal basic income (UBI) is one way to address disparities in wellbeing, top-down policies such as a UBI do not take into account the value of community autonomy and responsibility, a value that seems to be a key aspect of wellbeing in rural and small towns.

The CWB does not include local autonomy/responsibility in decision-making and policy implementation as a significant matter for wellbeing. For rural communities and small municipalities, this is arguably an important oversight in measuring wellbeing. If autonomy/responsibility could be taken into

account as a measure for CWB, this might go some way to alleviate the democratic accountability gap that rural communities often experience. Autonomy and responsibility also offers a measure of political engagement, not just in terms of larger political processes like voter turnout, but, in terms of day-to-day participation in meaningful community functions and activities.

We know that the CWB gathered data most recently in 2016, but at least one contemporary study suggests that the CWB has had no discernible impact on federal or provincial policy (Hayden and Wilson 2016, 7). From this data, we may have to conclude that the two most prominent attempts to measure wellbeing beyond GDP in Canada have failed to effect political change.

However, it is also possible to view the well-being indexes as sources of data and a historical record of changing sociological circumstances, and not necessarily as political tools. If we apply a community-based lens, we can also regard the CIW and CWB as research tools that can help communities identify areas of strength and areas of improvement in their delivery of social services.

Civic Engagement

Voter Turnout

Voting is both a duty and a right in a democratic nation. Voting gives the average person power to influence decisions that are related to their country, province, or municipality. Higher voter turnout is indicative of increased community pride, increased patriotism, and a stronger sense of community. Voter turnout is also indicative of an engaged community, which will be more likely to participate in other community activities such as recreation, public events, and government assemblies.

Figure 2.5 shows that the BRW had a slightly higher than average turnout for the 2019 provincial election. Municipal elections have a significantly lower turnout than other types of elections with under 40% of eligible voters participating. The 2015 federal and 2019 provincial elections had similar levels of voter turnout, at around 70-80% (Elections Canada 2022b; Elections Alberta n.d. b).

Federal elections occur every 4 years, on the third Monday of October. The last federal election took place September 20, 2021 with the next federal election occurring on or before October 20, 2025. In the 2015 Federal Election, Justin Trudeau became Canada's Prime Minister, leading a Liberal majority government with 184 seats in Parliament and 39.5% of the vote (Elections Canada n.d. a).

The voter turnout for the 2015 federal election for the BRW and surrounding areas falls mostly within 70-72% of the population. A few communities surrounding Wetaskiwin have slightly lower voter turnout, ranging from 66-70%. The voter turnout of Albertans in the 2015 federal election was 68.2% (Elections Canada n.d. b).

Although the Liberal Party won the federal elections, Alberta's 2019 provincial election resulted in the United Conservative Party (UCP) winning the majority of votes. Jason Kenney led the UCP until May 2022. In the 2019 provincial election, voter turnout in the BRW ranged from 69 to 80% of the population. Voter turnout in Alberta's 2019 provincial election was 67.5% (Elections Alberta n.d. b).

Understanding Voter Turnout

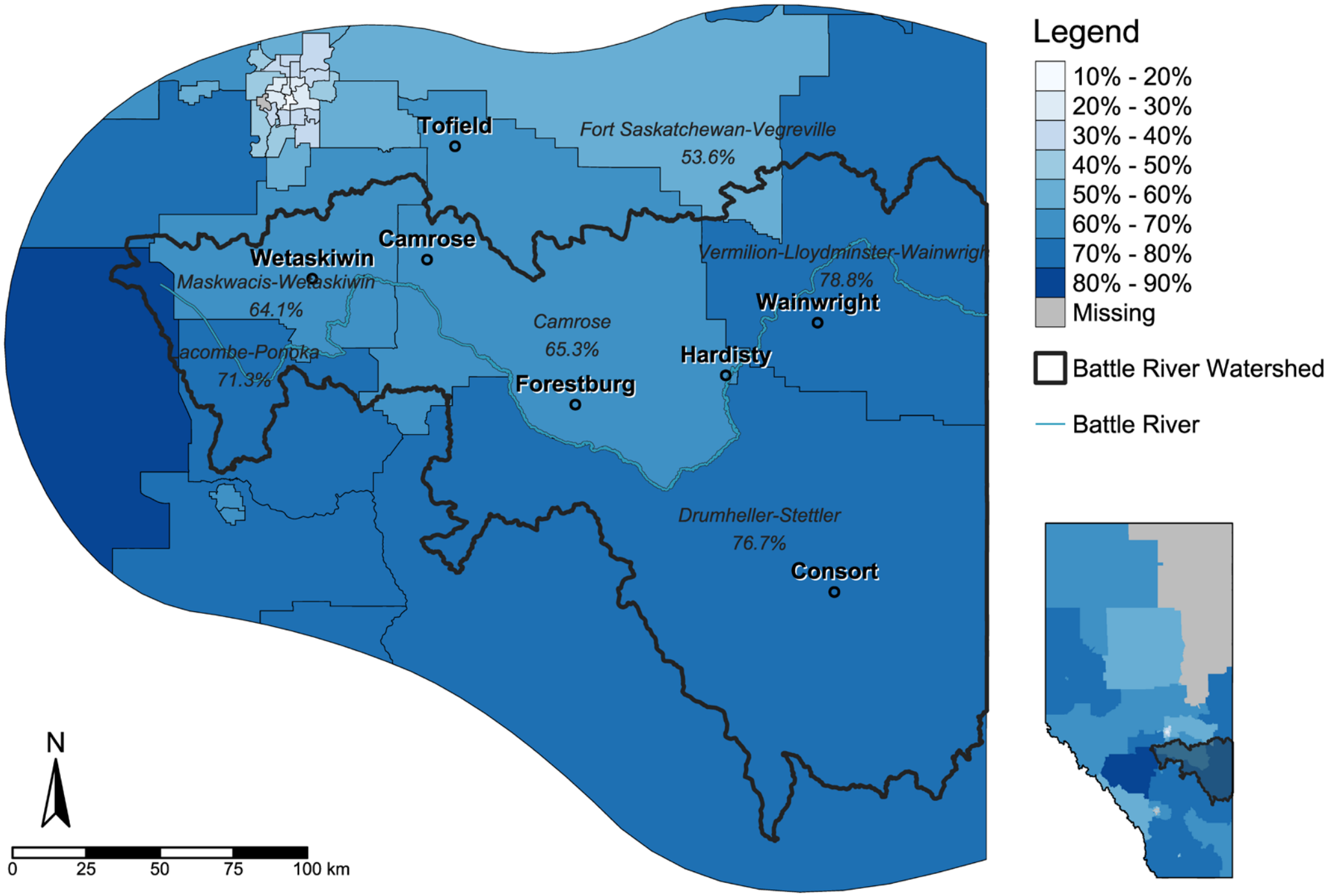
Voting is an opportunity for citizens to elect a political party and leader that matches their political views and gives opportunity for change in one's community. High voter turnout is often indicative of a strong sense of community, but also can be a significant indicator of protest or unrest.

National Elections

Based on data from Elections Canada, voter turnout in federal elections and referenda from 1867 to 2019 averaged 70.2% (Elections Canada 2022b). There are dips and rises in the data throughout each election year. It is important to consider that the population has significantly risen since 1867. The population of Canada in the 1867 federal election was at

Provincial Election Results (2019), UCP Vote

% of all votes that were cast for the provincial United Conservative Party candidate



Map 2.6: (Source: Elections Alberta. 2019. Provincial General Election Results).

3,230,000 people; the population of Canada in the 2019 federal election was 35,151,728 people (Elections Canada 2022b). In early elections, polling took place over several weeks or months (Elections Canada 2022b).

Provincial Voting

In recent years, voter turnout in Alberta has been increasing with each election. In 2011, the voter turnout was at 66%, rising to 77% in 2015 (Statistics Canada, 2020b). In the 2019 federal election, Alberta's voter turnout was 80%, ranking the province as third highest in Canada (tied with New Brunswick) (Statistics Canada 2020b).

Age-Group

Voter turnout by age has also risen in all age groups from 2011 to 2019 (Statistics Canada 2020a). The biggest change is in the 25-34 age group with 55% turnout in 2011 rising to 71% in 2019 (Statistics Canada 2020a). The age group with greatest voter turnout in the 2019 federal election is the 65-74 age group with an 85% voter turnout in 2019 (Statistics Canada 2020a).

Provincial Elections

Historically, the largest voter turnout in Alberta was in the 1935 provincial election at 81.8%, with the smallest voter turnout of 40.6% in 2008 (Elections Alberta 2008, 158; Elections Alberta n.d. a). Voter turnout in Alberta for the provincial elections averaged 55.2% from 1975-2019 (Elections Alberta n.d. a).

Before 2015, voter turnout was relatively low, ranging from the low-40s to mid-50s (Elections Alberta n.d. a). Alberta has been predominantly conservative for 40 years; in 2015, Rachel Notley and the New Democratic Party (NDP) were elected with a voter turnout of 57% (Elections Alberta n.d. c). The voter turnout for the 2019 provincial election was significantly higher at 67.5%, with 54.9% voting for the UCP (Elections Alberta n.d. b). Low voter turnout in Alberta for the provincial government prior to 2019 may be due to the stagnant Conservative Party leadership; once the NDP were voted into power in 2015, this may have given more Albertans reason to vote in the 2019 election.

Maps 2.6-2.8 represent the political parties most popular during the 2019 Alberta provincial election:

- UCP: Led by Jason Kenney, who won 55.1% of the popular vote. The UCP was most popular in the BRW, which had electoral district votes anywhere from 53.6% to 78.8% in favour of the UCP (Map 2.6.)
- Liberal Party: Led by David Khan. Only 0.9% of Albertans voted for Liberals. Less than 1% of BRW residents voted for the Liberal party (Map 2.7),
- NDP: Led by Rachel Notley, the official opposition to the UCP with 32.8% of Albertans voted for NDP. The NDP had electoral district votes in the BRW anywhere from 6.5% to 11.4% (Map 2.8; Elections Alberta n.d. a).

Voter Turnout

There is still a significant proportion of Albertans who do not vote. The most common reason for not voting in Canada is not being interested in politics, which was cited by 35% of non-voters under the age of 75 in 2019 (Statistics Canada 2020c, 2). For those aged 75 and older, the most common reason (49%) to not vote was illness or disability (Statistics Canada 2020c, 2). Everyday life reasons was cited by 46% of non-voters, which included being too busy (22%), having an illness or disability (13%), or being out of town (11%) (Statistics Canada 2020c, 2).

Women were more likely to report not voting due to everyday life reasons, in contrast to men being more likely to report not being interested in politics (Statistics Canada 2020c, 3). Five percent of non-voters were not able to prove their identity or address, had a lack of information about the voting process, or had issues with the voter information card (Statistics Canada 2020c, 3).

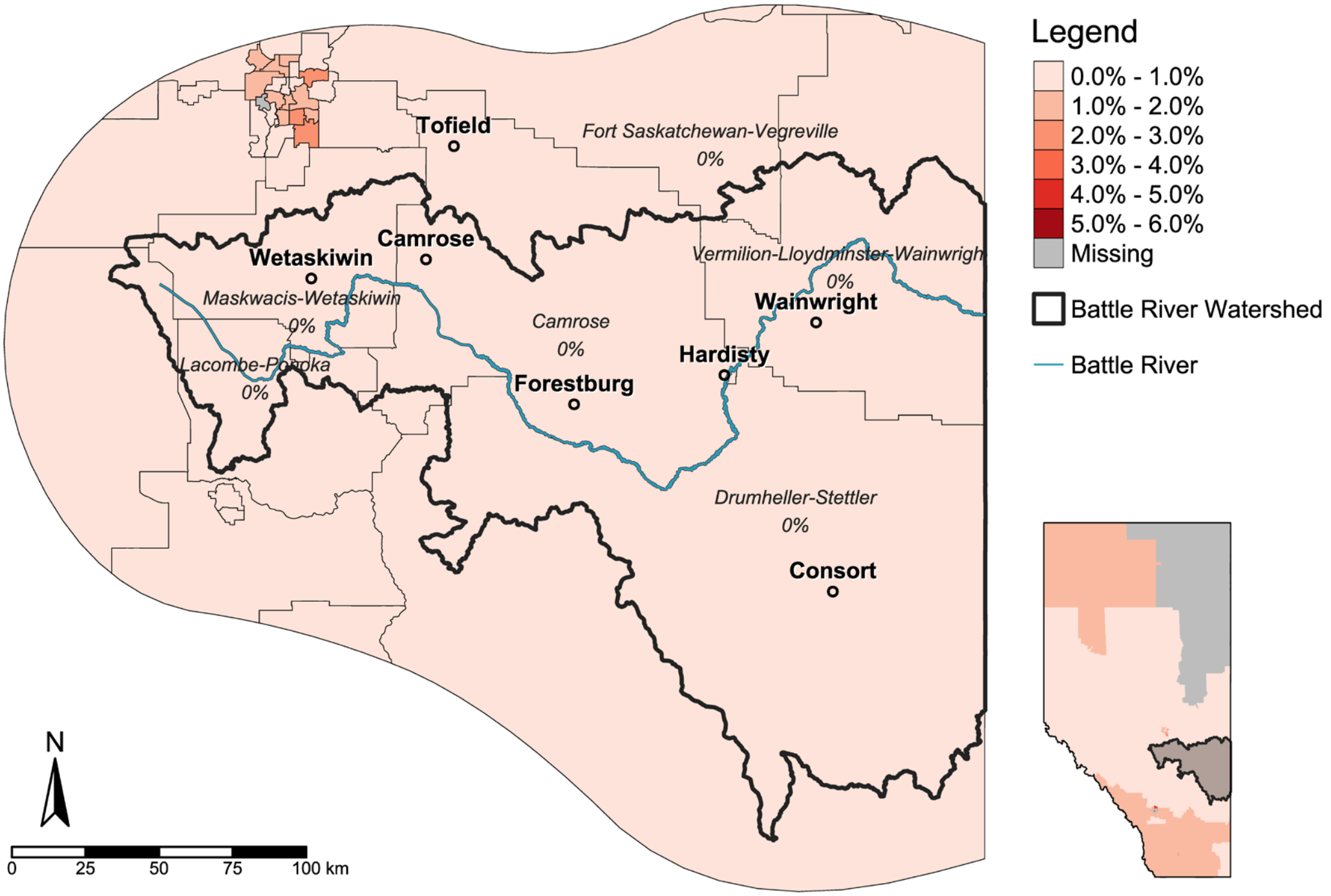
Watershed Stewardship

Watershed stewardship is the act of safeguarding essential sources of water, and Alberta has formalized these safeguarding activities into the Watershed Planning and Advisory Councils (WPACs) and Watershed Stewardship Groups.

The province is divided into 11 Watershed Stewardship Advisory areas, each with a WPAC (Government of Alberta n.d. r). Watershed Stewardship Groups are also

Provincial Election Results (2019), Liberal Vote

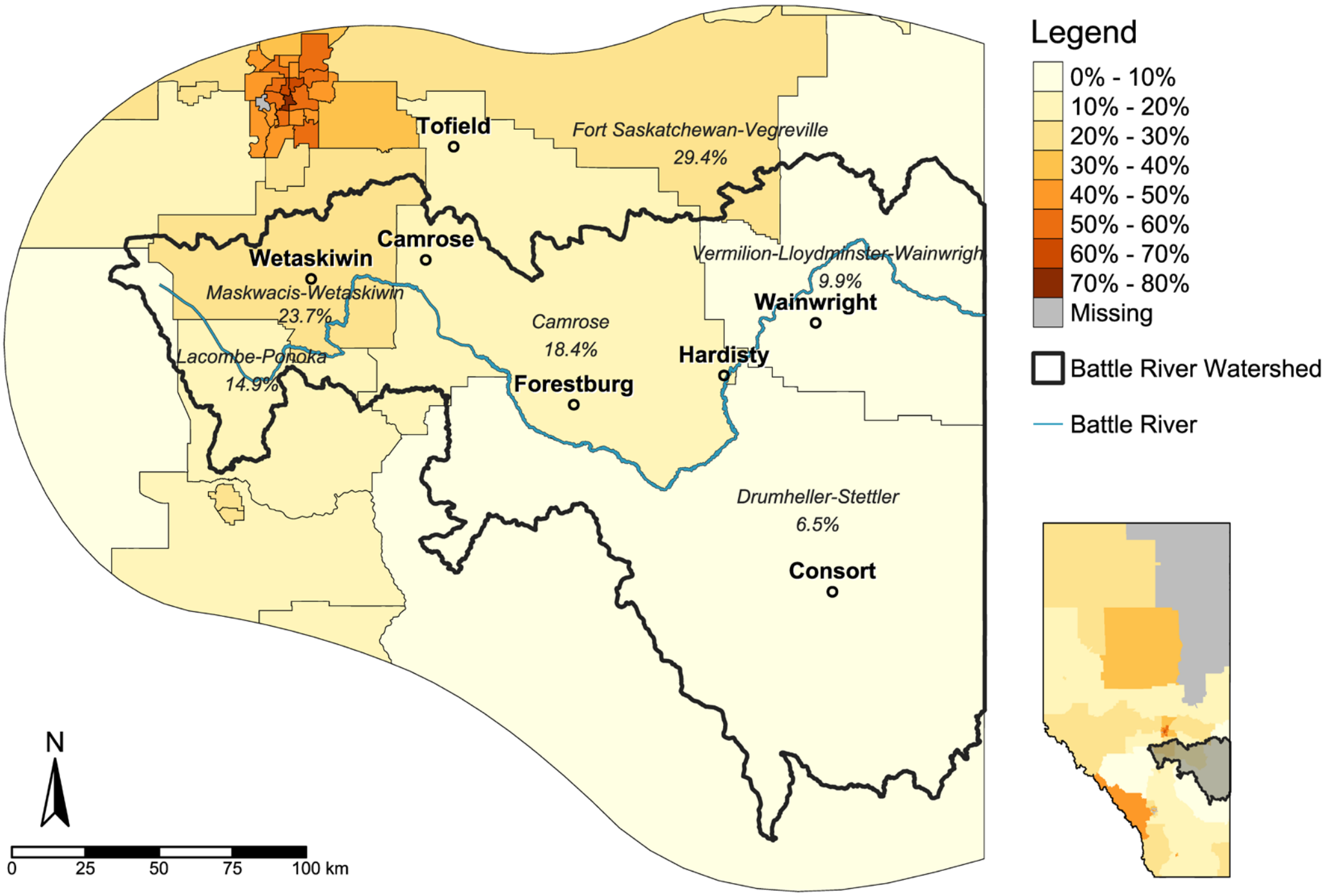
% of all votes that were cast for the provincial Liberal Party candidate



Map 2.7: (Source: Elections Alberta. 2019. Provincial General Election Results).

Provincial Election Results (2019), NDP Vote

% of all votes that were cast for the provincial New Democrat Party candidate



Map 2.8: (Source: Elections Alberta. 2019. Provincial General Election Results).

active as community-based, volunteer organizations devoted to environmental stewardship within a given watershed (Government of Alberta n.d. *q*).

Watershed stewardship is a unique measure of civic engagement in Alberta. From monitoring water quality to advising governments on plans of action, watershed stewardship groups function as liaisons between water sources, communities, industry, and government. High levels of watershed stewardship in a community indicate a respect for the local environment.

Understanding Watershed Stewardship

The Battle River Watershed Alliance (BRWA) is a non-governmental organization dedicated to preserving and enhancing the land and water in its basins. Stewardship values of the BRW include the conservation and enhancement of ecological, economic, social and cultural values. As a non-profit and non-governmental organization, volunteer work is essential to maintaining the core values of stewardship principles and the ecological health of the watershed. Stewardship is a way to help mitigate the issue of the declining health levels of ecosystems resulting from species and habitat loss.

Stewardship efforts work to protect the natural environment through conservation and sustainable practices. According to a recreation survey from 2017, 84% of Albertans enjoy participating in an activity where one can connect with nature, with camping and hiking listed as favorite activities (Advanis 2017, 12). Around half of participants report that the benefits of recreation are to "preserve Alberta's land, plants, and animals" and "improve quality of life" (Advanis 2017, 12). The conservation of watersheds and their ability to provide recreational activity for communities demonstrates why stewardship is important for both ecological and community health.

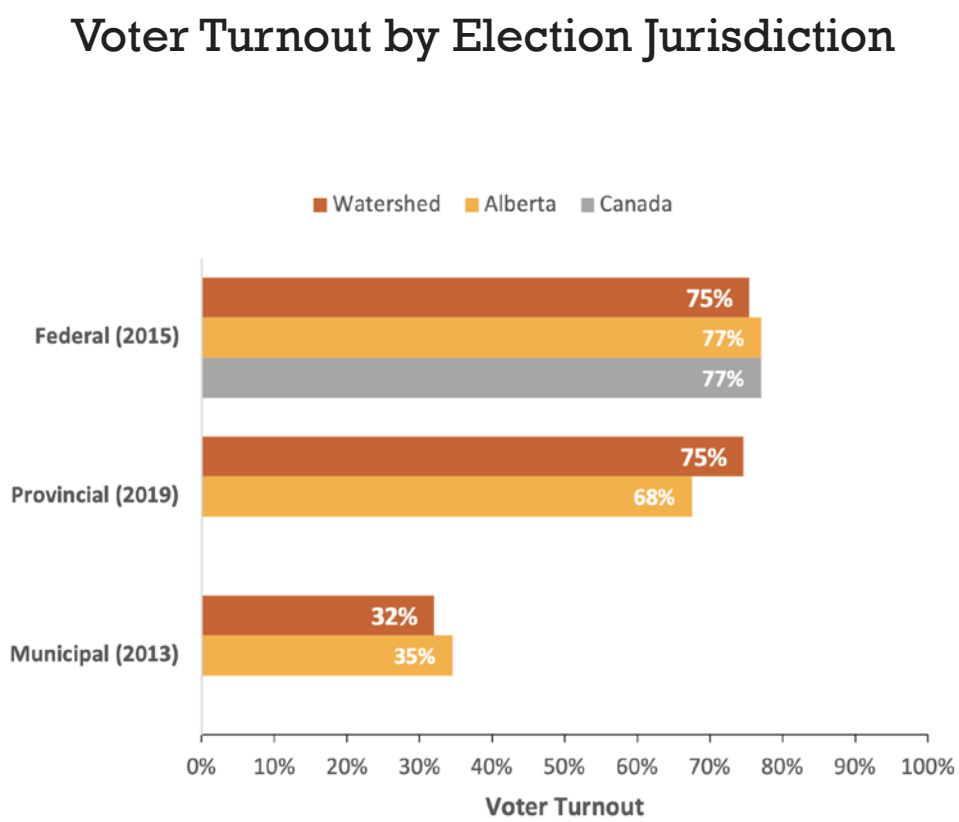


Figure 2.5: Voter turnout for the 2015 Federal Election, 2019 Provincial Election, and 2013 Municipal Election for the BRW, Alberta, and Canada (Source: Elections Alberta, 2019; Elections Canada, 2015; Government of Alberta, 2013).

Watershed Stewardship Activities

The 2017 Alberta Recreation Survey on Volunteer Work

The 2017 Alberta Recreation Survey on Volunteer Work shows that volunteering in parks is the least popular volunteering activity, with only 5% of respondents stating that they had volunteered in parks, as opposed to 18% in sports and 14% in culture (Advanis 2017, 12). It is not clear if these low numbers reflect low interest in volunteering for parks, or whether there are simply more opportunities to volunteer in other sectors.

It is difficult to find exact numbers for volunteers in Alberta parks. There are many opportunities to volunteer in parks in Alberta, either as an individual or for organizations. Volunteers typically perform stewardship activities (*e.g.,* cleanups, weed pulls, light maintenance), support special events in parks, or engage in longer-term involvements including ecological monitoring and trail building (Alberta Parks 2021).

Volunteering

People may be motivated to volunteer for several reasons, such as seeking to express humanitarian values through action and wanting to expand skills (Stukas et al. 2016, 113). A primary motivator for wanting to volunteer is the desire to help others, linked to feelings of self-worth (Stukas et al. 2016, 124). One study has found that both income and health are higher among volunteers compared to those who do not (Detollenaere, Willems, and Baert 2017, 9). Volunteering is described as expressing "values like altruism, solidarity, generosity, and social responsibility" (Jardim and Marques da Silva 2018, 1).

Barriers to Volunteering

Barriers to volunteering includes lack of time due to work and familial commitments, ill health, or lack of interest (Southby and South 2016). Volunteering increases with age, but decreases after age 75 (Southby and South 2016, 20). Younger age groups may face perceived barriers due to thinking they lack the necessary skills (Southby and South 2016). While some volunteer for the collective good, some may volunteer for individualistic reasons, such as gaining work experience or connections (Jardim and Marques da Silva 2018, 2).

Federal Election Voter Turnout by Electoral District (2008-2019)

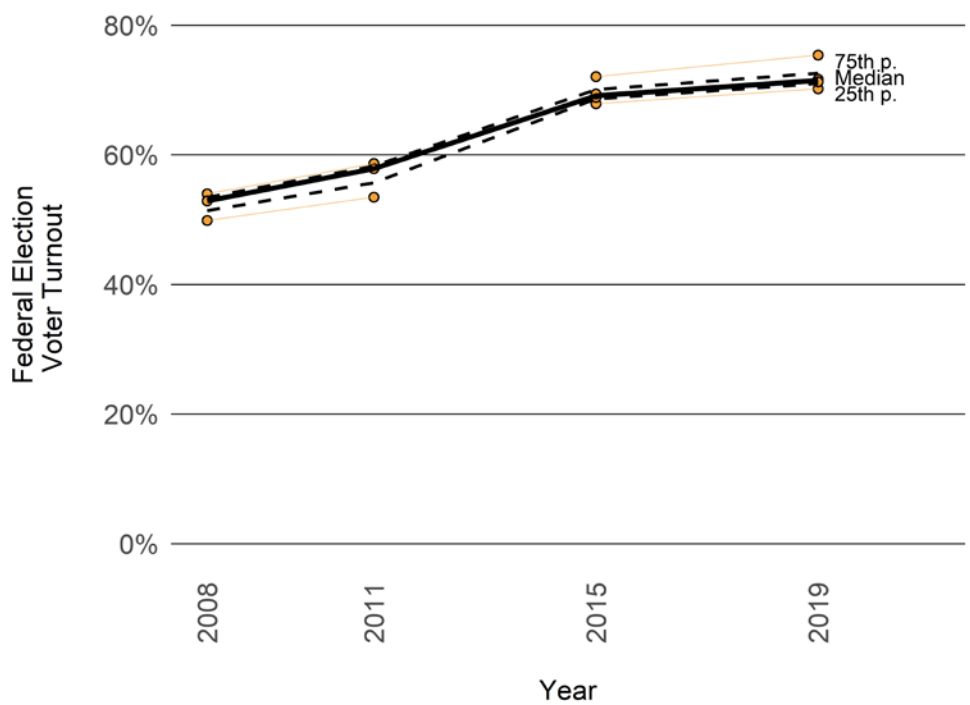


Figure 2.6: Federal election voter turnout (%) for each electoral district within the BRW from 2008 to 2019; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Elections Canada, 2019).

Policy Responses to Civic Engagement

Constructive watershed stewardship involves thinking, collaborating, and acting with others to protect, restore, and enhance watersheds so that they will continue to provide clean water supplies, ecosystem services, and habitats for a diversity of animal and plant species (Furniss et al. 2010). Measuring watershed stewardship as an aspect of civic engagement gives us an insight into the strength of a community's sense of place and social bonds. Higher civic engagement is linked to higher social capital, which is broadly defined as the links, shared values, and understandings in society that enable individuals and groups to trust each other and work together (Doolittle and Faul 2013, 1-2; Keeley 2007, 102).

We measure civic engagement in order to get a sense of the quality of life individuals have within communities. Stronger communities tend to grant individuals many opportunities

for engagement, from sports teams to support or participate in, to local cultural events, to providing job opportunities. Such activities help people build personal relationships within their communities and allow for a sense of safety, trust, and belonging.

How have governments responded?

The Open Government movement seeks to strengthen the partnerships and relationships between governments and citizens, community organizations and stakeholders through:

- information sharing,
- providing citizens with expanded opportunities and tools to understand and participate in governance, and
- offering citizens opportunities to influence and improve government policies that impact them (Government of Alberta 2017c, 5).

Canada began moving towards Open Government in 2011 after signing the Open Government Partnership (OGP) initiative, a platform where government leaders and civil society advocates join together to promote accountable, responsive and inclusive governance (Open Government and Government of Canada 2013). Joining the OGP requires the federal government to work with civil society groups to co-create two-year action plans with concrete steps and commitments across a broad range of issues (Open Government Partnership 2019).

Provincial Election Voter Turnout by Electoral District (2008-2019)

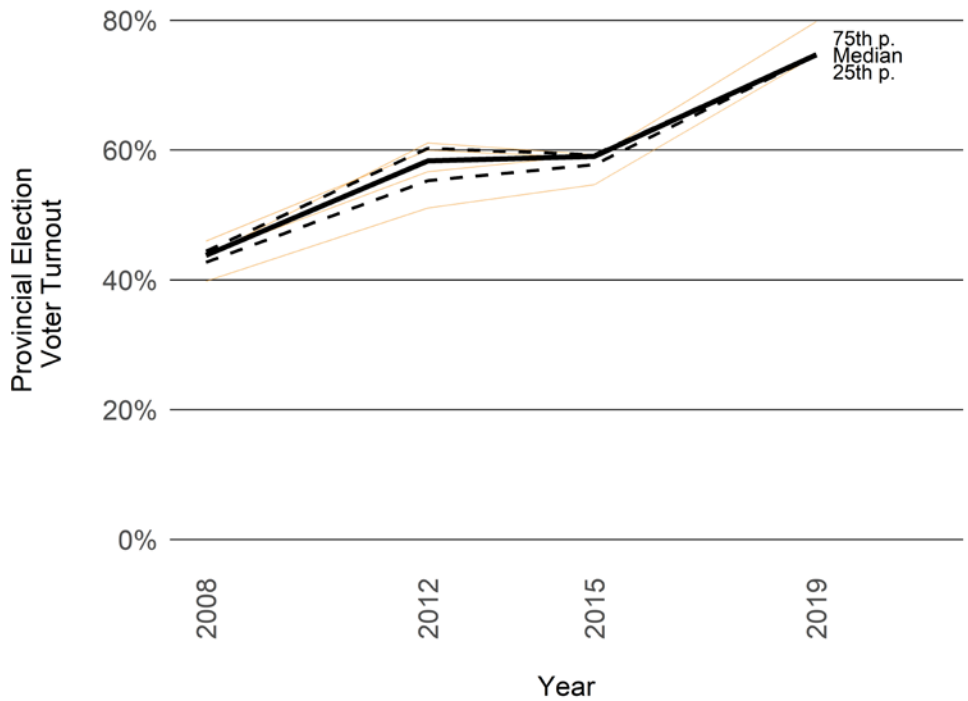


Figure 2.7: Provincial election voter turnout (%) for each electoral district within the BRW from 2008 to 2019; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Elections Canada, 2019).

In 2011, the Government of Canada created the Open Government Initiative, an action plan for publicly accessible government with three streams: open information, open data, and open dialogue (Open Government and Government of Canada 2013). From 2012-2014, the Government of Canada developed plans to:

- foster greater openness and accountability,
- provide Canadians with more opportunities to learn about and participate in Government,
- drive innovation and economic opportunities for all Canadians,
- create a more cost-effective, efficient, and responsive government (Open Government and Government of Canada 2013).

The 2018-20 Action Plan on Open Government provides a forum where citizens can submit inquiries and comment about recent or future policies (Open Government and Government of Canada 2018). In 2019, the Government of Canada launched the Open Data Portal, which offers more than 272,000 datasets from 20 departments and which has already resulted in over 100,000

dataset downloads since its launch (Open Government and Government of Canada 2013).

In 2017, the Alberta Government followed the Canadian Government and released a provincial Open Government Strategy. The Strategy utilizes online technology to give Albertans greater access to information and to gain greater efficiency in meeting their information needs (Government of Alberta 2017c, 4).

The Open Data Portal attempts to make provincial data easily and publicly available, develop a virtual library to enhance access to government publications, and lead the creation of a new public engagement framework to modernize the way governments and citizens communicate (Government of Alberta 2017c, 4).

What is being done?

Civic Engagement

Civic engagement initiatives develop effective citizenship skills. Such initiatives often target youth and marginalized or underrepresented community members. For example, in 2017 the Alberta Government created the Minister's Youth Council, which consists of 41 junior and senior high school students with diverse interests, identities, backgrounds and perspectives from all regions of Alberta. These students are council members for a 10-month term that aligns with the school year, and attend three meetings to provide their perspectives on several education topics (Government of Alberta 2019b).

Another example of civic engagement supported by government action is the establishment of a community anti-racism grant program in 2017 (Alberta Culture and Tourism 2018). Local organizations can apply for these grants to fund activities that build inclusive, anti-racist communities, in line with the government's stated commitment to fighting racism in our society.

Voter Turnout

Voting is one of the most fundamental aspects of civic engagement. Many political scientists link voting with the health of the democratic process and argue that declining voting rates may be symptomatic of a democratic deficit – a situation where a democracy is either structurally or in practice less than fully representative of the population it governs (Uppal and La Rochelle-Cote 2015).

Voter turnout often is used as an indicator of civic engagement because political participation influences public policy, and low participation in elections could result in policies that are not necessarily representative of key constituencies (Uppal and LaRochelle-Côté 2012, 4). Citizens are much more likely to engage with, and participate in, the electoral process when they also have higher levels of other forms of civic engagement (Duguay and Harell 2016).

Enhancing the electoral process to ensure that it maintains a substantial level of transparency, taking steps to increase voter access, and enforcing campaign laws concerning third-party advertising or campaign contributions are activities that seek to build citizen trust in the electoral system and attempt to reverse growing disillusionment with the political process (Root and Kennedy 2018).

2018 saw the passage of Bill 23, An Act to Renew Local Democracy in Alberta, which updates local election rules to improve transparency. The Bill requires candidates to disclose the names of donors who contribute more than $50 to a campaign, clarifies the definition of what qualifies as an expense under disclosure, and restricts campaign activities at voting stations (Government of Alberta 2018a). Bill 23 also requires communities of more than 5,000 people to hold advance votes to provide more opportunities for residents to cast ballots and increases locations for voting for people who are unable to access traditional polling places (Government of Alberta 2018a). This Act also grants the provincial elections commissioner the authority to investigate, prosecute, and enforce rules related to campaign finance and third-party advertising (Government of Alberta 2018a).

Other than disillusionment with the political process, there are a number of barriers to participating in an election. These include having a having an irregular or highly demanding work schedule, which is particularly common among those aged 25-34 (Uppal and LaRochelle-Côté 2012, 6). Immigration status among the voting population may play a role in voter turnout: some studies predict that a lack of experience with democratic processes, a lack of trust in institutions, or

differences in political culture contribute to a lower proportion of voters among new immigrants (Uppal and LaRochelle-Côté 2012, 6).

Factors contributing positively to voting participation include economic status, as employed individuals have been found to be significantly more likely to vote than the unemployed (Uppal and LaRochelle-Côté 2012, 7-8). Education is often considered to be a means of boosting voter turnout, and scholars have argued that a major reason for low political participation among young adults is because they lack the interest and knowledge to engage in politics. It is proposed that targeting young people with information tailored to connect their concerns to political opportunities will have the effect of increasing voter turnout (Duguay and Harell 2016).

Watershed Stewardship

WPACs report on the state of Alberta's watersheds, lead collaborative planning and facilitate education and stewardship activities within their respective watersheds (Government of Alberta n.d. r). WPACs derive their authority from Alberta Environment and Parks, but operate independently as not-for-profit organizations. The WPACs were adopted as a response to Alberta's 2003 Water for Life Strategy (Government of Alberta n.d. r).

Prior to the creation of the WPACs, many of Alberta's watersheds had existing watershed alliances, river-keeping groups, and other coalitions dedicated to the preservation and stewardship of water resources (Schmidt 2011). With the implementation of the Water for Life Strategy, many of the existing organizations were co-opted and repurposed into the new decentralized provincial system (Schmidt 2011). The Water for Life Strategy was created to reflect the government's commitments to manage and safeguard Alberta's water resources through multi-level, adaptive governance.

In 2008, a renewed Water for Life Strategy emphasized three main goals: safe, secure drinking water supply, healthy aquatic ecosystems, and reliable, quality water supplies for a sustainable economy (Government of Alberta 2008, 9-11). These goals are to be met through three key directions: knowledge and research, partnerships, and water conservation (Government of Alberta 2008, 13-15).

There are currently 11 WPACs representing the major river basins, including the BRWA. Each WPAC is tasked with the responsibility of producing a comprehensive state of the watershed report for their watershed (Government of Alberta n.d. r).

The State of the Watershed Report describes the history of the watershed, its natural and built features, the condition of watershed resources, and the impact of human activity on the watershed (Government of Alberta n.d. r). WPACs are also responsible for producing integrated watershed management plans (IWMPs) that provide advice to government and agencies that have policy and regulatory decision-making authority for land and resource management (Government of Alberta n.d. r).

These plans include participation from stakeholders and community representatives from within the watershed that help to form a consensus agreement on policy reforms (Government of Alberta n.d. r). A specific policy tool to facilitate planning, the Guide to Watershed Management Planning in Alberta, was finalized in 2015 to provide advice on the steps to developing and implementing a watershed management plan (Government of Alberta n.d. r).

Reflecting the province's adoption of a decentralized, multi-level approach to water governance, the Water for Life Strategy seeks to include stakeholders that are directly affected by specific water issues, and to share responsibility for water management across a network of partnerships that are empowered, informed and fully engaged in watershed stewardship (Government of Alberta 2008, 14). Within the Water for Life Strategy, the Government of Alberta frames its partner role and responsibilities as showing leadership, providing assurance, and carrying out compliance (Government of Alberta 2008, 14).

Besides evaluation and reporting, WPACs also engage in community education and outreach. Through their programming, WPACs aim to raise public awareness about environmental issues and stewardship opportunities within the watershed, and encourage public involvement in watershed management.

For the BRWA, multiple youth programs provide education and engagement to develop community-based stewardship across the Battle River and Sounding Creek Watersheds. BRWA youth programming includes:

- an Explore More program,
- a Waste in our Watershed tour,
- multiple Discover your Wetland field trips,
- a Yellow Fish Road activity,
- a Building Resilience program,
- the X-Stream Science field trip, and
- a Caring for our Watershed Contest (Battle River Watershed Alliance n.d. c).

As with other WPACs, BRWA activities, including field trips and classroom programming, allow schools to play a part in encouraging watershed stewardship among youth (Government of Alberta n.d. r; Battle River Watershed Alliance n.d. c). The BRWA also runs community programs that engage families and local residents, such as the Battle River Watershed Festival, a Photovoice project, Rolling Down the River Cycling Tour, Saskatoon Pie Baking Contest, and the Spirit of the Watershed (Battle River Watershed Alliance n.d. b).

Opportunities for intersectoral action:

Civic Engagement

As Robert Putnam illustrated in 2000, contemporary America has seen a consistent drop across all seven measures of social capital, including political participation, civic participation, religious participation, workplace networks, informal networks, mutual trust, and altruism (Putnam 2000). Putnam estimated that the decline in civic engagement after 1965 is: 10% due to pressure of work and double-career families, 10% to suburbanization and commuting, 25% to the individualization of media (*i.e.,* television), and 50% to generational change which includes less engagement in one's community as compared to previous generations (Putnam 2000).

Other scholars have asserted that civic knowledge is essential, and that schools are logical places for improving civic knowledge and engagement among youth (Shiller 2013, 70). These scholars have asserted that urban youth can be civically engaged when involved in projects or organizing intended to improve community conditions, not merely absorbing civic knowledge (Shiller 2013, 69). Engaging in controversial political discussions, doing certain kinds of community services, and getting youth to participate in non-sport extracurricular activities have all been found to increase in civic engagement (Shiller 2013, 70).

Voter Turnout

Many scholars have asserted that civic engagement encourages participation in other political activities, which in turn contributes to electoral participation (Wagle 2006, 301). Ways to engage youth includes engaging them in non-sporting extra-curricular activities, creating well designed service-learning programs, and civics engagements within schools (Putnam 2000). Furthermore, investment in education provides the greatest return in terms of political participation and citizen engagement, given its impact on cognitive and affective elements of participation (O'Neill 2006, i). These returns are likely to generate not only greater levels of and more effective involvement in politics and civil society, but also greater representational gains, both in the articulation of interest and from elected representatives (O'Neill 2006, 2).

However, demographic and socioeconomic characteristics serve as the bases for inequality in political participation with important implications for what policy measures, if any, can be taken to maximize such participation (Wagle 2006, 302). Voluntary organizations provide an important avenue for encouraging civic activity, and as such, policies ought to encourage their establishment and development (O'Neill 2006, ii). Encouraging more deliberative models of citizen participation in the development of policy, such as that adopted in the British Columbia (B.C.) Citizens' Assembly on Electoral Reform, would increase citizen engagement, but, importantly, might reduce the cynicism directed at governments and politics more broadly (O'Neill 2006, ii).

Social media use among young citizens can function as a positive intervention in terms of motivating political participation (Holt et al. 2013, 19). Both political social media use and attention to political news in traditional media increase political engagement over time (Holt et al. 2013). The widespread use of social media offers tangible potential

for increasing political participation through disseminating digital reminders to voter (Haenschen 2016, 542). When celebrities, who are often followed by teens and the youth in general, endorse voting or registering to vote, an increase in voter turnout is likely (Austin 2008). In 2018, Taylor Swift broke her apolitical stance to endorse two Tennessee Democrats. This created a surge of 65,000 registrations over one 24-hour period (Jagannathan 2018).

Watershed Stewardship

Increasing watershed stewardship through programs conducted through volunteer organizations, schools, or organizations such as the BRWA can enhance civic capacity, significantly improve awareness of watershed issues, and promotes watershed friendly attitudes and behaviours (Welsch and Heying 1999, 88).

Providing spaces for individuals to experience the outdoors can not only affect their personal health, but it can also help foster a sense of responsibility toward stewarding the environment in their local communities (Shandas and Messer 2008). When individuals feel a civic responsibility for protecting the environment, they frequently act collectively to develop initiatives that address the complex and diverse nature of environmental problems (Parisi et al. 2004, 98).

What else could be done?

Voter Turnout

Voter decline is a complex issue, and a number of proposals exist for encouraging voter turnout. Elections Canada conducts a Voter Information Campaign during federal elections to promote awareness of the election and to deliver information to specific underrepresented voter groups, including young people, Indigenous people, and people with disabilities. Other than information and education campaigns, jurisdictions around the world have experimented either with positive incentives to vote, including making the experience more entertaining with concerts and lotteries, or with compulsory voting and punishments including fines (Sukriono 2021, 4; La Raja and Schaffner 2022; Fowler 2013, 161-163).

Educational campaigns try to get at the issue of why people see or do not see voting as a meaningful activity, while both incentives and punishments mask the underlying reasons for voter apathy. A key finding from a University of Calgary researcher suggests that education campaigns will be more successful at encouraging voting if they avoid moralizing the issue: people are not persuaded to vote by being told that it is a duty, but are more likely to be persuaded when they are asked to consider personal reasons for voting (Berenstein 2019).

Watershed Stewardship

One of the goals of watershed stewardship is to increase public awareness about watershed management efforts, and to engage locals and other stakeholders in the management process to ensure stewardship activities and positive behaviours are taking place (Government of Alberta n.d. q). To achieve these goals, watershed managers should consider increasing watershed advocacy, education, and maintenance as well as pollution prevention, indicator monitoring, and watershed restoration. Implementing these strategies and measures can promote greater watershed stewardship by enhancing public support of watershed health.

Ecosystem services provide a framework for understanding the many contributions of living nature to people's quality of life, from water purification to provision of food and climate stabilization. Ecosystem services are also related to individual psychological well-being and community health, with many people reporting greater feelings of happiness and an improved sense of meaning and purpose in life with increasing levels of time spent outdoors (Bratman et al. 2019, 1-3). Creating spaces for individuals to experience the outdoors can not only affect their health, but it can also help foster a sense of responsibility towards the environmental conditions in their local communities (Shandas and Messer 2008).

Protecting the environment is often a social activity: an individual motivation to safeguard a natural area can easily become collaborative, and may include such civic activities as developing initiatives to complement existing laws and local regulations that target the interdisciplinary and intersectoral challenges associated with environmental problems (Parisi et al. 2004, 98).

Parks and Recreation

Parks, Conservation, and Protected Areas

Parks, conservation areas, and protected areas have a positive effect on community health for several reasons. Probably the most obvious reason is contact with nature, which many people enjoy for its own sake. There is also increasing evidence that time in nature is good for us: people who spend at least two hours a week in green spaces report having better physical and mental health (White et al. 2019)

Parks provide opportunities for exercise, social connection, relaxation and stress management, and healthy hobbies such as bird watching. In addition to the health benefits of green spaces for people, parks, conservation areas, and protected areas contribute to the preservation of plant, animal, and fish population numbers and biodiversity. Parks also support water quality and quantity, which has downstream benefits for human health and economies. Protected natural areas have been shown to drive local job creation, attract businesses and skilled workers, and sustain working farms and ranches. For these reasons, the number and size of conserved and protected areas within the BRW can be linked to community health across personal wellbeing, ecological, and economic indicators.

Understanding Parks, Conservation, and Protected Areas

Alberta is currently home to 473 provincial parks (Alberta Parks 2018). There are currently 30 provincial parks in the BRW. Four of these parks are on the list of sites which have been slated for full or partial closure, or transferral to alternative or third-party management (Map 2.9).

Provincial parks comprise 0.03% of the total land mass of Alberta and 0.7% of the land area of the BRW, amounting to 21,763 hectares (Map 2.9). In Alberta, National and Provincial Parks make up 13.7% of the total provincial land area (Alberta Parks 2018; Alberta Wilderness Association n.d.; Statistics Canada 2016).

History of the Provincial Parks and Protected Areas Act

- 1930s: The Alberta Legislature passed the Provincial Parks and Protected Areas Act. This Act officially began Alberta's provincial park system and saw the creation of 5 provincial parks by 1932. One of those parks was Gooseberry Lake, which lies within the BRW (Alberta Parks 2022).
- 1930s-1940s: The Great Depression and World War II resulted in limited funding availability for new provincial parks.
- 1950s-1960s: In 1951, a new Parks Act was passed. The Department of Land and Forests was put in charge of parks and a new Parks Board was established. During the 1950s, the Alberta Forest Service built forest recreation areas in order to localize environmental impacts of human activity to one, or only a few, areas. Another purpose was to lower the risk of forest fires linked to random camping. The Transportation Department began creating highway wayside campsites which would act as accessible recreation areas for people in automobiles.
- In 1964, the Parks Act was amended, which expanded the provincial parks network to add wilderness areas and natural areas. This eventually led to the creation of the Wilderness Areas Act. The Wilderness Areas Act took over wilderness areas and allowed for the founding of ecological reserves.
- 1970s: The establishment of 46 provincial parks took place over two decades, between 1951 and 1971. These parks were mostly for outdoor recreation and prioritized activities such as boating, fishing, beaches, camping, picnicking, and playgrounds.
- 1973: Minister of Lands and Forests, Allan Warrack, outlined several issues within the Alberta Legislature regarding inadequacies of the park system. Warrack stated that more park lands were needed, that existing parks were in urgent need of enhancement, and that there were major resource development struggles in parks. Another issue was that Albertans in metropolitan areas had very few opportunities to go to parks. Warrack's influence

resulted in the significant increase in funding over the next three years and the Alberta Parks network grew substantially. Parks were selected based on recreation opportunities and the conservation of natural traits.

- 1980s: The 1980s saw an increase in parks placed around bodies of water such as reservoirs, lakes, and rivers. This was done with the goal of providing recreational access to water bodies, as well as to localize environmental impact to smaller areas and to control shoreline erosion.
- In 1995: Special Places Initiatives was passed which saw the creation of 29 new protected areas (Alberta Parks 2022).
- 2020: A plan released by the Alberta UCP Government is the first to outline the removal of over 150 provincial parks. In response to this, Opposition party NDP introduced a bill on May 27, 2021 to prevent the provincial government from selling provincial parks without consulting the public. Bill 218: Provincial Parks (Protecting Park Boundaries) Amendment Act (2021) stated "government cannot reduce the size of a provincial park or remove them from the parks system without public consultation and approval from the Legislature."

Benefits of Parks

Research has shown that having green spaces within urban areas can have positive effects on mood and stress levels, in addition to promoting physical activity (van den Bosch and Sang 2017, 375). While much of the BRW is rural, certain areas, such as Camrose, are urban.

Small cities such as Camrose have benefited greatly from the creation of walking and running paths that run through the green areas of the city. Additionally, parks in the surrounding area are easily accessible via roads and include fishing ponds, recreational lakes, and hiking or walking paths. The promotion of physical activity and recreation promotes both physical and mental health, as those physically active are less at risk for health conditions.

Living in busy cities exposes one to environmental stressors, such as increased noise, crime, air pollution, and overcrowding which can lead to mental distress (Rugel et al. 2019, 365). Having greater access to green and natural spaces is associated with positive mental wellbeing (Wood et al. 2017). Parks and green spaces promote mental wellbeing through the restorative benefits of contact with nature, stress reduction, and the facilitation of social interaction (Wood et al. 2017). Residents in neighbourhoods with higher quality and quantity of parks have lower levels of psychological distress (Wood et al. 2017).

Conservation

Apart from promoting community health, parks and natural areas are important to protect the ecological integrity of the species that inhabit them. Parks Canada Conservation and Restoration (CoRe) projects serve to restore the national parks through measuring ecosystem change and recover the species-at-risk (Parks Canada Agency 2018, iii). Conservation of national parks is important as it slows down species extinction. For example, from 1895 to 2006, 57 species of freshwater fishes were driven to extinction in the United States due to human activity; the implementation of conservation acts worked to mitigate this rate of species loss (Wilson 2017, 8).

Policy Responses to Parks and Recreation

The 2009-2019 Plan for Parks introduced short- and long-term activities and a framework for decision-making to inspire people to discover, value, protect, and enjoy the natural world and the benefits it provides for current and future generations. While Alberta Tourism, Parks and Recreation has a long history of public engagement, regional planning introduces a new approach to parks management. This Plan for Parks includes key planning elements also found in the Land-Use Framework (LUF), and both seek to achieve people-friendly communities and recreational opportunities, healthy ecosystems and environment, and sustainable economies based on land and natural resources within the province (Government of Alberta 2009, 4).

At the core of the Plan for Parks are four priority action areas, including a strategy for involving Albertans in creating recommendations regarding the use of parks in their

area through a Parks Advisory Council. These recommendations will help inform region-specific planning models and provide input and advice to the Minister on park policies and initiatives. It is also hoped that, through providing a forum for discussion of trends, issues, and challenges affecting Alberta's parks, the Parks Advisory Council will engage Aboriginal communities, develop a process for nominating new parks, ensure accountability through commitments and deliverables, and diversify existing volunteer programs and partnerships (Government of Alberta 2009, 5).

In 2020 the government instituted new coal legislation which would have had significant effects on the governance of protected areas in the province. The legislation repealed some parts of the Coal Development Policy's stringent protections, the document which since 1976 has restricted open-pit mines across most of the province's Rocky Mountains and Foothills (Government of Alberta 2020c; Fletcher, Anderson, and Omstead 2020).

This reversal was implemented without public consultation, and was met with overwhelming resistance from individual citizens as well as from people working together, including First Nations, and several ranchers from the Rocky Mountain eastern slopes. The main concern among the various opposition groups was that increased coal mining will cause complex and irreparable harm to the environment, endangering the health and livelihoods of several human and ecological communities. Some of the risks of coal mining include leaching of selenium, nitrite, ammonia, phosphorus, and hydrogen sulphide into freshwater bodies. These hazardous substances could eventually find their way into the many wells that supply rural Alberta's drinking water (Fletcher, Anderson, and Omstead 2020). Because of the strong public disapproval, the UCP Government was forced to reinstate the 1976 Coal Policy in February 2021 (Government of Alberta n.d. b).

What is being done?

There are three main pieces of legislation that provide legal direction and guidance for managing Alberta's system of provincially protected areas. These are: the Provincial Parks Act, the Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act, and the Willmore Wilderness Park Act (Alberta Parks 2020).

The Provincial Parks Act (2022):

- provides for the establishment, protection, management, planning and control of provincial parks, wildland parks, and provincial recreation areas,
- provides for the preservation of Alberta's natural heritage and ecological integrity, and
- pledges to secure protected areas for the benefit and enjoyment of current and future generations (Government of Alberta 2017d).

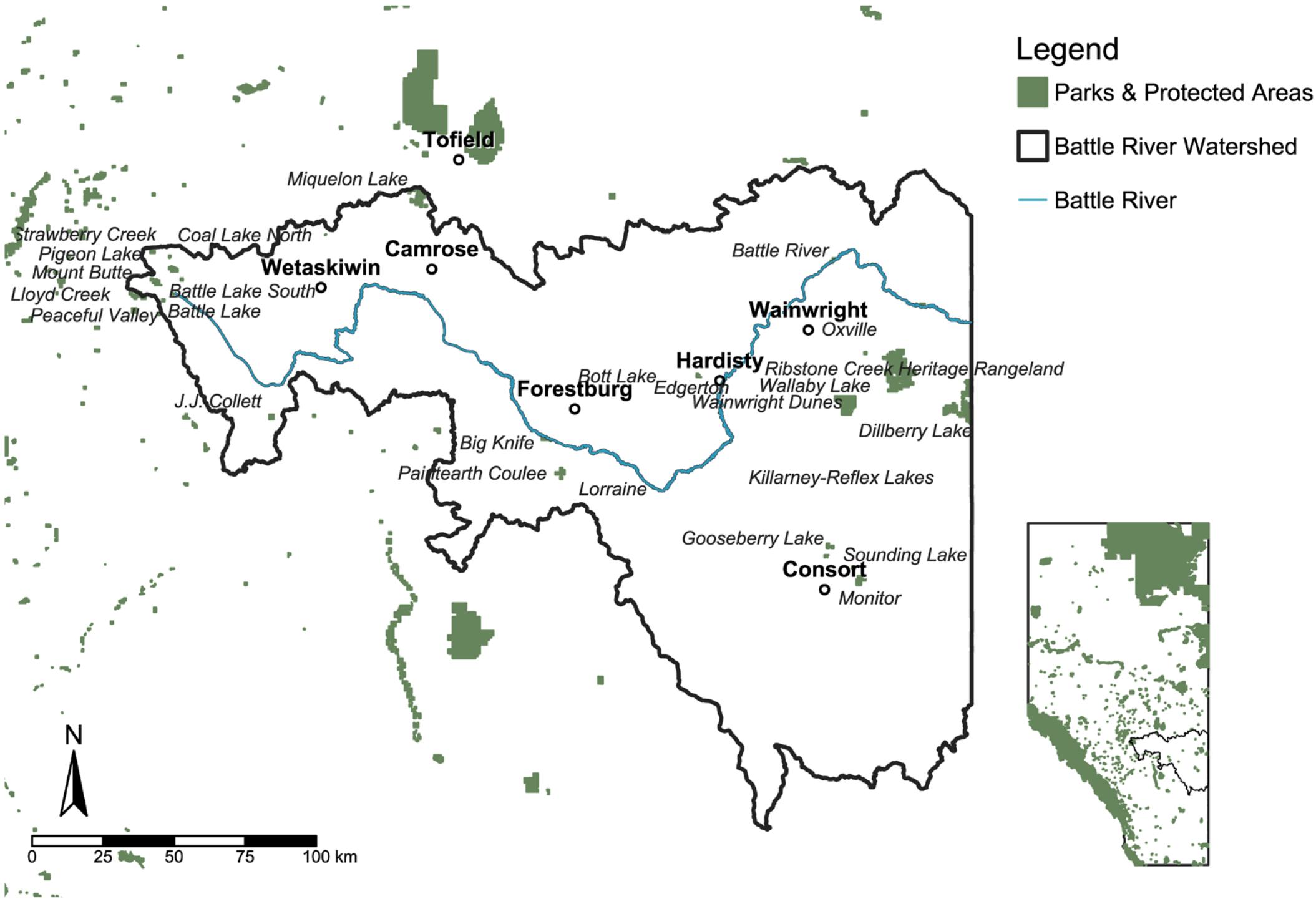
Additionally, the Provincial Parks (Section 7 Declaration) Regulation provides clarification for the designation of lands to be managed under the Act that are not established as parks or recreation areas (Alberta Parks 2020). Section 7 is used to address interim management of lands that have been acquired for park purposes but are not yet designated or where activities not permitted in a park are being managed until the activity is completed and the lands can be designated (Alberta Parks 2020).

The Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act governs the establishment of Wilderness Areas, Ecological Reserves, Natural Areas, and Heritage Rangelands and provides a coarse level of direction for their management (Government of Alberta 2014). The natural areas established under the Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act preserve and protect sites of local significance while providing opportunities for low-impact recreation and nature appreciation activities (Alberta Parks 2020).

In addition to protected areas-specific legislation, the Environmental Protection and Enhancement Act is the primary act in Alberta through which regulatory requirements for air, water, land, and biodiversity are managed (Government of Alberta 2021b).The Act supports and promotes the protection, enhancement, and wise use of the environment by designating proposed activities for which approval or registration is required (Government of Alberta 2021b). The purpose of the Act is to recognize the need for Alberta's economic growth and prosperity in

Parks and Protected Areas

Land cover of provincial and federal protected areas.



Map 2.9: (Source: Government of Alberta, Environment and Parks. 2022. Parks and Protected Areas in Alberta).

an environmentally responsible manner and the need to integrate environmental protection and economic decision in the earliest stages of planning (Government of Alberta 2021b, 22).

Opportunities for intersectoral action

When we take a holistic view of health, we understand that environmental integrity and human health are interconnected. When it comes to parks and protected areas, an explicit goal of the parks system is to engage people in nature. To accomplish this goal, parks personnel work to make parks accessible and attractive to a wide cross-section of people. For this reason, knowing and understanding popular perceptions of parks, protected areas, and conservation efforts is important to effectively marketing protected areas (Abukari and Mwalyosi 2020).

Taking perceptions of parks and protected areas into account can inform parks management and improve park-people relationships through targeted interventions that are meaningful to local communities (Allendorf, Aung, and Songer 2012, 42). Effective management of parks will allow these areas to take on larger and more important roles in relation to their surrounding communities, as protected areas can contribute to the livelihood of local communities, bolster provincial and national economies through tourism revenues, replenish fisheries, and play a key part in the mitigation of, and adaption to, climate change, among other vital social and ecological services (Watson et al. 2014, 67).

Local residents represent a key stakeholder group for parks and protected areas because of their frequent interaction with parks through recreation and other activities, and through a sense of 'place attachment' or feeling of identity, belonging, and care (Buta, Holland, and Kaplanidou 2014, 1; Halpenny 2010). Programs and initiatives designed to increase local residents' attachment to their community, such as recreation programming, special events like concerts, and wildlife walks should be encouraged and supported by park managers (Buta, Holland, and Kaplanidou 2014, 1). Allowing some carefully managed uses of the park also facilitates more positive social connections and attitudes towards local parks, as long as other extensive park area resources are protected and basic principles of sustainability and conservation are followed (Buta, Holland, and Kaplanidou 2014, 1).

Providing opportunities for local residents to participate in meetings, public hearings, community projects, and management decisions helps foster local trust in parks and park personnel, and trust among local residents is key to creating and sustaining park attachment and appreciation (Ryan 2006).

What could be done?

We have seen that the goals for parks and protected areas creation and maintenance typically aim to fulfill two broad objectives: conserving natural areas deemed especially worthy of protection, and connecting people with nature and recreational activities. When we consider improvements to the policy framework for protecting parks and enhancing access to natural spaces in Alberta, one of the first places we can look is towards other jurisdictions within Canada. In Canada, British Columbia stands out for its protected areas legislation and other area-based conservation initiatives.

Protected lands and waters make up 15.4% of B.C.'s land base and 3.2% of B.C's marine areas (Environmental Reporting BC 2016). B.C. Parks manages most of the protected land and a third of the protected waters in B.C. These protected areas are governed by several pieces of legislation and fall into one of the following designations: Ecological Reserve, Provincial Park, Protected Area, or Conservancy and Recreation Area (Environmental Reporting BC 2016).

One possibility for land and water conservation and protection comes through the establishment of tribal parks by Indigenous communities and organizations. Canada's National Parks are implicated in the country's history of colonialism, with Banff and Jasper National Parks in particular being sites of forced removals of Indigenous communities (Youdelis 2016).

Although consultation and even co-management with local Indigenous communities has been incorporated into the parks planning process, some Indigenous groups in Canada and the United States are moving to create parks and protected areas without state involvement, designed specifically to reflect Indigenous values and to conserve areas of special importance to local Indigenous

cultures and ways of life (Carroll 2014). Tribal parks do not seek provincial or federal recognition nor partnership, but are also distinct from private enterprises.

One example of this approach specific to the Canadian context are the *Tla-O-Qui-Aht* Tribal Parks near Tofino, British Columbia (Murray and King 2012, 389-390). The *Dasiqox* Tribal Park in *Tsilhqot'in* territory in the Chilcotin region of British Columbia, declared by the *Tsilhqot'in* Nation in 2014, is another example of a new protected area that reflects Indigenous values and functions as a way for First Nations to exercise governance over an area of traditional land. While these protected areas are governed and managed by Indigenous people, they are open to the public and receptive to public support through donations and other forms of community engagement.

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CHAPTER THREE

WEATHER AND CLIMATE

TABLE OF CONTENTS

INTRODUCTION

The Weather and Climate chapter focuses on the impacts of anthropogenic disruption and climate change. Weather and climate are driving forces for the wellbeing of an ecosystem and community, as they influence warming/cooling temperatures, precipitation rates, and altering food patterns and habitats for a species. Weather and climate also impact heat-related illnesses, such as edema, heat stroke, allergies, and asthma.

Measuring Weather and Climate

1. Air Quality

Air Quality is influenced by air pollutant concentrations, such as nitrogen dioxide, sulfur dioxide, etc. These pollutants are affiliated with the prevalence of asthma, allergies, chronic obstructive pulmonary disease (COPD), and heart conditions. Carbon dioxide emissions are also important as they are an indicator of greenhouse gas (GHG) emissions. Alberta's carbon dioxide emissions are found to have substantially increased in recent decades.

2. Climate Change & Weather Patterns

Examples of extreme weather events include natural disasters of flooding, major fires, blizzards, as well as droughts and severe storms. These events can cause major economic disruption due to destroyed infrastructure and declines in productive yield. These events also impact the wellbeing of the species and habitats within a community due to the sudden disruption of their balanced ecosystem.

Plant hardiness zones give a geographic measurement on suitable regions that plants can grow in. Harsh weather patterns can change the plant hardiness zone of a certain region, which can be consequential to the plants that typically thrive in these zones.

3. Climate Related Illnesses

Climate related illnesses include edema, heat stroke, allergies, and asthma. These illnesses intersect with the social determinants of health (SDOH) as certain groups are disproportionately affected. For example, rural residents are disproportionately impacted by these illnesses due to the nature of working outdoors within the agriculture and oil/gas industries. Older residents are also at greater risk, along with higher rates of chronic illnesses. The change in seasonal trends is found to influence the prevalence/severity of these heat-related illnesses, ultimately affecting one's quality of life in their community.

The policy sections in this chapter will provide a snapshot of the legislation and other policy tools that currently exist to protect and promote the wellbeing of Albertans in relation to weather and climate. Policy around weather and climate ranges from formal and direct acts and regulations such as the Occupational Health and Safety (OHS) Act to informal and indirect measures such as the federal subsidy for electric and hybrid vehicles.

Understanding the Political Context of Weather and Climate

The indicators in this chapter provide examples of the ways environmental health, human health, and community wellbeing are interrelated. For example, there are meaningful connections between effective forest fire management strategy, air quality, economic wellbeing, and community resilience, and health effects like asthma and COPD (D'Evelyn et al. 2022).

Overall Policy Design

One of the potential lessons from this chapter is that municipalities have meaningful scope for action, whether through introducing local climate adaptation and disaster response plans, planning and developing local infrastructure that is friendly to pedestrians, bicycles, and public transit, or educating at-risk residents about health concerns, like allergy and asthma management and heat-related illnesses. Where they face similar problems, other jurisdictions in Canada and other countries around the world can also supply helpful policy examples. For example, Norway has a similar economic profile to Alberta, with heavy reliance on fossil fuel extraction at the base of their economy. Unlike Alberta, Norway has had significant success with reducing their GHG emissions, diversifying their economy, and reducing reliance on fossil fuels to power other sectors of their economy.

In Alberta, weather-relevant policy speaks to working conditions, recreational activities, and extreme weather responses. The provincial government publishes bulletins from OHS on working in winter conditions so that workers and employers know the risks of winter work, the rights of workers, and the responsibilities of employers (Government of Alberta 2019b). Because so much of Alberta's industrial work is year-round outdoor work,

policy that aims to keep workers safe in extreme temperatures is a key piece of the province's approach to weather and climate.

Weather-related policy at other levels of government include the City of Edmonton's Extreme Weather Response, which is an aspect of the city's Emergency Preparedness planning (City of Edmonton 2022). Edmonton's hot weather policy includes increasing the number of sources of publicly available potable water, and disseminating information about how to obtain emergency or crisis services for people in distress for weather-related reasons.

At the provincial level, party politics and political culture matter when it comes to support for implementing policies to address climate change. Alberta has had many decades of conservative governments, some of which have been overtly hostile to environmental concerns, and Alberta's political culture abruptly shifted from politically progressive to politically conservative around the time of the Great Depression (1929). The province's reliance on the fossil fuel industry means that governments are often wary about enacting legislation that might be perceived either as anti-business or anti-oil (Salomons and Parkins 2018).

At the federal level, Environment and Climate Change Canada maintains data on weather, wildlife, environmental indicators, pollution, and Canada's climate change plans and commitments (Government of Canada 2022d). The federal government's Weather, climate and hazards web page links users to current weather, historical weather, and information about severe weather and climate-related hazards (Government of Canada 2021d).

Public Safety Canada is mandated with federal emergency management, including prevention, preparedness, and recovery from weather and climate-related disasters including flooding, fire, winter storms, earthquakes, and tsunamis (Public Safety Canada 2022).

Canada has also set domestic targets for reducing GHG emissions and decarbonising our economy and infrastructure (Environment and Climate Change Canada 2022). Canada also participates in the construction of global climate policy, primarily through the United Nations Framework Convention on Climate Change. International efforts to meaningfully address climate change have had limited effective, and a primary reason for this limited progress is because, after the initial success of ratifying a new protocol, many states have failed to take meaningful action to achieve the targeted reduction of emissions (Salomons and Parkins 2018, 84).

Alberta is struggling to reduce GHG emissions, does not achieve the best asthma outcomes, and is affected every year by extreme weather events. These problems are all in different policy domains and some problems may prove easier to solve than others. It seems unlikely that hailstorms, blizzards, and locust infestations in Alberta can be stopped by policy – but it is possible for communities to protect themselves from the worst effects of droughts, flooding, and fires, or to effectively reduce rates of childhood asthma or heat-related injury among agricultural workers.

For municipalities, there is a vast array of barriers to responding to climate change, including more urgent priorities, inadequate knowledge, inadequate information, and an overall lack of capacity (Salomons and Parkins 2018, 90). Other barriers to municipal action may include the belief among local governments that their role is in dealing with 'local matters,' and that climate change is a 'global matter' (Robinson and Gore 2005, 107).

Public perception of climate change also plays a role in preventing municipalities from taking action, as government action must receive public support (Robinson and Gore 2005, 108). Even if the public wants climate action to be taken by their municipal governments, there may still be barriers such as organizational and budgetary capacity and jurisdictional authority (Robinson and Gore 2005, 108).

In Canada, the largest municipalities are only beginning to develop climate adaptation policies. The City of Edmonton implemented their Climate Resilient Edmonton: Adaptation, Strategy, and Action Plan in 2018, which lays out actions including gathering ecological information; conducting risk assessments; reducing emissions within city limits; and working to mitigate climate-related impacts on health, safety, and social wellbeing (City of

Edmonton 2018). Larger municipalities may have greater organizational and budgetary capacity to develop climate change policy, but it may be possible for smaller communities to adapt these plans.

Polling consistently shows that Albertans are more likely than other Canadians to be skeptical of climate change, believe too much attention is paid by the federal government to climate change, believe Canada is doing more than the rest of the world to deal with climate change, and have the most opposition to a carbon tax (Forum Research 2014; Angus Reid Institute 2015; Environics Institute for Survey Research 2014).

The Conservative Government under Prime Minister Harper was also openly hostile to environmental organizations, stating that people and groups "opposed to oil and gas infrastructure [are] 'radicals' with an 'ideological' agenda" (Salomons and Parkins 2018, 85), and employing more staff at the Canada Revenue Agency (CRA) to conduct audits of charities that were specifically critical of the Conservative administration (Salomons and Parkins 2018, 85-86).

Climate Related Health Impacts

Heat-Related Illness

Heat-Related Illness covers several related pathologies, including heat exhaustion and heat stroke. Both heat exhaustion and heat stroke result from excessive fluid loss during periods of long exposure to hot temperatures and result in hyperthermia (Healthwise and Alberta Health Services 2022). Symptoms of heat exhaustion include pale, cool, and moist skin, nausea, vomiting, weakness, fatigue, dizziness, and headaches (Healthwise Staff 2021a).

Heat stroke is classified as a medical emergency because it can be fatal. It occurs when body temperatures rise to dangerous levels because the body has become severely dehydrated and can no longer cool itself through perspiration (Healthwise Staff 2021b).

While high summer temperatures are an obvious source of heat-related illness, an increase in these illnesses could be tied not only to seasonal cycles, but also changes to a work environment, or inadequate access to shelter (Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch 2011, 5-6).

Individual susceptibility also depends on a number of other risk factors, including age (either young children or seniors), low socioeconomic status (SES) and homelessness, chronic illness, including heart disease, and outdoor work or work in confined areas at high temperatures (Groot, Abelsohn, and Moore 2014, 729). As with all health issues, an increase in heat-related illness indicates a drop in community health, although with heat-related illness these fluctuations in community health are likely to be seasonal and not long term.

Table 3.1 shows the prevalence of heat-related illness for all health zones in Alberta in 2019. The South, Central, and North Zones all show much higher rates than either Calgary or Edmonton. However, the Central Zone shows the lowest prevalence rate among the high-ranking zones, slightly lower than the North Zone and well below the South Zone.

As of 2019, the prevalence rate of excessive heat-related injuries in the BRW and surrounding areas was 10-12 per 100,000 population (Map 3.1). The Alberta average of excessive heat-weather injuries is 6.45 per 100,000 population indicating that the BRW and surrounding areas are slightly above the provincial average (Alberta Health n.d.).

In 2019, the Central Health zone had a prevalence rate of 11.14 per 100,000 population for heat-related illnesses (Table 3.1). In the month of August, average temperatures for central Alberta ranged from 21 to 23°C (Government of Alberta n.d. h). These relatively high temperatures, along with occupational risk, such as the greater prevalence of farmers in this region, may account for the heat-related illness in Central Alberta.

Southern Alberta has the highest rate of heat-related illness in the province at a rate of 16.95 per 100,000 population (Table 3.1). This may be due to the high temperatures that range from 24-27°C in the month of August in this region (Government of Alberta n.d. h).

As seen in Maps 3.2 and 3.3, the male population of the BRW exhibit a higher rate of excessive heat-weather injuries compared to the female population. The male rate falls mostly in the 14-16 per 100,000 population range, while the female prevalence rate falls in the 6-8 per 100,000 range. The Alberta average for the prevalence rate of excessive heat-weather injuries for the male population is 11.6 per 100,000 population, and 7.4 per 100,000 population for the female population. In 2019, the prevalence rate of heat-related illnesses in the Central Zone of Alberta for males was 15.33 per 100,000 and 7.16 per 100,000 for females (Map 3.3; Map 3.2).

More generally, males have greater incidence of heat stroke and heat-illnesses than women (Alele et al. 2020, 4; Gifford et al. 2019, 26). Globally, temperature and heat-related injuries including heat stroke has been rising in both males and females (Alele et al. 2020, 4; Gifford et al. 2019, 30). There are many risk factors for the higher incidence of heat-related injury. Risk factors may include occupational heat stress, and studies on athletes also found that heat-injury and dehydration is more common in the male population (Gifford et al. 2019, 30).

Excessive Heat-weather Injuries by Health Zone (2019)

Health Zone	Population	Prevalence Rate
South	308,811	16.95
Calgary	1,684,975	4.17
Central	475,522	11.14
Edmonton	1,421,740	3.19
North	480,106	11.98

Table 3.1: Excessive heat-weather injuries (age-standardized # of emergency department visits per 100,000 population) by health zone in 2019 (Source: Alberta Health, 2019).

Risk Factors for Heat-Related Illness

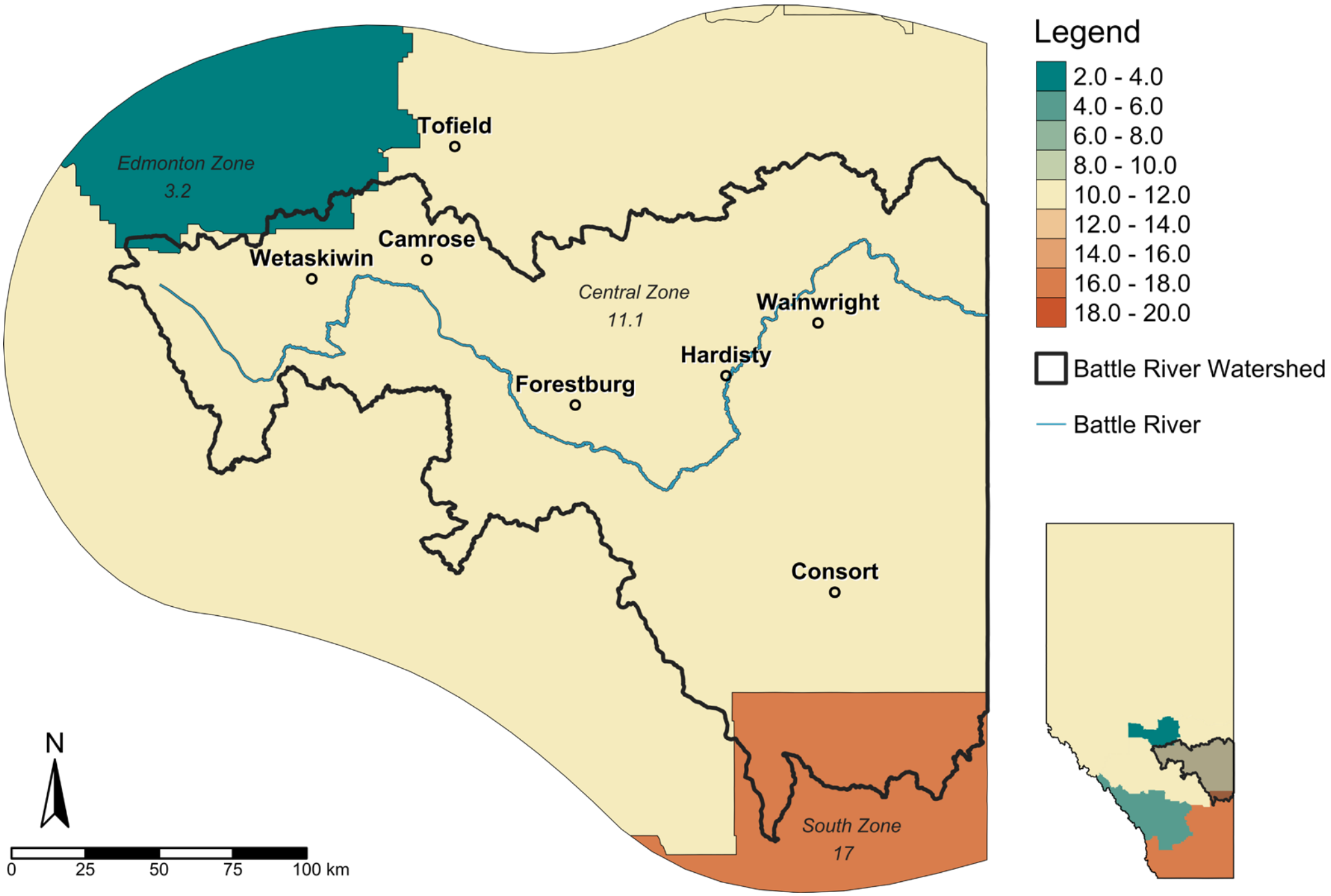
Heat-related illnesses can strike anyone, but certain populations are at greater risk. These include infants and young children, older adults, people with chronic illnesses such as diabetes, lung disease, and heart failure, and workers in certain industries including outdoor work and work in confined spaces (Groot, Abelsohn, and Moore 2014, 729; Healthwise and Alberta Health Services 2022). These demographic factors are complicated by racial and socioeconomic factors.

Geographic Location

People living in urban areas are more at risk from the effects of heat waves "because heat is trapped by tall buildings and air pollutants, especially if there is a high level of humidity" (Healthwise and Alberta Health Services 2022). Other risks in urban areas include lack of vegetation to mitigate heat (Qiu et al. 2013). However, rural areas face their own challenges in coping with heat-related illness, including a high prevalence of outdoor agricultural work and industrial work, and work in confined spaces that require proper ventilation including in greenhouses, agricultural

Excessive Heat-weather Injuries (2019), Males and Females

of emergency department visits per 100,000 population (age-standardized)



Map 3.1: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Injury).

processing plants, and on industrial job-sites (Adam-Poupart et al. 2014; Fortune et al. 2013).

Industrial and Environmental Risks

Industrial and environmental events such as forest fires create seasonal and periodic air quality issues, including elevated levels of particulate matter and other forms of air pollution. Air pollution can exacerbate the effects of extreme heat days by trapping additional heat – although this association is complex and requires further study (Buckley et al. 2014) – and further endangering the health of people with chronic conditions, such as lung disease, which compromise the body's ability to manage heat (Andersen et al. 2011; Hajat, O'Connor, and Kosatsky 2010, 856-857).

In industries such as the agricultural industry, adequate labour protection regulation is especially necessary to protect the rights and health of temporary foreign workers (Spector, Krenz, and Blank 2015; Laate and Dr. Mirza Consultants Inc. 2020, 92).

Social Determinants of Health

Heat-related illnesses intersect with other SDOH, including age, chronic illness, racialization, and SES (Gronlund 2014; Bassil et al. 2009, 605). There is some evidence that extreme heat events also pose a particular danger to people experiencing mental illness (Schmeltz and Gamble 2017, 2). With inadequate mental health and addictions services in rural regions (Rural Health Services Review Committee 2015, 10-11), heat-related illnesses that are co-linked with mental health factors will prove more complicated to treat. Some recommended interventions for heat-related illness pose hurdles for people living in poverty as these recommendations involve purchasing and using air-conditioning units (Hajat, O'Connor, and Kosatsky 2010, 858), and/or having access to adequate shelter (Bassil et al. 2009, 605). For unhoused people, access to adequate shelter is often not an option, particularly in rural areas with inadequate infrastructure to address homelessness (Waegemakers-Schiff and Turner 2014, 57).

Heat-weather Injuries in the Central Health Zone (2010-2019)

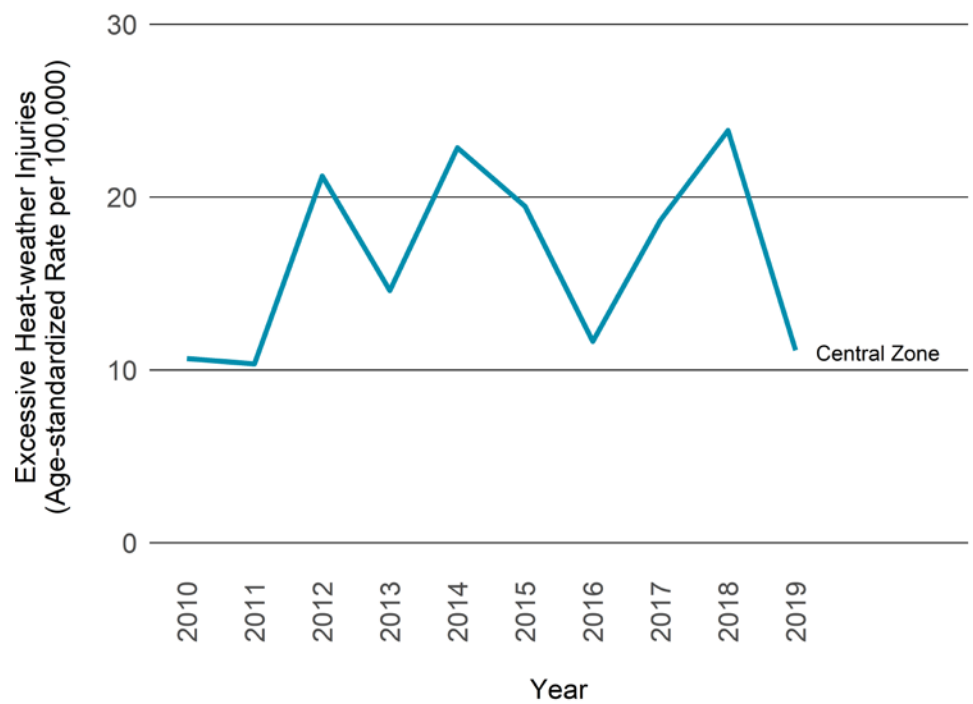


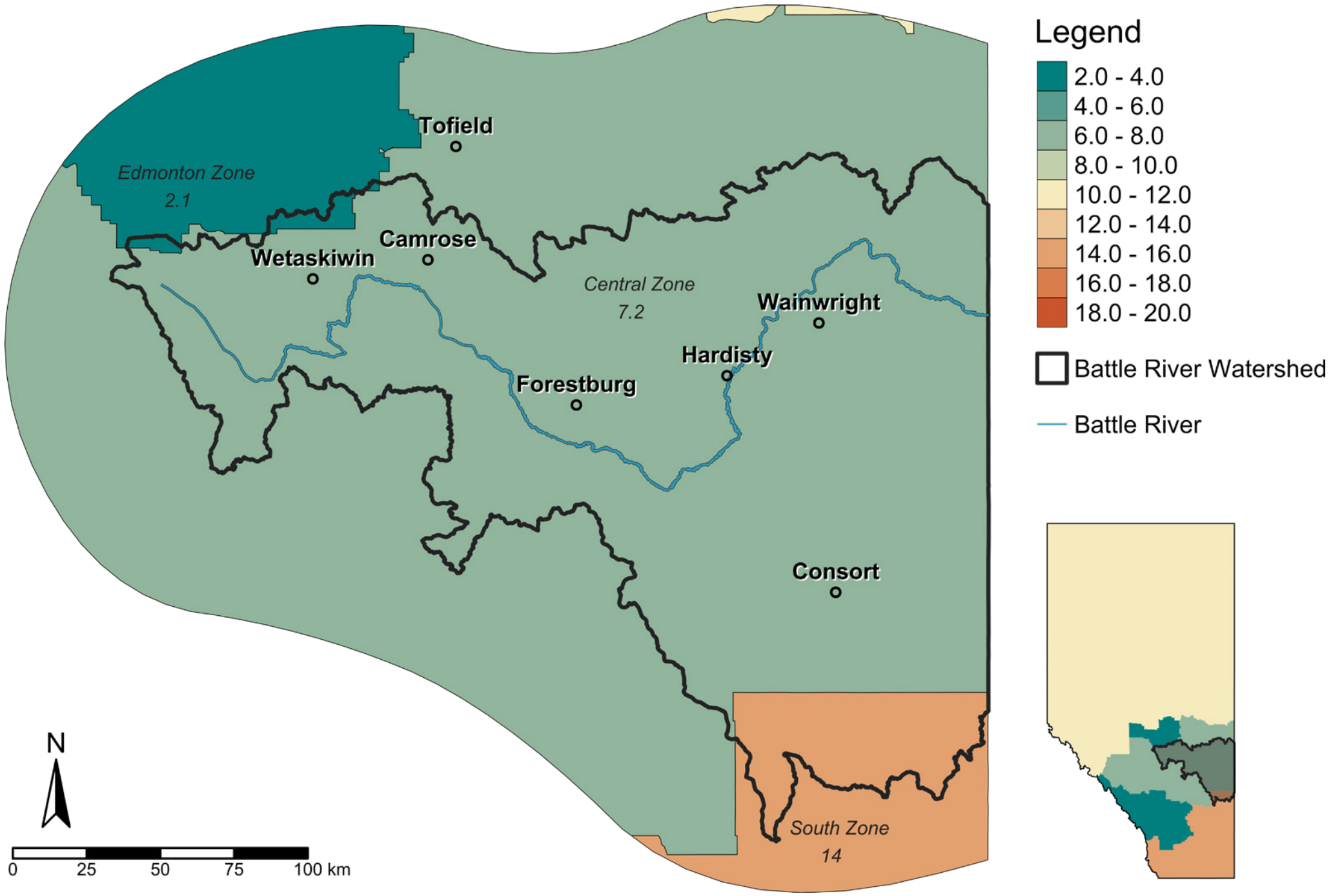
Figure 3.1: Excessive heat-weather injury rate (age-standardized rate per 100,000 population) within the Central Health Zone (which includes the BRW) from 2010 to 2019 (Source: Alberta Health, 2019).

Climate Change

As a northern country, Canada is expected to experience temperature increases due to climate change (Martin et al. 2012, 605). While Canadians are at greater risk of suffering cold-related mortality and morbidity, "projected increased temperatures are sufficient to change the relative levels of heat- and cold-related mortality in some cities" (Martin et al. 2012, 605). Capacity to generate and interpret local data will be an important tool for planning and responding to the health-related effects of climate change. For rural areas,

Excessive Heat-weather Injuries (2019), Females

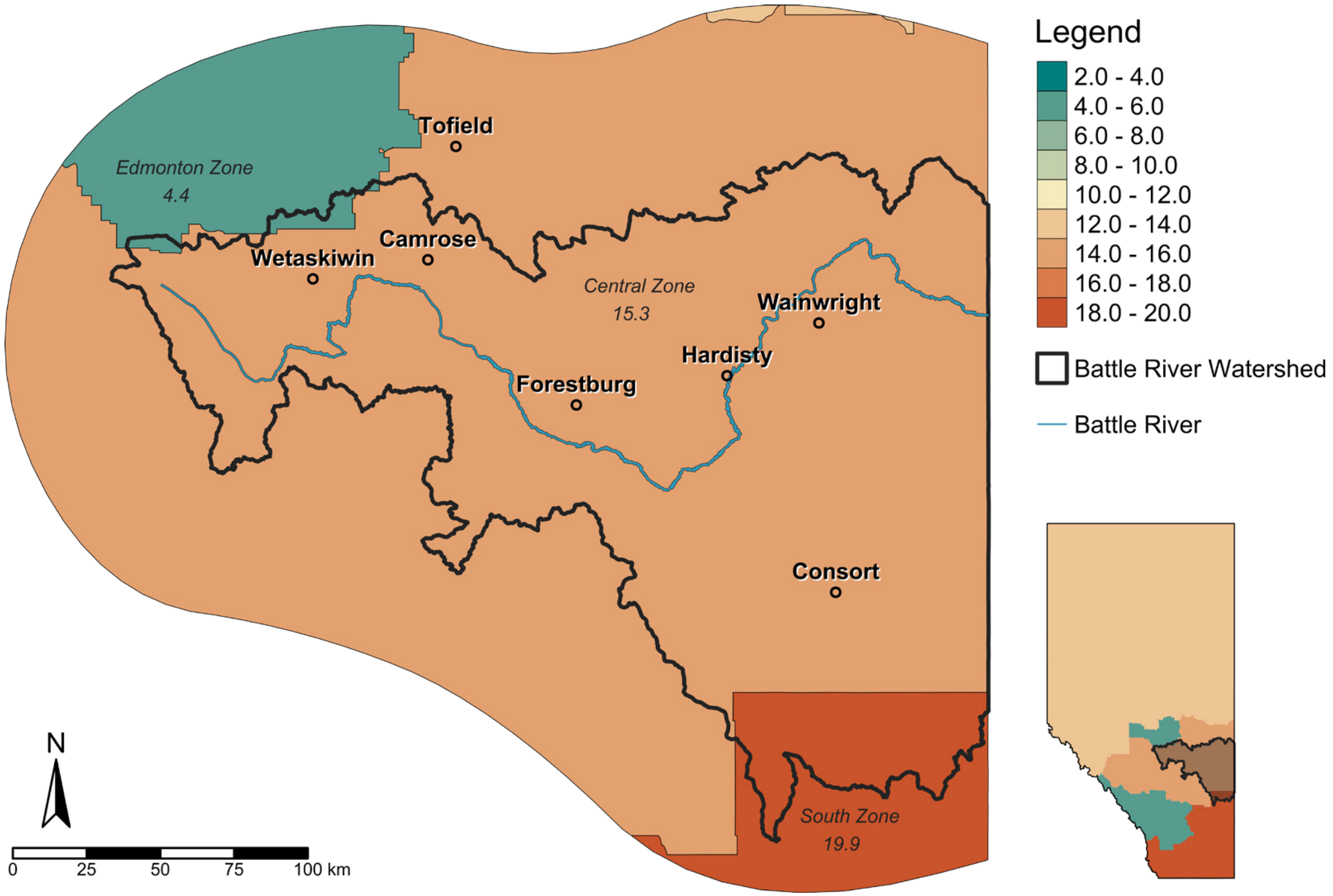
of emergency department visits per 100,000 population (age-standardized)



Map 3.2: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Injury).

Excessive Heat-weather Injuries (2019), Males

of emergency department visits per 100,000 population (age-standardized)



Map 3.3: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Injury).

this may mean specific interventions, starting with improved monitoring of the prevalence of both heat-and cold-related illness.

Gap in Rural Research

It is important to note that the majority of studies researching the effects of heat waves and the prevalence of heat-related illness, in Canada and internationally, locate their research in urban areas (Hondula, Georgescu, and Balling Jr. 2014; Dolney and Sheridan 2006; Martin et al. 2012; Smoyer-Tomic and Rainham 2001; Rainham and Smoyer-Tomic 2003; Alberini, Gans, and Alhassan 2011). Among other factors, higher concentrations of vulnerable populations and the urban heat island (UHI) effect (Sánchez, Peiró, and Neila 2017, 3-4), mean that so far, urban municipalities have been the more obvious sites for research (Dolney and Sheridan 2006, 94-95).

Very little research speaks directly to health concerns related to climate change in rural areas. This presents clear challenges for understanding and managing heat-related illness in rural areas, particularly since rural communities face their own complex risks in relation to heat-related illness. These risks include: inadequate access to emergency and specialized medical care, high prevalence of outdoor and manual labour, and demographic and socioeconomic considerations, including risks related to age, racialized factors, and poverty (Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch 2011, 15-16; Gronlund 2014, 3-5).

To better understand, predict, and plan for the expected increase and frequency of extreme heat days in the BRW, there is a clear need for climate change research that centres around rural areas. Other areas of research and policy development might include a watershed-level response plan, along the lines of those being implemented in urban municipalities (Smoyer-Tomic and Rainham 2001, 1241; Alberini, Gans, and Alhassan 2011, 4683-4684), but tailored to the needs and specific conditions of rural regions.

Asthma and Allergies

While most allergens, such as pet hair, select foods, and latex are present year-round, allergens such as pollen see seasonal spikes. Pollen can be measured using pollen counts, and these numbers can be used as predictors for how severely affected pollen allergy sufferers will be in a given year, season, or month (Schmidt 2016). Temperature can also affect the pulmonary system of people who live with allergies and asthma: extremes in temperature and humidity as well as rain and thunderstorms can aggravate bronchial tubes, causing constriction and shortness of breath (Asthma and Allergy Foundation of America n.d.). Suffering from asthma and allergies can correlate with a moderate to severe, albeit temporary, decline in quality of life that may be felt elsewhere in the community.

In a particularly bad pollen season, or in communities with high rates of asthma and allergies, people may suffer from attendant mental health challenges including depression and anxiety, and may be physically uncomfortable enough to have to miss work or restrict their activities (Guzman et al. 2007; Dave et al. 2011).

Similar to heat-related illness, this indicator of community health will likely see seasonal fluctuations. While asthma is a condition requiring lifelong management, seasonal allergies tend to affect quality of life only temporarily. Seasonal allergy is likely to be a viable indicator of community health only during particular periods of the year, while asthma prevalence is likely to tell us something about community health year-round. Over a lifetime, both allergies and asthma can significantly affect an individual's quality of life, and changing rates of allergies and/or asthma in a community can be a valuable indicator of broader environmental trends, such as air quality and vegetation species composition (Baldacci et al. 2015, 1092; Jiang, Mei, and Feng 2016; Simard and Benoit 2010, 550).

Wetaskiwin County remains the region with the highest prevalence rate of asthma in the BRW, with the female population having a slightly higher rate at 18.1% compared to 16.5% of males having asthma in this region (Map 3.5; Map 3.6). In the Central Zone of Alberta, the asthma prevalence rate of the female population is 12.69% while the asthma prevalence rate of the male population is 12.08% (Map 3.5; Map 3.6). The Alberta average for the female population is only slightly higher at 12.7% compared to 11.9% of the male population (Map 3.5; Map 3.6).

Understanding Asthma and Allergies

Asthma

According to Alberta Health Services "asthma is the most common chronic disease of childhood and the leading cause of hospitalization in children" (Alberta Health Services n.d.). The prevalence of asthma in Alberta is approximately 12% when all ages are considered (Alberta Health Services n.d.). Asthma is a disease most often characterized by chronic airway inflammation. The symptoms of asthma may change over time, but rarely do patients become permanently symptom free, so asthma often does require lifelong management. About 50% of people diagnosed with asthma have subpar disease control. This often leads to a worsened quality of life and an increased susceptibility to lung disease as time passes. "The Conference Board of Canada report on Chronic Lung Disease estimated that by 2020, 3.5 million Canadians will have asthma with total annual costs approaching $3.1 billion"(Alberta Health Services n.d.).

Asthma onset is most likely to occur in childhood, but adults can also develop the disease (Subbarao, Mandhane, and Sears 2009). The causes of asthma are complex, but evidence exists that prenatal and early exposure to traffic pollution (McConnell et al. 2010, 1021) and tobacco smoke are two generally accepted triggers (Chan-Yeung et al. 2005, 52; Becker et al. 2004, 650), while being breastfed as an infant has protective effects (Chan-Yeung et al. 2005, 54; Becker et al. 2004, 654-655).

Asthma Prevalence by Health Zone (2019)

Geographical Area	Asthma Prevalence (%)
South	13.09
Calgary	12.49
Central	12.42
Edmonton	12.52
North	10.55
Alberta	12.30

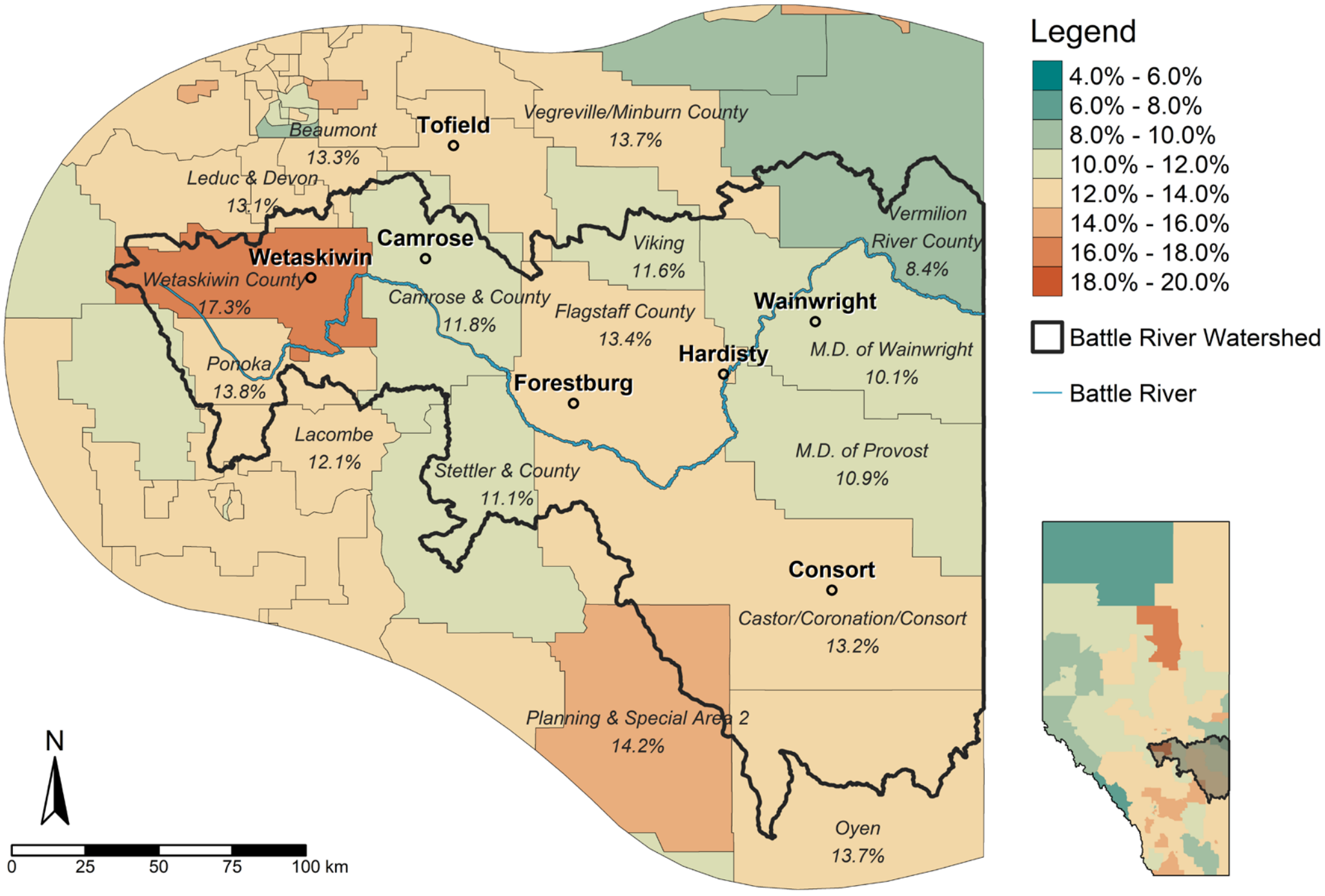
Table 3.2: Asthma Prevalence (age-standardized % of the population with condition) by health zone in 2019 (Source: Alberta Health, 2019).

While asthma has both a genetic and an environmental component, a number of environmental factors influence the likelihood of developing asthma. Factors which decrease likelihood are early infections, daycare attendance, and living in a rural area (Midodzi et al. 2010, 7), although data supporting the protective factor of rural location is contested (Vlaski and Lawson 2015, 131; Lawson et al. 2017, 1).

Once an individual has developed asthma, they will likely be sensitive to outdoor and indoor environmental triggers, including aeroallergens such as mold, weed, tree, and grass pollen, and air pollution (Dales et al. 2004, 303). Chu et al. (2014, 430) find that some rural activities, such as living with livestock, seem to offer a protective effect against asthma, while other regular farming activities seem to increase the prevalence of hay fever. The link between asthma and air pollution, specifically from traffic, might account for some of the difference in prevalence between rural and urban areas, but air quality itself is something that varies between rural areas, depending on economy/industry, land-use, and other environmental factors (Sears 2014, 219).

Asthma Prevalence (2019), Males and Females

% of population with condition (age-standardized)



Map 3.4: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Asthma).

Allergies

Seasonal allergies and asthma have some common triggers and are both likely to result from a combination of environmental and genetic factors. Unlike food allergies, which can present a real risk of fatality and serious health complications for affected individuals, seasonal allergies are a fairly common health issue. They affect people across Canada (and globally), and for most people are a nuisance, rather than a serious condition.

There are limited preventative treatments available, and most are behavioural. For example, limiting time outdoors and/or limiting potentially aggravating activities such as mowing lawns. Active treatment for the most part involves symptom management and mitigation by the individual, including reducing allergens in the home, wearing a mask, rinsing the sinuses, and using over-the-counter allergy medication (Asthma and Allergy Foundation of America 2015; Bergmann et al. 2021, 176; Hermelingmeier et al. 2012, e119; Healthwise Staff 2021c).

Seasonal allergies also offer information about climate patterns and vegetation. Progressively earlier or later onset of allergies might indicate variability and long-term trends in the onset of spring and summer in relation to the calendar year. Seasonal allergies are also related to vegetation as some plants (particularly trees, grasses, and plants in the Asteraceae family such as ragweed) provoke allergies much more strongly than others (Sierra-Heredia et al. 2018, 2). Studying changes in the pollen season has the potential to tell us what we might expect in terms of changes in the prevalence of seasonal allergies (Ziska et al. 2011; Ziska et al. 2019; Reid and Gamble 2009).

Walton (1959) identifies three major allergenic triggers: tree, grass, and weed pollen. Deciduous tree pollen is the first seasonal irritant, followed by grasses, then weeds (Walton 1959). A more recent study shows weed pollen (specifically ragweed) to be an allergenic irritant through the summer and into September (Simard and Benoit 2010, 549).

Walton (1959) points to urbanization and industrialization as a major driver of both tree and weed pollen intensity, noting that many street trees intentionally planted in urban areas can be allergenic, and that weed growth tends to follow land disturbance and the movement of people and goods associated with urbanization and industrialization. Agriculture also tends to create conditions favourable to weed growth. Simard and Benoit (2010, 549) show, however, that different crops and different cultivation methods have different effects on the presence and abundance of common ragweed. Weeds and strategies for weed control are thus linked both to agricultural productivity and to public health (Simard and Benoit 2010; Walton 1959).

Risk Factors for Asthma and Allergies

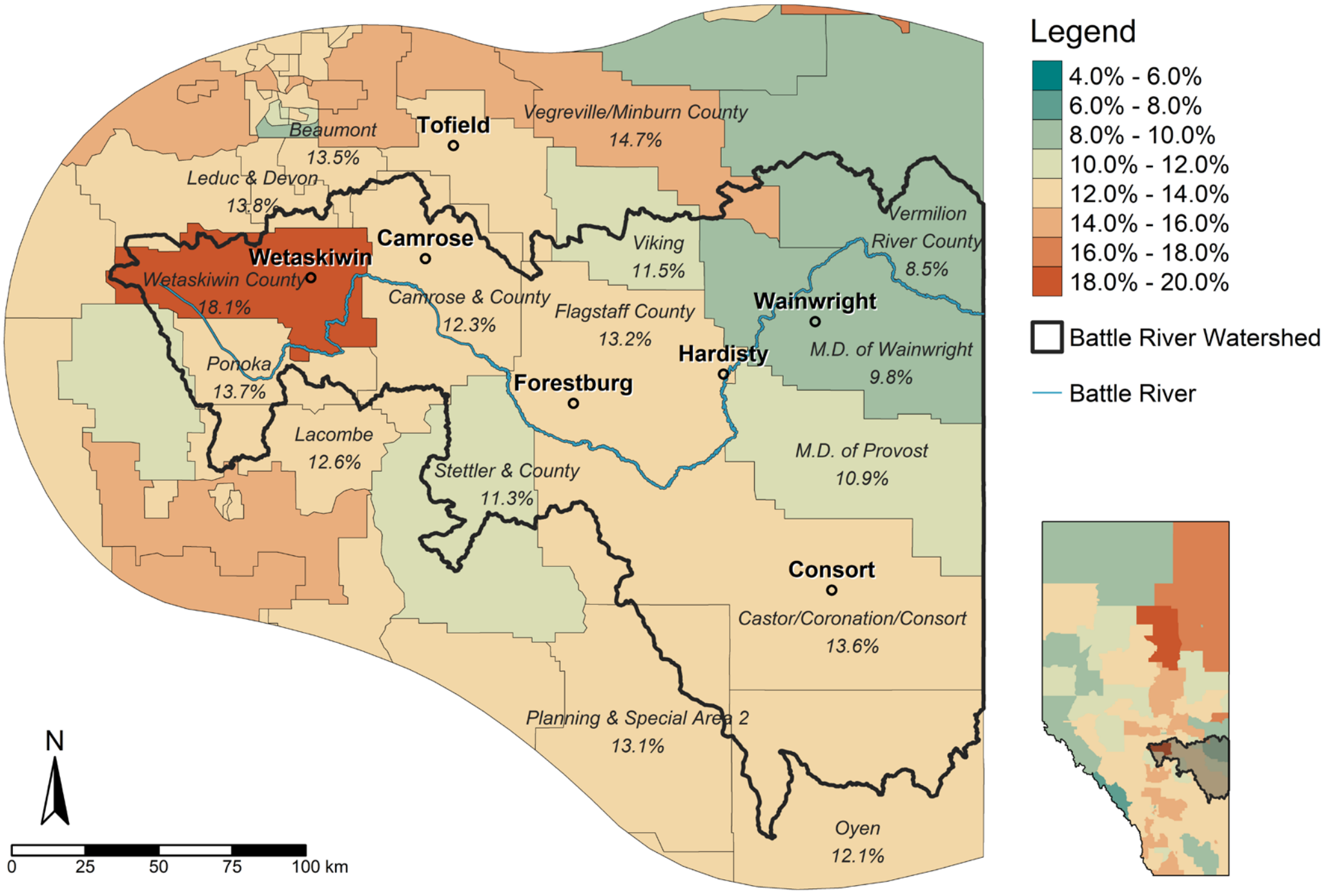
The causes of both asthma and allergies are complex and not well-understood (Subbarao, Mandhane, and Sears 2009, E181). Some research purports that asthma and allergy rates seem to be levelling off globally (Sears 2014, 219), while other research finds rates of asthma and allergies have reached the level of a worldwide public health concern (Sierra-Heredia et al. 2018, 1).

Asthma is also an illness that is linked to socio-economic factors, including exposure to environmental triggers such as industrial or traffic pollution (Bacon et al. 2009) and/or a lack of access to adequate medical care (Valet, Perry, and Hartert 2009). Several studies focus on the prevalence of asthma in Indigenous communities and among Indigenous peoples, and indicate a lower prevalence of asthma among Indigenous children living on-reserve and/or in rural areas and small towns than in the general Canadian population (Chang, Beach, and Senthilselvan 2012, e68; Gao et al. 2008, 139; Crighton, Wilson, and Senécal 2010, 147; Ye, Mandhane, and Senthilselvan 2012, 361).

Living in an urban area raises the prevalence of asthma among Indigenous peoples (Chang, Beach, and Senthilselvan 2012, e69-e71). It is possible the apparent difference in prevalence may be related to under-diagnosis in rural and remote areas, but further research is required to understand the exact causes of the difference. Gender is another complicating factor, since asthma tends to affect more boys than girls before puberty, and more women than men in adulthood (Postma 2007, S133).

Asthma Prevalence (2019), Females

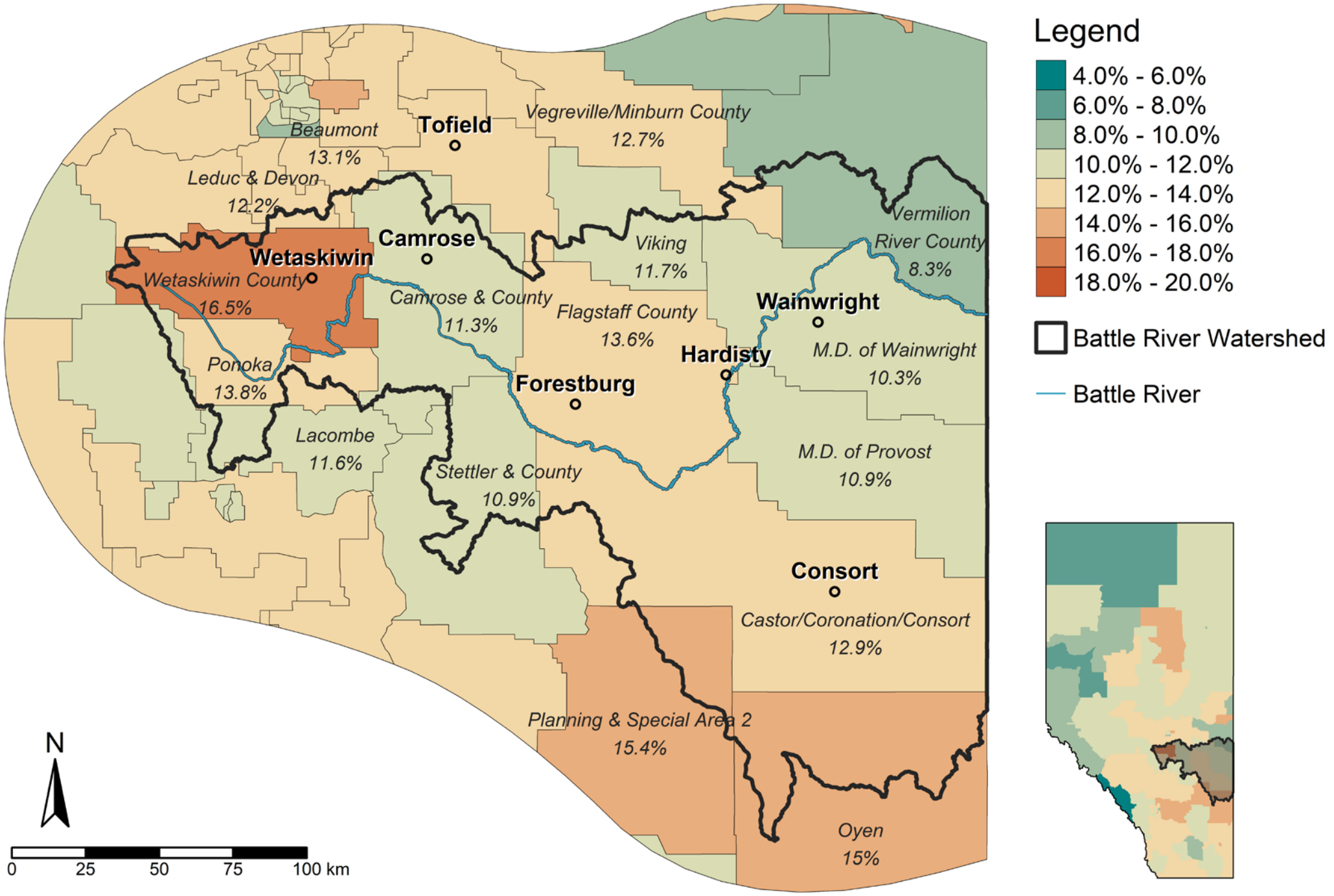
% of population with condition (age-standardized)



Map 3.5: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Asthma).

Asthma Prevalence (2019), Males

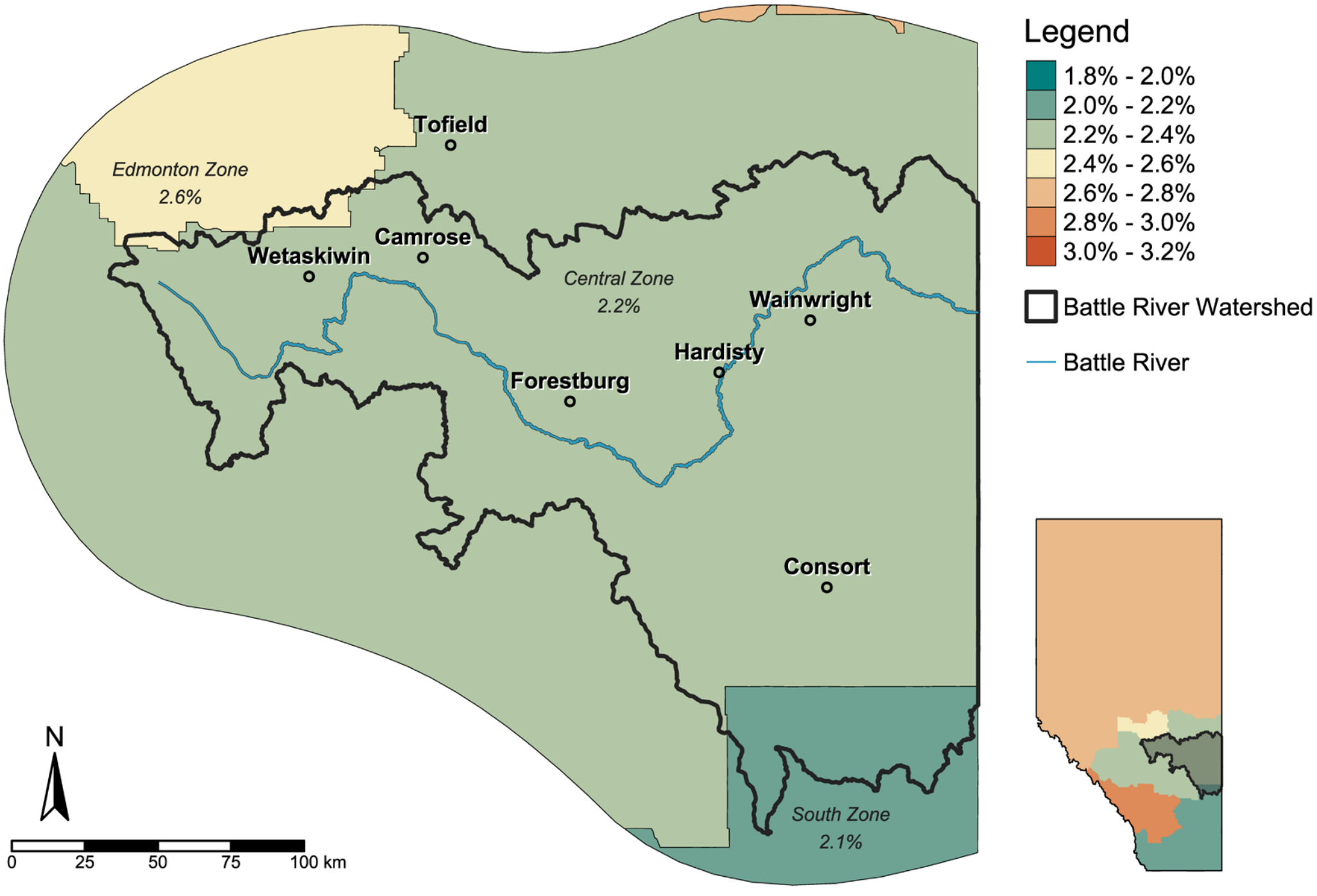
% of population with condition (age-standardized)



Map 3.6: (Source: Alberta Health, Analytics and Performance Reporting Branch. 2019. Interactive Health Data Application: Asthma).

Allergies and Recurrent Sinusitis (2017), Male and Female

% of population diagnosed with condition (age/sex-standardized)



Map 3.7: (Source: Alberta Health Services, Analytics. 2017. Diagnosis Prevalence by Age, Sex, Zone).

Climate Change

Linking the prevalence of asthma and seasonal allergies directly to climate change is not straightforward. Particularly in the case of asthma, genetic factors, environmental factors, and socioeconomic factors not linked to climate play a significant role in whether or not an individual will develop asthma. Once an individual has developed asthma, however, environmental conditions can trigger an asthmatic event. Many of these environmental triggering conditions are shared with seasonal allergies, and there is some evidence that plant life cycles are changing in response to climate change (Demain 2018, 2).

Ziska et al. (2011) find that at multiple testing sites globally, ongoing temperature increases (of both maximum and minimum temperatures) are linked to increasing atmospheric pollen loads and to the longer duration of the pollen season. Schmidt (2016, A71), Reid and Gamble (2009, 460) suggest that increased carbon dioxide (CO_2) concentrations are stimulating plant growth, also triggering an intensification and longer duration of pollen production. Demain (2018, 2-3) sets these findings among other potential effects of climate change, noting the likelihood of increasing precipitation, having an increased effect on mold growth in buildings, increasing thunderstorms and ground level ozone interacting with pollen to create lung irritation, and fine particulate matter from forest fires exacerbating respiratory disease.

Asthma and seasonal allergies are illnesses that demonstrate the complex linkages between individual, biology, socioeconomic factors, and environment. It is likely that environmental changes linked to climate change, including increased storms and precipitation, milder winters, more forest fires, and changes in the plant community or pollen season will affect the prevalence and severity of these inflammatory illnesses in the BRW and in rural regions more generally. However, they are also illnesses that can respond to public health interventions, including campaigns to reduce tobacco usage, promotion of breastfeeding, strong support for childcare, and improved access to healthcare. The intriguing possibility of a protective effect of living in a rural area itself deserves more attention (Genuneit 2012).

Policy Responses for Climate Related Health Impacts

Measuring climate-related health impacts gives us insight into the effectiveness of public health and safety systems at identifying, addressing, and/or preparing for the threats that changing weather might bring (United States Environmental Protection Agency 2017). Measuring the health effects of climate change provides necessary evidence for local, national and international public health planning (World Health Organization 2018). Tracking health information over time can help policy makers to understand the effectiveness of their interventions and revise policies and guidance where necessary. Having access to data about climate-related health impacts allows local, provincial and national policymakers to see what kinds of actions have been effective in reducing adverse health effects resulting from extreme weather and climate change, and will help to inform effective planning and implementation across multiple jurisdictional scales (World Health Organization 2018).

How have governments responded?

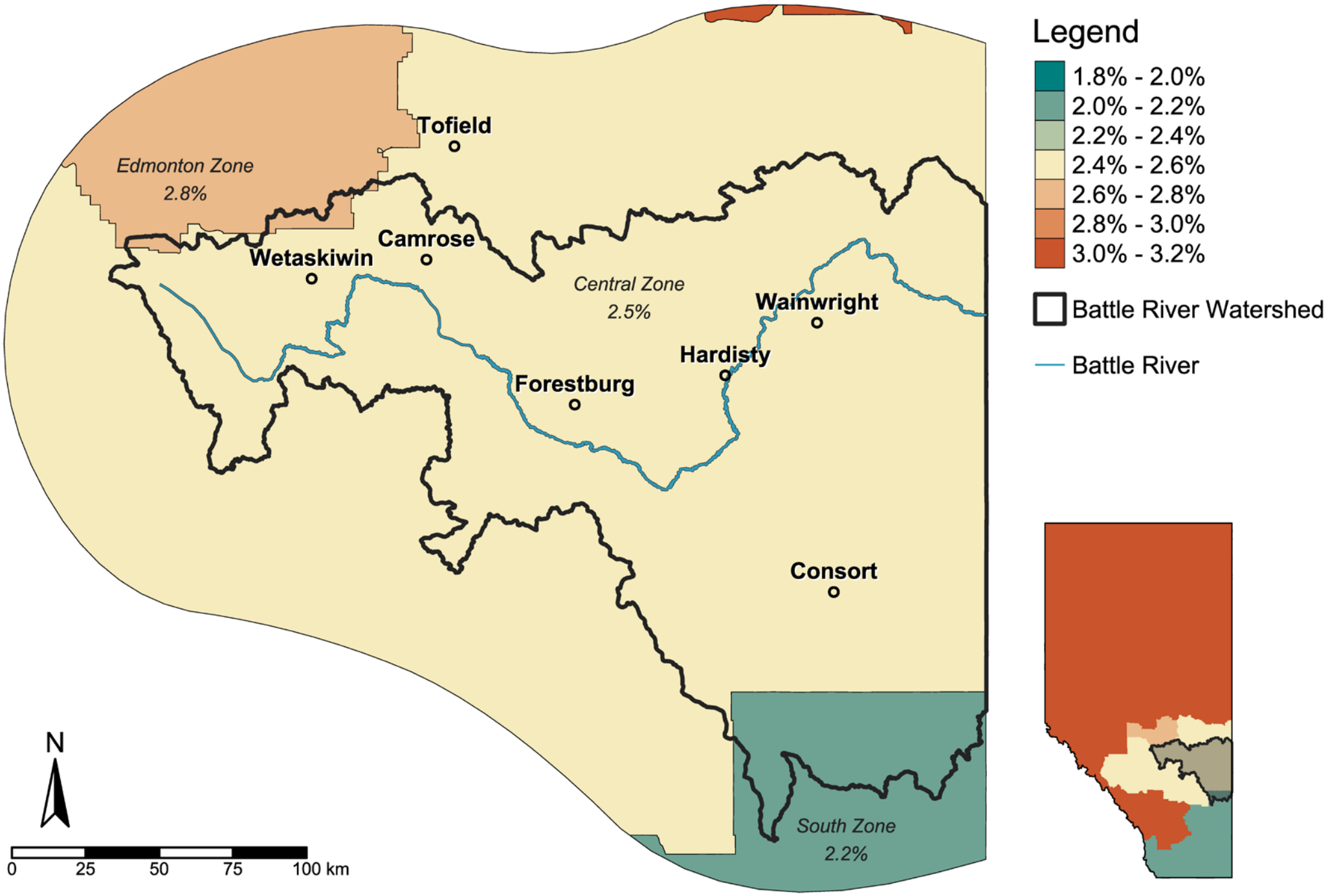
Heat-related illnesses and asthma in Alberta is mostly confined to the province's healthcare system. There are examples from other jurisdictions in Canada, and at the federal level, that show policy around heat-related illness and asthma can be part of broader systemic interventions into public health and safety.

For example, the Canada OHS Regulations contain specific provisions for temperature, working conditions, and for indoor air quality (Government of Canada 2022b). For many other important issues discussed in this Atlas, including climate change, personal wellbeing, chronic illness, and mental health, the Alberta Government releases strategic plans and frameworks to address and improve health outcomes. However, there is as of yet no strategic plan to address climate-related health impacts at the provincial level, including no plan for community actions or education campaigns.

The Alberta Government has published a manual of best practices for working in heat and cold. The manual defines and describes heat stroke and details actions a worker or employer can take to prevent heat stroke in

Allergies and Recurrent Sinusitis (2017), Female

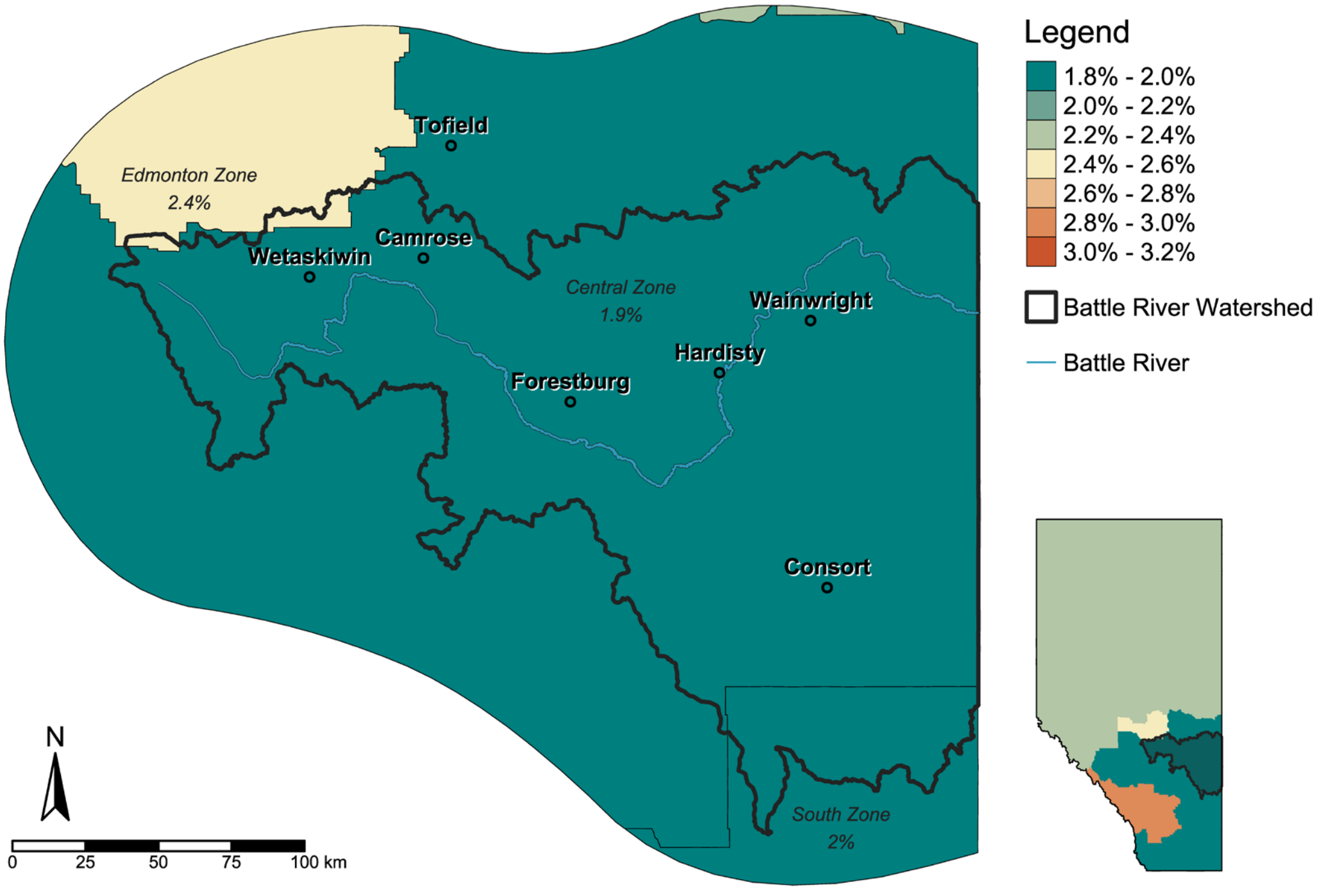
% of population diagnosed with condition (age/sex-standardized)



Map 3.8: (Source: Alberta Health Services, Analytics. 2017. Diagnosis Prevalence by Age, Sex, Zone).

Allergies and Recurrent Sinusitis (2017), Male

% of population diagnosed with condition (age/sex-standardized)



Map 3.9: (Source: Alberta Health Services, Analytics. 2017. Diagnosis Prevalence by Age, Sex, Zone).

situations where there is a heat-related risk (Government of Alberta 2014). Because this guideline has no power to compel action, and because there is no provincial legislative strategy around heat-related illness, the onus for preventing and/or dealing with heat stroke falls on the individual in Alberta. As we will see, a similar situation is apparent in the province's approach to asthma.

If an individual contracts asthma, that illness must be dealt with through the primary health care system, which focuses on treating patients as isolated individuals, and which treats health issues without also treating their social aspects. Under the current policy model, climate-related illnesses are treated as individual pathologies, to be addressed within the health care system (Clark 2012). This places the majority of the burden for illness-management onto the individual after a diagnosis, and results in limited opportunities for communities and healthcare systems to implement policies and programs that might reduce the incidence of illness.

If the community were to play a more active role in preventative education and practices, this might free up time and resources within the healthcare system for activities such as fostering healthy self-management and providing services more supportive of individuals managing their illness (Clark 2012, 195-196). Examples of this approach might be to involve local schools in planning to control or minimize asthma or engaging the community in asthma education. However, a systematic review of community-level health interventions suggests that more and better studies are needed in order to understand the mechanisms of health-supporting behaviour change in community settings (Anderson et al. 2015).

What is being done?

Heat-Related Illnesses

The National Joint Council (Public Service Canada) document, Occupational Health and Safety Directive (2022), states that the ideal workplace temperature range for workers is between 20-26°C. The document also states that temperatures between 17°C and 20°C and above 26°C can be uncomfortable for workers, and working either at low or high extremes should not exceed 3 hours daily or 60 hours annually (National Joint Council 2022). All provinces and territories in Canada, except Alberta, have OHS regulations which address temperature, but Alberta and Prince Edward Island (P.E.I.) addresses temperature safety in the workplace only through non-binding guidelines (Canadian Centre for Occupational Health and Safety 2022).

Public Service Canada's OHS Act states in section 3(1) that "every employer shall ensure, as far as it is reasonably practicable for the employer to do so, the health and safety and welfare of workers engaged in the work of that employer" (Government of Alberta 2022c, 12). The Act also applies to workers currently at the worksite but are not participating in the employer's work, and other people that are at or near the worksite who may be impacted by the worksite hazards (Government of Alberta 2022c, 12).

In 2011, the federal government published a toolkit for public health and emergency management officials that communicates the health risks of extreme heat events (Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch 2011). This toolkit is designed to guide the development of targeted heat-health communications campaigns and necessary outreach products for specific audiences. The toolkit provides an overview of extreme heat events and the potential health risks to all Canadians, especially those most vulnerable to heat-health impacts (Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch 2011). The toolkit also guides communication concerning heat-health risks and strategies, including scientifically sound health messages to support the development of effective communication campaigns, guidance to help develop community-specific and tailored heat-health communication campaigns, and template materials for public health and emergency management officials, including fact sheets, a media release, and checklists (Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch 2011).

In 2014, the Government of Alberta published a document entitled Best Practice – Working Safely in the Heat and Cold. This resource is targeted at individuals who primarily work

outdoors, but can also be of benefit to enclosed workplaces. Working Safely in the Heat and Cold is designed to help individuals understand how their body operates in both hot and cold climates, understanding when it is too hot or cold, recognizing the health risks that exist when working in the hot and cold, knowing how to take basic temperature measurements or understanding weather information, and knowing how to properly control exposure hazards (Government of Alberta 2014, 3). This report stresses the importance of preventative measures, as heat stroke victims often die before contact is made with a healthcare worker (Government of Alberta 2014, 28). However, because this document is aimed at workers, not healthcare professionals or data specialists, it is unclear if it has had any effect on worker behaviour and workplace conditions, in terms of heat-related incidents requiring medical intervention.

Asthma and Allergies

With limited exceptions, no provincial acts or regulations deal directly with proactively reducing the prevalence of asthma and/or allergies. The one exception to this situation is the Protection of Students With Life-Threatening Allergies Act, which came into effect on January 1, 2020, and establishes requirements for school boards to develop policies that make schools safer for students with life-threatening allergies (Government of Alberta 2020e). Indirectly, the air quality acts and regulations and the carbon equivalent emission reductions regulations discussed later in this chapter are intended to reduce the severity and occurrence of allergies that Albertans and Canadians have.

Alberta's Environmental Public Health Indoor Air Quality Manual guides Alberta Environmental Public Health professionals in their investigation and management of indoor air quality, and specifies methodologies and approaches useful in problem identification, risk intervention, and harm reduction (Indoor Air Quality Manual Working Group and Alberta Health Services 2012). The manual also provides practitioners with toxicological, risk assessment, and risk management principles, indicating the specific factors affecting indoor air quality for Albertans (Indoor Air Quality Manual Working Group and Alberta Health Services 2012).

The Alberta Government also offers a number of asthma and allergy management resources for patients of all ages. One of these tools is the web-based information resource called the Asthma Action Plan, which walks individuals through daily asthma management (Alberta Health Services and Healthwise 2022). In 2010, the Government of Alberta worked with Anaphylaxis Canada to create an online training tool to help students with allergies. This tool gives teachers and administrators quick access to important and easy-to-understand information for keeping students with allergies safe (Government of Alberta 2010).

A number of non-profits and non-governmental organizations also provide support to asthma and allergy sufferers in Alberta and across the country. The international Asthma & Allergy Friendly Certification Program helps consumers to avoid potentially allergenic products through their labelling initiative (Asthma Society of Canada n.d.). While this program is not a government initiative, it is administered in Canada through a partnership between the non-profit Asthma Canada and Allergy Standards Limited (Asthma Society of Canada n.d.). Asthma Canada provides resources, support, and a political voice for asthma patients across the country. Their activities include advocacy for clean air and energy, choice and access to treatments, and access to medicines in schools. They also offer education on asthma self-management and prevention through effective handling of symptoms.

Opportunities for intersectoral action

One place where we might look to measure intersectoral action is in emerging regulation around air pollution and GHG emissions. In 2015, Environment Canada began to phase in new emissions and fuel standards, drawing from standards set by the U.S. Environmental Protection Agency (Government of Canada 2015). These standards apply to new passenger cars, light trucks, and some industrial vehicles from model years 2017-2025. They also lower the sulfur content of gasoline.

The Alberta Government also maintains the Renewable Fuels Standard (RFS) Regulation, updated as of January 1, 2020, which requires that fuel suppliers sell gasoline containing a minimum annual average of 5% renewable

alcohol, and diesel with a with a minimum of 2% renewable diesel (Government of Alberta 2020e, 6).

What could be done?

Every year, communities around the world face the challenges of extreme weather. In Alberta, summer forest fires create economic damage, release large amounts of carbon back into the atmosphere, and significantly reduce air quality across the province (University of British Columbia n.d.). Fires and other extreme hot weather events cause increases in heat-related illnesses and asthma prevalence (Rossiello and Szema 2019). Provincial and federal government initiatives and regulations that support clean air and energy may help to address some of the root causes of weather and climate related illnesses.

The Government of Alberta has tended to approach weather and climate-related illness through the use of guidelines and campaigns directed toward individuals (Canadian Centre for Occupational Health and Safety 2022). There is an opportunity for the province to address environmental illnesses through effective regulations that target these illnesses as social phenomena, and not just as individual pathology. One example of a preventative, socially-informed policy would be regulation to ensure that all public and private indoor facilities in the province maintain a standard of air quality at or above the Indoor Air Quality Guideline that governs air quality for all occupied Government of Alberta buildings. This would improve indoor air quality for a significant proportion of businesses, workplaces, and public service providers in Alberta (Alberta Infrastructure, Technical Services Branch 2003).

To reduce severe incidences of allergic reaction in children, the Government of Alberta could also develop legislation modelled on the Province of Ontario's Sabrina's Law. Sabrina's Law requires all school boards to have policies and procedures to effectively intervene if a student or other school user experiences an anaphylactic event on school property or at a school event. Plans could include ensuring that teachers and other staff are trained to provide first aid for severe allergic reactions (Government of Ontario 2005).

Providing children and parents with resources for asthma education significantly increased knowledge about the disease in rural families with children suffering from persistent asthma (Butz et al. 2009, 818). Educational interventions for young children were most effective when they are designed as individualized sessions with interactive knowledge tests. Educational sessions for parents and children were also found to increase self-efficacy (*i.e.* personal perception of capability), which has a strong influence on decision-making for self-management as well as the amount of effort and persistence devoted to these behaviours (Butz et al. 2009, 819-820).While such educational programs do incur a cost to the healthcare system, they may also repay their costs by reducing the burden on the healthcare system as patients and their caregivers become more effective at managing asthma without a doctor's intervention (Coffman et al. 2009).

Climate Change and Weather Patterns

Extreme Weather Events

Extreme weather events are a significant element of community health, both in terms of the immediate impact of the event, and because of long-term economic consequences. Flooding can ruin entire crops, while drought can prevent a crop from growing to harvest. Fire can displace people, destroy private property and community infrastructure, and damage forests and animal habitat. Extreme snowfall can disrupt access to a region and challenge supply chains.

These are only a few of the extreme weather events a community can face over the course of a year. Natural disasters, such as flooding and fire, divert community revenue toward repair and reconstruction. People may move away and businesses may close if individuals feel it is too risky to continue living in the community. Personal wellbeing and physical health may decline because of extreme heat and cold, as extreme temperatures mean people choose to stay indoors or commute by vehicle instead of walking or cycling.

Extreme Heat

Extreme heat weather events are classified as days where the temperature is above +30°C. Extreme heat weather events increase the further south-east you go. West of the BRW,

near Wetaskiwin and Camrose, there were 0-5 days of extreme heat weather events from 1981-2010. In the more central areas of the BRW, such as Forestburg and Wainwright, there were 5-10 cases of extreme heat weather events per year. Further south, near Consort, there were 10-15 cases of extreme heat, ultimately reaching to 20-25 cases of extreme heat in the south-east regions of the BRW per year (Map 3.10).

Extreme Cold

Extreme cold weather events are classified as days where the temperature is below -30°C. From 1981-2010, most of the BRW and surrounding regions had 5-10 days of extreme cold weather events per year. There are spots around Wetaskiwin and Wainwright where there have been 10-15 extreme cold weather days per year (Map 3.11).

Understanding Extreme Weather Events

The increase in extreme weather events generally correlates with climate change. In Alberta, extreme weather events include droughts, forest fires, heavy precipitation with associated increased risk of flooding, and individual severe storms (Government of Alberta n.d. d). Alberta's climate has been rising in temperature, with winter temperatures increasing by +0.5-1°C per decade since 1950 (Hayhoe, Stoner, and ATMOS Research & Consulting 2019). A projected weather change for Alberta that would have implications for the agriculture industry is the projection of a two-week lengthening of the frost-free season, a two-four-week increase of the growing season, as well as a 50% increase in the number of rare 'wet days' (Hayhoe, Stoner, and ATMOS Research & Consulting 2019).

Risk Factors of Extreme Weather Events

Economy

Between 1983 and 2008, an average of $100 million a year was lost due to extreme weather (Government of Alberta n.d. d). This amount has increased dramatically since 2009, largely due to the acceleration and intensification of climate change effects. In Alberta, an average of $673 million per year was spent toward insured losses from extreme weather events from 2009 to 2012 (Government of Alberta n.d. d).

Drought is the primary concern within the agricultural industry. In 2001 and 2002, droughts brought devastating impacts to Canada's economy, with Alberta being hit hard (Agriculture and Agri-Food Canada 2016). These included: a $3.6 billion drop in agricultural production, employment loss of over 41,000 jobs, a net farm income of zero in Alberta, crop production losses, and long-lasting impacts including soil and other damage by wind erosion, deterioration of grasslands, and herd reductions (Agriculture and Agri-Food Canada 2016).

Adaptation is a key consideration in the agriculture industry as an essential element in curtailing the consequences of extreme weather events. For example, one strategy of adaptation would be technological developments, such as new crop varieties and resource management innovations (Agriculture and Agri-Food Canada 2004). Some farmers may be more suited to adapt, but this may be more difficult for other farms, perhaps due to economic reasons or lack of resources. Ultimately, not every single farm can withstand the consequences of extreme weather events and many farmers have lost their jobs and a major part of their livelihoods due to the ongoing impacts of climate change.

Plant Hardiness Zone Changes

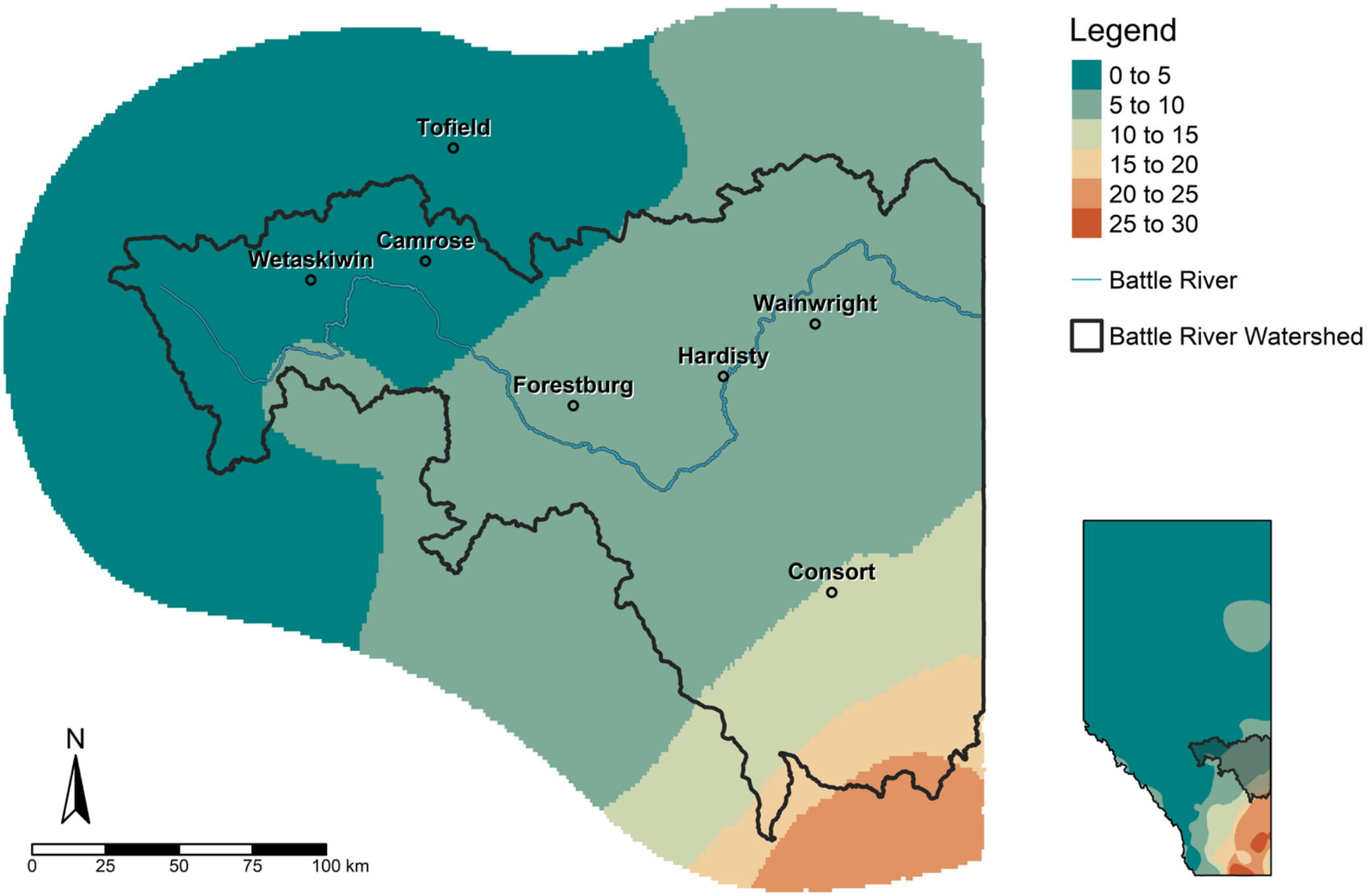
Canada's Plant Hardiness Zones and Extreme Minimum Temperature Zones map the relative climatic conditions for a given geographic area. (Natural Resources Canada and Government of Canada 2021b). The Plant Hardiness Zone formula considers a number of climatic variables, including frost free period, maximum snow depth, and amount of rainfall (Natural Resources Canada and Government of Canada 2021a).

Hardiness zones range from 0 (coldest) to 8 (warmest), meaning that plant species with a hardiness zone rating of 0, 1, 2, or 3 can safely grow in a region that is a 3b zone. Zones can also be divided into sub-zones of a (coldest), b (warmer), and c (warmest) (Tree Time Services Inc. n.d.).

Particularly in Alberta and other agriculture-intensive regions, a rise or decline in community health will likely follow changes in farming prosperity. If local farms are

Extreme Heat Events (1981-2010)

of days above 30 degrees Celsius per year



Map 3.10: (Source: Government of Canada, Environment and Climate Change Canada. 2010. Climate Normals).

thriving and growing more tender plants over a longer season, this will likely have a positive effect on community health. If there is effective control for invasive weeds, they may not become an issue, but improper control could lead to major ecological issues that may also affect the community's future prosperity.

Table 3.3 shows Plant Hardiness Zone Index Scores in the BRW have increased by between two and three points since 1961, indicating that climate in the region seems to be becoming slightly milder. However, most parts of the BRW remain at zone 3b, meaning that throughout the watershed the plant hardiness zone remains quite harsh.

Change in Plant Hardiness Zones

Climate change has significantly altered the plant hardiness zone ratings in certain regions throughout Canada. The Canadian hardiness zones for 1981-2010 were significantly different from the zones from 1931-1960 (McKenney et al. 2014, 344). As temperatures are projected to continue to warm, plant hardiness zones may change in the future as well.

In 1961 the average Plant Hardiness Index score in Alberta was 33.0. This increased to 36.4 in 2010. These scores indicate that Alberta's plant hardiness zone has changed from a 3a to a 3b (Natural Resources Canada and Government of Canada 2021c).

Risks of Changing Plant Hardiness Zone Rates

The warming climate may increase production of certain crops due to the lengthening of the growing season. There are greater opportunities for food production in Northern regions as areas that were once too cold may now be suitable for growth of crops such as wheat and potatoes (Hannah et al. 2020, 5).

However, there are also negative consequences to the impact of hardiness zone changes. Hannah et al. (2020, 11-12) lists three implications to the impact of climate change on increasing agriculture production:

- Greater agricultural production in more regions will result in greater release of carbon into the atmosphere, further perpetuating global climate change,
- Biodiversity will decline in mountainous and northern regions, and
- Water degradation will result in poor community and ecosystem health ecosystem health.

Another major consequence of warming temperatures is the introduction of invasive plant and insect species. Invasive plant species that were able to grow in Southern regions may now have the ability to adapt and grow northwards as the plant hardiness zone changes in these regions. Increased CO_2 production may promote invasive plant species growth as well. The warmer climate also allows invasive insect species to increase their growth rate, dispersal, and survival (Finch et al. 2021, 65-66).

Policy Responses for Climate Change and Weather Patterns

Climate change has become a defining issue of our time. We face dynamic challenges such as rising sea levels and shifting weather patterns that can drastically impact human society by causing devastating floods and jeopardize food production. Climate change affects human lives and health by threatening essential components of good health: clean air, safe drinking water, a nutritious food supply, and reliable shelter (World Health Organization 2021).

Making weather and climate measurements at local, regional, and national levels helps us to understand climate variability and climatic changes on different scales. Improving our knowledge of what is happening to the climate can help us to understand the social dimensions of climate change, and help us to better plan adaptation measures to combat the real and potential impacts of climate change (Shako 2015).

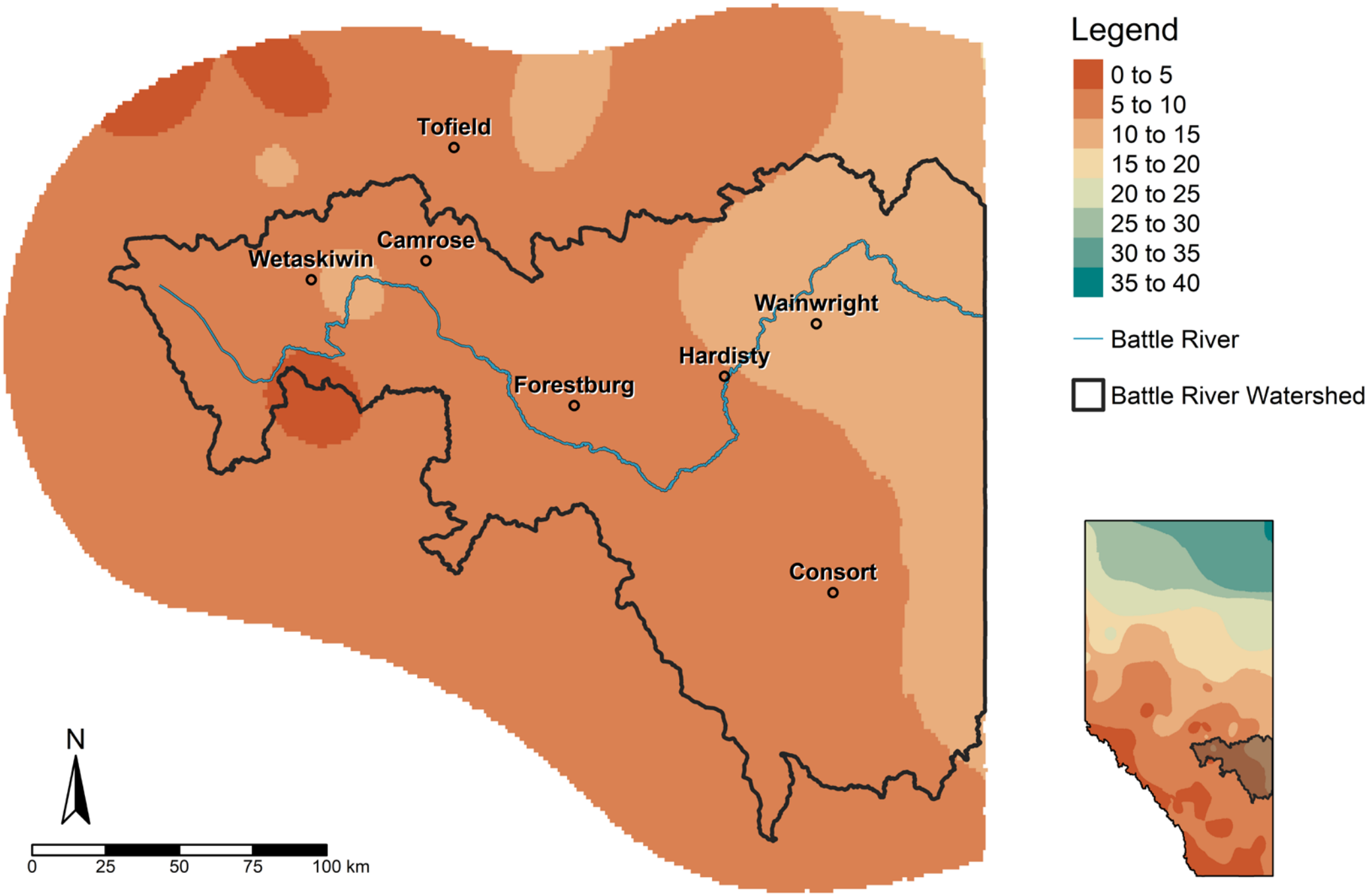
What is being measured?

In 2002, the Progressive Conservative Party, under Premier Ralph Klein, enacted Alberta's first climate change action plan. Entitled Albertans and Climate Change: Taking Action, the plan was also the first climate action plan in Canada.

Albertans and Climate Change set out to provide a framework for an "aggressive set of actions that [would] reduce GHG emissions and train Alberta's economy to operate in a

Extreme Cold Events (1981-2010)

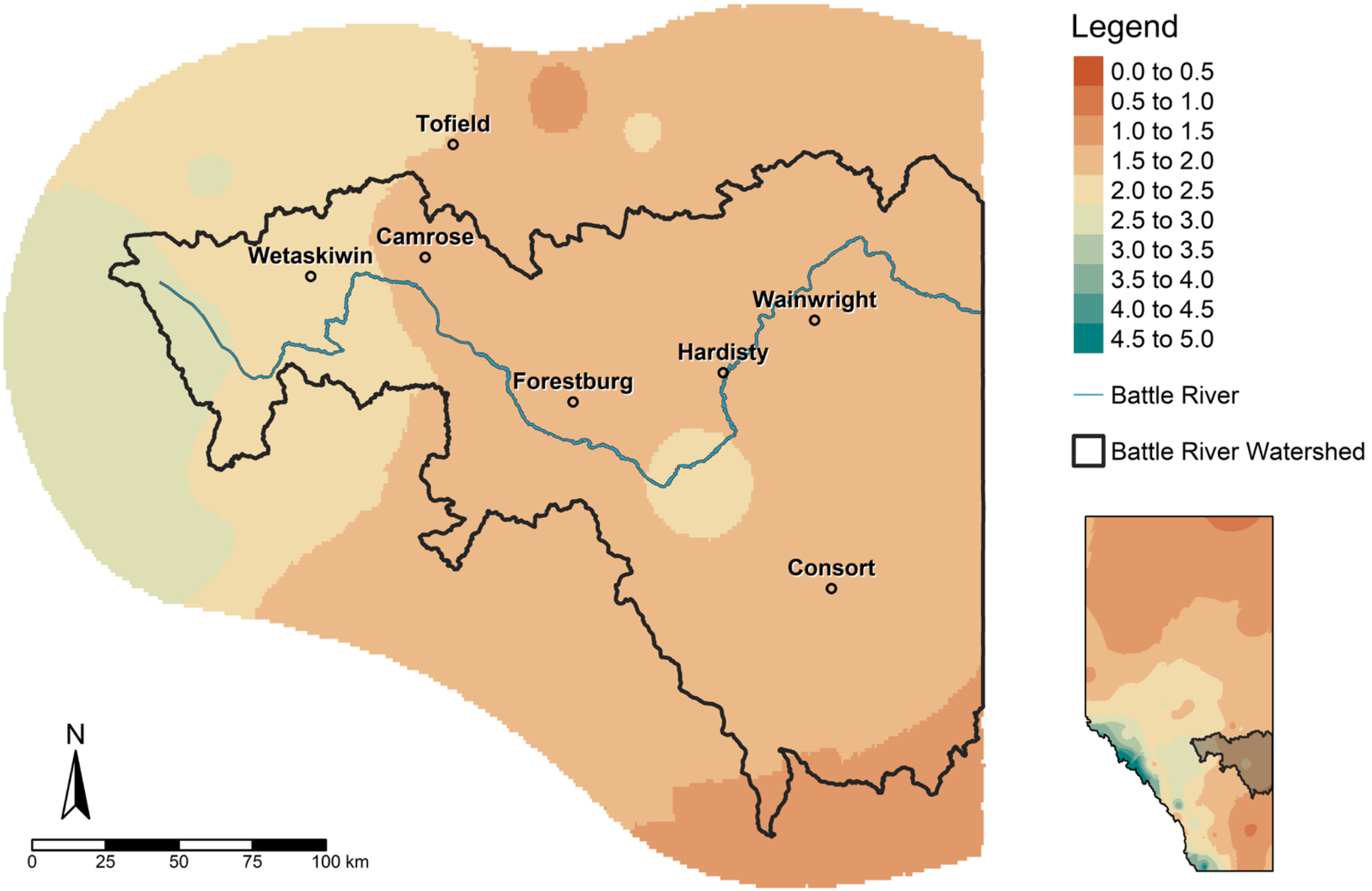
of days below -30 degrees Celsius per year



Map 3.11: (Source: Government of Canada, Environment and Climate Change Canada. 2010. Climate Normals).

Extreme Precipitation Events (1981-2010)

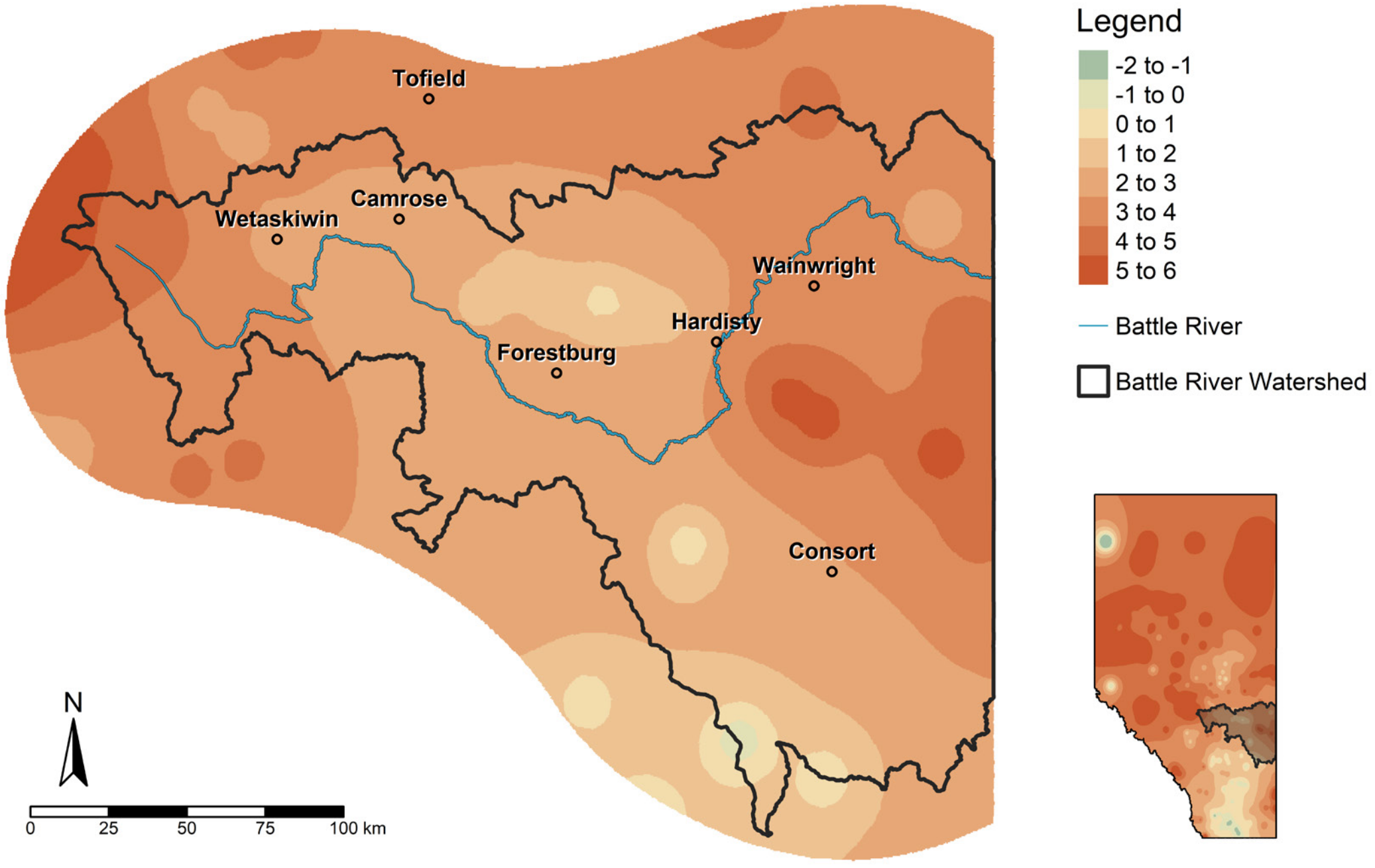
of days above 25 mm of precipitation per year



Map 3.12: (Source: Government of Canada, Environment and Climate Change Canada. 2010. Climate Normals).

Change in Plant Hardiness Index

Difference in plant hardiness index from the 1961-1990 period to the 1981-2010 period; increases in plant hardiness index indicate greater probability of plant survival



Map 3.13: (Source: Government of Canada, Natural Resources Canada. 2010. Plant Hardiness Zone by Municipality).

way that contributes to our environment and our future" (Government of Alberta 2002, 2). Specific actions were to be taken around emissions management, development of technology to control industrial emissions, energy efficiency, and development of renewable energy (Government of Alberta 2002, 9).

Provisions were also made to begin monitoring and collecting data on carbon management, and climate change adaptation. Specifically, the plan stated that: "By the year 2020, the province will reduce GHG relative to Gross Domestic Product (GDP) by 50 per cent below 1990 levels. This is a reduction of about 60 million tonnes of CO_2 equivalent (CO_2e) gases. By 2010, Alberta expects to have achieved an emissions intensity improvement of more than 20 per cent and will have reduced emissions by the carbon dioxide equivalent of about 20 million tonnes below expected levels" (Government of Alberta 2002, 10).

Plant Hardiness Zone Change by Municipality

Region	1961-1990 Index Score (0-100)	1961-1990 Zone	1981-2010 Index Score (0-100)	1981-2010 Zone	Index Change
Camrose	36	3b	38	3b	2
Lacombe	36	3b	39	3b	3
Forestburg	37	3b	39	3b	2
Provost	31	3a	37	3b	6

Table 3.3: Plant hardiness zone index (a score based on 7 climate variables and ranges from 0-100), plant hardiness zone, and change in plant hardiness zone index from the period 1961-1990 to 1981-2010 (Source: Extracted from the Natural Resources Canada Plant Hardiness Zone by Municipality web site at http://planthardiness.gc.ca/ph_main.pl?m=22&lang=en).

Alberta's 2008 Climate Change Strategy, released under Premier Ed Stelmach, emphasized "responsibility, leadership and action" (Environment Alberta 2008, 9). The goals included: implementing carbon capture and storage through storing quantities of CO_2 in Alberta's geological formations (depleted oil and gas reserves, coalbeds, and deep saline aquifers), accelerating the transformation of energy production in the province through support for technological innovation in sustainable energy, and reducing barriers and creating incentives for the implementation of renewable and alternative energy sources. This strategy sought to meet the 20 megaton reduction intensity target from the 2002 plan in 2010. Additional emissions reduction targets included stabilizing GHG emissions by 2020 through a 50 megaton reduction, and by 2050, reducing emissions by 200 megatons (Government of Alberta 2008).

A 2012 David Suzuki Foundation assessment of provincial and federal emissions reduction plans revealed that Alberta continues to be the largest GHG emitter in Canada, and emissions have increased more in Alberta than in any other province since 1990. The report notes that the 2008 Climate Change Strategy allowed Alberta's GHG emissions to keep growing until 2020 and the province will likely only achieve one-third of its emission reduction goal for 2020.

The report also finds that Alberta's intensity-based emissions trading targets allow absolute emissions to continue rising, and the province's $15/tonne partial carbon price applies to only 12% of emissions from large industrial polluters, reducing the equivalent incentive for clean energy to less than $5/tonne of emissions (Holmes 2012). If Alberta

wants to achieve its 2050 GHG emission reduction targets, the carbon charge needs to be at least $100/tonne (Holmes 2012).

In 2015, the newly-elected New Democratic Party under Premier Rachel Notley enacted the Climate Leadership Plan (CLP), which again focused on reducing carbon emissions. This plan also included language about diversifying the economy, creating jobs, and protecting Albertans' health and the province's environment (Government of Alberta 2018).

The CLP focused on four pillars of emissions reduction:

- implement a new price on GHG emissions (*i.e.*, carbon pricing),
- phase-out pollution from coal-generated electricity by 2030 and generate 20% of electricity from renewable sources by 2030,
- cap oil sands emissions at 100 megatonnes per year, and
- reduce methane emissions from upstream oil and gas production by 45% from 2014 levels by 2025 (Government of Alberta 2018).
-

The CLP also described six main action areas:

- climate leadership through policy and legislation,
- energy efficiency,
- innovation and clean technology,
- transit and infrastructure,
- electricity transition, and
- support and engagement of Indigenous communities to achieve these objectives (Government of Alberta 2018).

In 2019, the United Conservative Party under Jason Kenney won the election with an overwhelming majority on a promise to cut the Carbon Tax that "hasn't helped reduce GHG emissions and took money out of the pockets of working families" (Global News 2019). In June 2019, the legislature passed Bill 1: the Carbon Tax Repeal Act that repeals the tax, and it was signed into law (Global News 2019).

Climate policy under the current UCP government encompasses a range of activities, from reducing methane emissions to phasing out emissions from coal and pricing carbon for large emitters (Government of Alberta n.d. e). Under the UCP, however, a separate office for climate change policy and environmental monitoring was eliminated in fall 2019 (The Canadian Press 2019).

What is being done?

Extreme Weather Events

Responses to managing extreme weather must take into account two considerations: (1) what kind of weather events are anticipated, and (2) what kinds of activities, spaces, and infrastructure are at risk? Some events are more likely in certain places than in others. For example, Alberta is at high risk for drought, fire, flooding, and extreme snowfall, but at relatively low (or extremely low) risk from earthquakes or tropical storms. Agriculture is vulnerable to severe weather, but so are residential areas, oil and gas extraction and processing sites, and small and large municipal areas and the services they house, like schools and hospitals.

Climate change, including drier summers and changing precipitation regimes, is one component of forest fire risk. It is important not to underestimate, however, the more immediate effects of our forest management practices and our land-use and land development practices in contributing to fire severity and destructiveness. Much of western North America is composed of landscapes that historically burned regularly, often with Indigenous assistance. Many of the tree species in our forests require fire to reproduce and remain healthy. In recent years, more attention is being paid to forest management that incorporates prescribed burning and Indigenous cultural burning (Lewis, Christianson, Springs 2018; Lake and Christianson 2019). Other options for reducing fire severity in wildland areas may involve replanting with mixed species, including aspen and other less fire-susceptible conifers (Cumming 2001).

For much of the 20th Century, government and industry in North America approached wildfire with a policy of total suppression (Davis et al. 2018). Along with logging practices favouring forests composed of single-age, single-species trees (for ease of harvesting and maximum economic return), fire-exclusionary policy has resulted in overstocked stands filled with relatively young trees from fire-adapted species such as lodgepole pine, and brushy fuels. These choices in forest management have contributed significantly to creating fire-prone forests.

Along with forest-management choices, we have intensified construction and development in what is known as the

wildland-urban-interface (WUI) (de Scally et al. 2018, Theobald and Romme 2007). The WUI is a particularly vulnerable site for fire because fires in the WUI disproportionately affect homes, other critical infrastructure, and communities. Changes to forest management and to land zoning might have some beneficial effects on reducing the severity of forest fires, but many stakeholders, including all levels of government, the forest industry, developers, and homeowners, will have to be persuaded of the necessity of changing our current approach, and will then have to follow through on fireproofing measures and recommendations (McGee 2007, Harris et al. 2011).

Current fire response in Alberta is coordinated through Alberta Agriculture and Forestry's Wildfire department (Government of Alberta 2022a). The regulations in the Forest and Prairie Protection Act specify compliance and enforcement responsibilities of authorized officials, including Fire Guardians, Forest Officers, Peace Officers, and other law enforcement officers (Government of Alberta 2020a). Seasonal fire bans, which aim to prevent people from starting wildfires inadvertently with campfires or through burning debris at home, are a first line of defence, and burning during a fire ban may result in warnings, fines, cost recovery for fire damage, and prosecution (Government of Alberta 2022a).

The federal government plays an important role in coordinating and assisting other levels of government in managing disasters and mitigating the effects of severe weather (Government of Canada n.d.). Although disasters are addressed at the local level first, more severe events require coordinated responses involving multiple levels of government. Through the Emergency Management Act, 2008's National Disaster Mitigation Strategy, and the Government Operations Centre, the Department of Public Safety and Emergency Preparedness helps to coordinate national disaster response and recovery program support. To assist in planning and forecasting, the federal government maintains weather, water and climate data; collects information for use in predicting the intensity, duration and frequency of storms; and sets building codes and standards (Government of Canada n.d.).

In 2018, the federal government launched the Canadian Agricultural Partnership (CAP), a five year program that aims to help farmers manage significant risks, including risks from extreme weather and natural disasters that threaten the viability of their farm and are beyond their capacity to manage (Government of Canada 2021a). The federal government also created the Disaster Financial Assistance Arrangements program to provide funds to help provinces and territories recover from natural disasters (Government of Canada 2022c).

This program enables provinces, territories, and municipalities to plan for or mitigate severe weather events through strategic investments that improve resilience against potential disasters (Government of Canada 2022c). For example, new land-use plans encourage communities to not build in flood plains, and might mandate the use of building codes that factor in minimum levels of weather and flood resilience to help ensure that new infrastructure is designed to withstand severe weather (Office of the Auditor General of Canada 2016). Similarly, the government of Alberta has flood risk management guidelines for the location of new facilities funded by Alberta Infrastructure.

These guidelines apply to buildings such as schools, courthouses, hospitals, legislature buildings, communication centres, extended care facilities, universities, and airports (Government of Alberta 2017). The provincial government has also allocated $1.25 billion for green infrastructure projects over the years 2018-2028. The funding was given to projects that support climate change mitigation, adaptation, resilience and disaster mitigation, and environmental quality. To receive the grant, the projects must have met at least one of the following outcomes: increased capacity to manage more renewable energy, increased access to clean energy transportation, increased energy efficiency of buildings, and/or increased generation of clean energy (Government of Alberta n.d. i).

The province has three carbon offset protocols to support methane reductions in the oil and gas sector, including an offset protocol to encourage converting existing pneumatic equipment to highly efficient options, an offset protocol for solution gas conservation, and an offset protocol for engine fuel management and vent gas capture projects (Government

of Alberta n.d. k, Government of Alberta 2021d). The Technology Innovation and Emissions Reduction (TIER) Regulation is "Alberta's industrial GHG emissions pricing regulation and emissions trading system," and replaced the Carbon Competitiveness Incentive Regulation (CCIR) on January 1, 2020. The TIER system applies automatically to facilities that emit at least 100,000 tonnes of CO2e GHG per year, and smaller emitters can opt in to the system. The Alberta government follows the legislation of the federal government to phase out coal-fired electricity generation by 2030, but Alberta's full transition will be complete in 2023, seven years ahead of the federal targets and reduce methane emissions by 45% by 2025 (Government of Alberta n.d. j, Government of Alberta n.d. e).

Plant Hardiness

Alberta's response to prohibited noxious and noxious weeds is supported by the Alberta Weed Survey, which is conducted on a semi-regular basis. The most recent weed survey was conducted in 2017, under the leadership of a biologist working for Agriculture and Agri-Food Canada. In 2017, the Battle River Watershed Alliance (BRWA) released a planning document entitled Non-native and Invasive Species Management: A Review of Policies and Practices (Battle River Watershed Alliance 2017). Long intervals between surveys, and irregular surveying mean that knowledge about what weeds farmers are dealing with lags behind farmers' experiences in having to manage weeds, some of which may be new and some of which may already be established and resistant to common control methods (Alberta Pulse Growers n.d.).

Coal

In 2020, the Alberta Government attempted to rescind the province's 1976 Coal Development Policy, which restricted open-pit mines across most of the province's Rocky Mountains and Foothills (Fletcher, Anderson and Omstead 2020). The policy was rescinded without prior public consultation and was widely seen as an attempt by the provincial government to spur industrial development in response to a downturn in the province's economy (Fletcher, Anderson and Omstead 2020). The move was opposed by almost 70% of Albertans from across civil society, including ranchers, First Nations, and environmental groups (Riley 2021). As a result of public opposition, the Coal Policy was reinstated on February 28, 2021, but many citizen groups and watchdog organizations remain concerned about whether and how the reinstated protections will be enforced.

The 1976 Coal Development Policy states that "[n]o development will be permitted unless the government is satisfied that it may proceed without irreparable harm to the environment," and then established four categories of land in relation to coal exploration (Fletcher, Anderson, and Omstead 2020). All coal development is forbidden in Category 1 lands, which include the Rocky Mountains. Category 2 lands are off-limits to open-pit mining, and include both mountains and foothills. Category 3 covers a strip of land east of the foothills, and Category 4 centres around the Hinton area. (Fletcher, Anderson, and Omstead 2020).

The attempted rescindment particularly targeted Category 2 land. Opposition groups spoke out against the potential for irreparable harm to the environment and to other important sectors of Alberta's economy including ranching and tourism. Coal mining brings the risk of chemical leaks into sources of fresh water. Under an expanded coal policy, leaks of selenium, nitrite, ammonia, phosphorus, hydrogen sulphide, and other hazardous substances could make their way from new coal projects in the Eastern Slopes into Alberta's water wells (Fletcher, Anderson and Omstead 2020).

Opportunities for intersectoral action

From the perspective of community health, extreme weather is a quadruple threat: an extreme weather event threatens population health, is often accompanied by damage to public health-protective and community infrastructure, imposes novel and pervasive burdens on communities, and responses to the event rely on critical infrastructure whose potential failure both creates new burdens and diminished response capacity (Hunter et al. 2016).

Extreme weather events also inspire community cohesion as community members and volunteer organizations step in to help those who may have lost property or been

injured as a result of the event (Hunter et al. 2016). Research has sought to understand rural communities' capacity to absorb the impacts of and recover from the actual occurrence of an extreme weather event (Tisch and Galbreath 2018, Karman 2020, Harries et al. 2018).

Responding to and recovering from extreme weather events can test a community's infrastructural and social resilience. Resilience is a concept that has gained attention in community development research in recent years, with studies by Magis (2010), Buikstra et al. (2010), and Maclean, Cuthill, and Ross (2014) discussing the characteristics of resilient communities in relation to disruptive events.

Resilience implies not only recovery from disruption, but also the capacity to change and transform according to new circumstances without losing core values or core measures of wellbeing (Magis 2010). Community development that emphasizes social networks and social support focuses on building "solidarity and agency" through encouraging the identification of felt needs, building participation, and promoting self-help (Buikstra et al. 2010). Social networks and people-place connections are key attributes of resilience, allowing people to feel supported, to feel a sense of belonging and stability, and to experience a sense of commitment and connection to a community (Maclean et al. 2014).

Buikstra et al. (2010) found that possessing a positive outlook was a critical part of community and individual resilience because it allowed individuals to bounce back sooner from adversity. Community resilience comes from experience, as well as ongoing formal and informal learning, all of which contributes to resilience by learning from diversity. An early experience of struggle and hardship (learned through, for example, childhood farming) is more likely to build up a community ethos of resilience. Finally, infrastructure and support services, a diversified and innovative economy, and responsive and engaged leadership all contributed to a resilient community (Buikstra et al. 2010, Maclean, Cuthill, Ross 2014).

What could be done?

In Canada, jurisdiction to address disasters falls primarily to the provinces (Public Safety Canada 2019, 2). This makes sense, because many extreme weather events are localized and coordinating responses between different levels of government requires extensive planning and communication.

However, weather and climate related disasters are often generalized in their effects. For example, forest fire seasons affect entire provinces and require support from wildfire personnel from across Canada. On the Prairies, droughts or floods threaten agricultural production, the livelihoods of farmers, and Canada's economic productivity. These events require not just immediate, site-specific mitigation and cleanup responses, but also longer term responses including support for economic recovery and financial support and insurance.

Disaster management requires foresight and investment in infrastructure and personnel. Although this work happens at all levels of government, with municipal, regional, and provincial bodies coordinating in response to smaller-scale disasters, Public Safety Canada holds a primary role in disaster coordination and response for national emergencies (Public Safety Canada 2022).

The carbon tax has become one of the most powerful tools that governments can use to encourage households and companies to pollute less. By putting a price on carbon emissions, governments can create a strong incentive to pollute less, use greener practices, and invest in clean technology. Imposing a carbon tax forces households, businesses, and industries to shift to cleaner technologies, which increases the demand for energy-efficient products and helps spur innovation and investment in green solutions (David Suzuki Foundation n.d.).

Sweden is one example of using a carbon tax effectively. Sweden estimates it has reduced its GHG emissions by 20% since 1991 by using a carbon tax, helping the country reach its 2012 Kyoto Protocol target. (David Suzuki Foundation n.d.). The case of Sweden demonstrates that economic decline is not guaranteed as a result of the carbon tax as since the carbon tax was introduced, Sweden's economy has grown by more than 100% and Sweden currently ranks fourth in the world on economic competitiveness (David Suzuki Foundation n.d.).

The main reason for the tax effect on energy intensity is more efficient turbines in oil production, which contribute to half of the energy intensity effect (Bruvoll and Larsen 2004). The rest is due to reduced energy use relative to consumption and production in other sectors (Bruvoll and Larsen 2004). While a household's opportunity to reduce energy intensity through substituting new cars for gasoline is limited, households may substitute public for private transport (Bruvoll and Larsen 2004). The substitution possibility and emissions are also relatively high in the manufacturing of industrial chemicals, wholesale and retail trade, and production of other private services, and the tax also affects the emissions through the reduction in energy intensity in these sectors (Bruvoll and Larsen 2004).

Air Quality

CO_2 Equivalent Emissions

The greenhouse effect is the process that keeps the surface of the earth warm. Gases in the earth's atmosphere, including carbon dioxide, water vapour, ozone, and nitrous oxide, trap some of the sun's energy maintaining a temperature on the earth's surface that allows life to exist (National Geographic 2022; Denchak 2019). Greenhouse gases (GHGs), are affected by human activities such as farming, fossil fuel use, and electricity generation. Increasing GHG emissions as a result of human activity are, according to the Government of Canada and other national and international scientific and governmental organizations, the primary cause of climate change (Government of Canada 2019a; European Commission n.d.; United Nations n.d. b).

The most common measure for total GHG emissions in a specified region over time is CO_2 equivalent (CO_2e). This indicator is a measure of seven GHG released through human activities. The CO_2e equation allows these gases to be compared to each other, and their ability to trap solar energy to be measured as equivalent to the greenhouse potential of CO_2 (Government of Canada 2019b).

Communities that emit large amounts of GHG are increasingly likely to find themselves affected by new tax burdens, as governments turn to carbon taxes and other emissions taxes to discourage GHG production. Measuring, regulating, and reducing GHG emissions will contribute positively to a community's environmental impact and reduce that community's effect on the global climate.

The BRW emitted almost 23 million tonnes of GHG in 2017. Converted to per capita measure, this rate is about 3.5 times the rate for Alberta as a whole.

Flagstaff County serves as a provincial distribution hub for the North American oil and gas sector. Lacombe County is another region within the BRW that produces a high amount of CO_2 emissions. Agriculture is the predominant industry of Lacombe, with over 1,045 farms and 95% of the county dedicated to agriculture (Lacombe County n.d.).

It is commonly assumed urban municipalities are greater perpetrators of producing GHG emissions, likely due to greater population size and industrialization; however, this does not always hold true. In 2018, Edmonton produced 1.7 million tonnes of CO_2e, whereas Flagstaff County produced 2.2 million tonnes of CO_2e (Government of Alberta, 2022b).

Understanding CO_2 Equivalent Emissions

Carbon dioxide emissions provides an accurate measurement of the amount of GHG emissions in a region. Human activities allow

excessive release of CO_2 emissions through transportation, farming, fossil fuel use, and electricity generation. The consequences of the high carbon and GHG emissions include "air pollution, introducing toxic materials in the pollution, introducing toxic materials in the soil, water and air, loss of ecological habitat and biodiversity, water pollution, forest destruction, toxicity and seepage from tailings ponds" and more (Davidsen 2014).

Populations at Risk

Rall, LaFortune, and Human Rights Watch (2020) wrote: "Indigenous peoples in Canada are among the lowest contributors to greenhouse emissions in the country, yet academic research shows they are among the most exposed to climate change impacts."

In these communities, climate change is a major driver of food poverty due to the reduction of harvestable resources available. This decline is attributed to climate change due to "changing ice and permafrost, wildfires, warming water temperatures, changes in precipitation and water levels, and unpredictable weather" (Rall, LaFortune, and Human Rights Watch 2020). Since food cannot be sufficiently harvested to feed communities through means of hunting or fishing, the cost of purchased foods becomes insurmountable and access to healthy foods is difficult (Rall, LaFortune, and Human Rights Watch 2020). With these weather events, the Indigenous peoples lose their traditional way of life in hunting and gathering, resulting in food insecure communities.

Risk Factors for CO_2 Equivalent Emissions

Oil

According to the Government of Canada (2022e), between 1990 and 2018, CO_2 emissions increased by 24.3%. One of the primary causes of this rise in emissions is due to the expansion of oil sands and the resulting economic boom in Canada. Extraction from the oil sands began in 1967, but the mining and extraction process in Northern Alberta skyrocketed after 1990 (Heyes, Leach, and Mason 2018).

Canada is the third largest oil reserve in the world, accounting for 10% of global oil reserves. Of the estimated total 171 billion barrels of oil, 166.3 billion barrels are found in Alberta's oil sands (Government of Canada 2019). The oil and gas sector is the largest GHG emitter in Canada, accounting for 52% of total emissions in 2019 at 191.4 megatonnes of CO_2 (Government of Canada 2021).

Agriculture

CO_2 emissions from agricultural practices have risen steadily since 1990. In 2019, the agriculture sector emitted 72.7 megatonnes of CO_2 compared to 57.5 megatonnes in 1990 (Government of Canada 2021). Agricultural CO_2 emissions in 2019 accounts for 8% of Canada's total GHG emissions. Agricultural soils either emit or absorb CO_2, and emissions to the atmosphere occur via decomposition of crop residue and soil organic matter. CO_2 emissions also come from fossil fuel consumption on the farms itself, such as through the use of coal, natural gas, and oil for farm machinery and infrastructure (Government of Canada 2012).

Reducing Carbon Emissions

In 2019, the federal government implemented a federal carbon tax which places a cost on the amount of carbon that can be emitted. This means that consumers are subject to a fee for fossil fuel usage such as gasoline and coal. For example, if a consumer uses a fuel-burning car or heats their home using natural gas, they will be subject to higher tax fees. The carbon tax system is a way of meeting the goal of reducing GHG emissions by more than 30% by 2030 as part of the Paris Agreement plan (Government of Canada 2021).

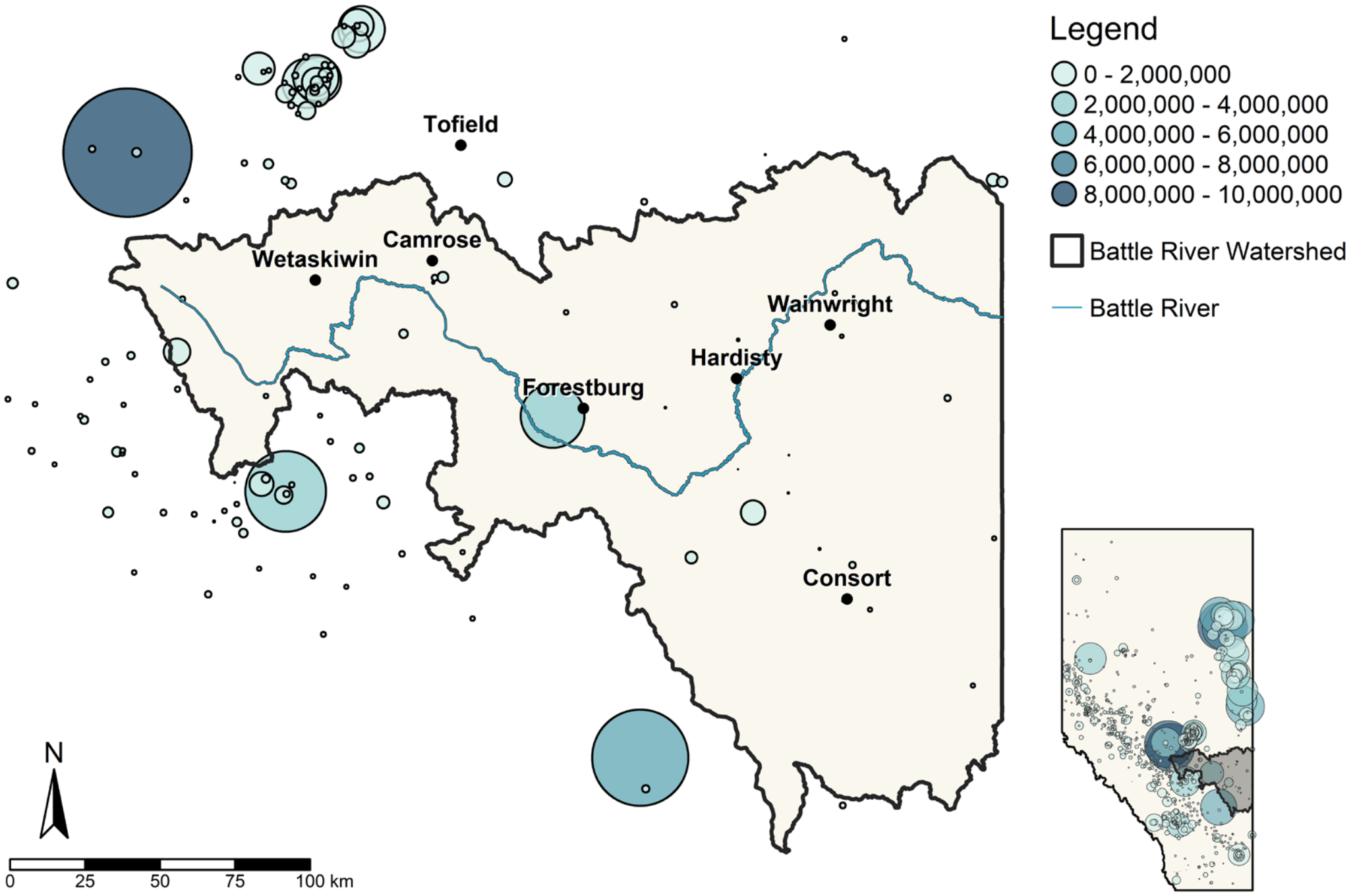
The Paris Agreement was adopted in 2015 with the goal for countries to reduce their carbon emissions as an effort to circumvent climate change. The goal is to: "Hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change" (United Nations n.d. a).

Air Quality Parameters

Air quality is affected by a variety of human-produced and naturally occurring substances. Canada measures several key air pollutant concentrations; nitrogen dioxide (NO_2), sulfur dioxide (SO_2), volatile organic

Greenhouse Gas Emissions from Facilities (2018)

Total annual emissions of greenhouse gases from facilities, expressed as tonnes of carbon dioxide equivalent



Map 3.14: (Source: Government of Canada, Environment and Climate Change Canada. 2018. Greenhouse Gas Reporting Program (GHGRP) - Facility Greenhouse Gas (GHG) Data).

compounds (VOC), peak ground-level ozone (O3), fine particulate matter ($PM_{2.5}$), and carbon monoxide (CO). Emissions of any one of these chemicals in concentrations above Canadian Ambient Air Quality Standards (CAAQS) parameters set by the Canadian Council of Ministers of the Environment (CCME) could lead to local ecological damage, and may result in temporary or long term air quality reductions (Canadian Council of Ministers of the Environment n.d.).

Air pollution can pose a serious health risk to people who live with asthma, allergies, COPD, and several heart conditions, and is an important factor in community health (Canadian Council of Ministers of the Environment n.d.). Measuring air quality can help a community gain insight into their environment, since air pollution is affected not only by human-produced industrial emissions, but also by vegetation and topography. We can intervene in some kinds of air quality issues, like regulating emissions from industry, but other kinds of emissions, such as those from pollen or wood-heated homes are more difficult to predict and control. Within Alberta as a whole, several regions exhibit poor air quality for a number of the measured parameters, especially average fine particulate matter, average nitrogen dioxide, and average sulfur dioxide (Map 3.16; Map 3.17; Map 3.18).

Air Pollutants:

- **Ozone (O_3):** causes respiratory symptoms and further aggravates existing conditions of asthma or other chronic lung diseases, as well as damaging the integrity of plants and decreasing agricultural crop yields (Canadian Council of Ministers of the Environment n.d.).
- North-west and south-east of the BRW and surrounding regions have slightly higher O_3 emissions at a rate between 35-40 ppb. Apart from those regions, O_3 emissions in the BRW mainly fall between 30-35 ppb. As of 2015, the average O_3 emissions in Alberta is 33.8ppb (Map 3.15),
- **Fine particulate matter ($PM_{2.5}$):** causes health issues of asthma attacks, chronic bronchitis, and heart attacks, as well as causing changes to soil and water chemistry (Canadian Council of Ministers of the Environment n.d.). $PM_{2.5}$ emissions are highest north- west of the BRW, reaching rates of 8-11 µg/m2. As of 2018, the average $PM_{2.5}$ emission rate in Alberta is 8.4 µg/m2 (Map 3.16),
- **Sulfur dioxide (SO_2):** significantly impacts respiratory conditions and leads to airway inflammation, as well as interfering with plant photosynthesis and energy metabolism, thereby decreasing plant growth and yield (Canadian Council of Ministers of the Environment n.d.). SO_2 emissions are variable in the BRW.
- Most of the BRW has SO_2 emission rates of 0.1-0.8. Around the town of Hardisty, SO_2 emission rates reach up to 1.0ppb. As of 2015, the average SO_2 emission rate in Alberta is 0.28ppb (Map 3.17),
- **Nitrogen dioxide (NO_2):** aggravates respiratory diseases, such as asthma, and contributes to allergic responses (Canadian Council of Ministers of the Environment). NO_2 also contributes to the formation of ozone and acid rain (Canadian Council of Ministers of the Environment n.d.),
- NO_2 emissions are also quite variable in the BRW. Most of the BRW has NO_2 emission rates that range from 4-8ppb. As of 2016, the average NO_2 emission rate in Alberta was 8.8 ppb. Data trends show that Alberta has been the leading province in NO_2 emissions from 2000-2016, presumably due to the province's large oil and gas industry sector (Map 3.18),
- **Volatile organic compounds (VOCs):** prolonged exposure can increase the risk of developing cancer as this compound is a carcinogen, as well as contributing to the formation of smog (Canadian Council of Ministers of the Environment n.d.).

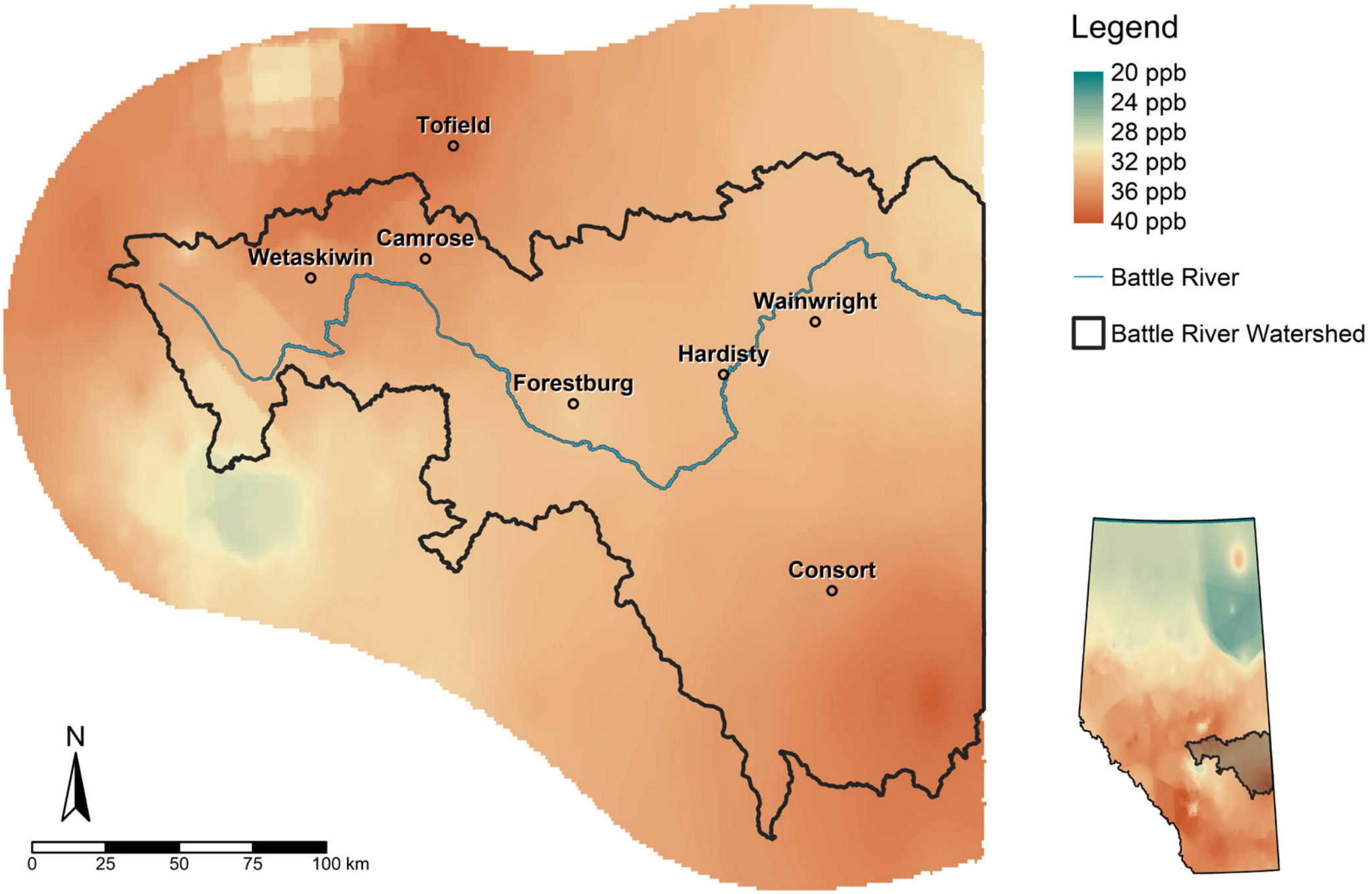
Populations at Risk

Low Socioeconomic Status

Air pollution and exposure differs across demographic and socioeconomic groups. In major Canadian cities, persons of lower SES typically live closer to major pollution sources, such as industries and highways, and often are at greater exposure to air pollution. These populations are also more susceptible to the health effects of air pollution such as cardiovascular diseases, respiratory issues, and cancer. Exposure to air pollutants

Ozone Concentration (2015)

Estimated concentration in parts per billion (ppb) of ozone in the air



Map 3.15: (Source: Canadian Urban Environmental Health Research Consortium (CANUE). 2016. Ozone (O3) (O3CHG_A_YY). Compiled from Environment and Climate Change Canada, Air Quality Research Division data, DMTI Spatial Inc. postal codes.
Environment and Climate Change Canada, 2017. Air Quality Research Division, Toronto, Canada. Data files: CHRONOS_Ground-Level_O3_NA_2002.nc to CHRONOS_Ground-Level_O3_NA_2009.nc inclusive, generated July 2017.
Environment and Climate Change Canada, 2017. Air Quality Research Division, Toronto, Canada. Data files: GEMMACH_Ground-Level_O3_NA_2010.nc to GEMMACH_Ground-Level_O3_NA_2015.nc inclusive, generated July 2017.
Robichaud A, Ménard R, Zaïtseva Y, Anselmo D. Multi-pollutant surface objective analyses and mapping of air quality health index over North America. Air Qual Atmos Health. 2016; 9(7): 743–759.
Robichaud A, Ménard R. Multi-year objective analyses of warm season ground-level ozone and PM 2.5 over North America using real-time observations and Canadian operational air quality models. Atmospheric Chemistry and Physics. 2014 Feb 17;14(4):1769-800).

is associated with demographic factors such as lower income, unemployment rate, and lower educational attainment (Statistics Canada et al 2017). For example, neighbourhoods marked by low education, lone parent families, and low median income are often at greater risk of NO_2 exposure (Buzzelli & Jerrett 2007).

Urban vs. Rural Communities

To estimate health effects and associations between air pollution exposure, the Government of Canada conducted a study to identify groups with more or less exposure in different geographic regions of urban versus rural (Statistics Canada et al. 2017). The study examines "exposure to ambient $PM_{2.5}$ by visible minority, immigrant and SES in Canada, while stratifying the analysis across the urban-rural divide"(Statistics Canada et al. 2017). Based on this census, we again see that urban municipalities face greater exposure in comparison to rural areas (Statistics Canada et al. 2017). We can likely attribute this to high transportation and traffic volume in these great urban cities, compared to lower levels of concentrated transportation in rural areas (Jiang, Mei, and Feng 2016, E33; Eyre et al. 1997, 13).

Visible Minorities/Immigrants

At a national level, $PM_{2.5}$ exposure of visible minorities was higher than the 'white' population, as well as immigrants in comparison to non-immigrants; however, 96% of the visible minority population live in urban municipalities (compared to 66% of the 'white' population). $PM_{2.5}$ exposure is lower among Indigenous peoples. Within these cities, exposure was greater for people living in lower-income households, presumably due to closer proximity to these big industries that emit a lot of air pollution (Statistics Canada et al. 2017).

Greenhouse Gas Emissions from Facilities in the Battle River Watershed (2010-2019)

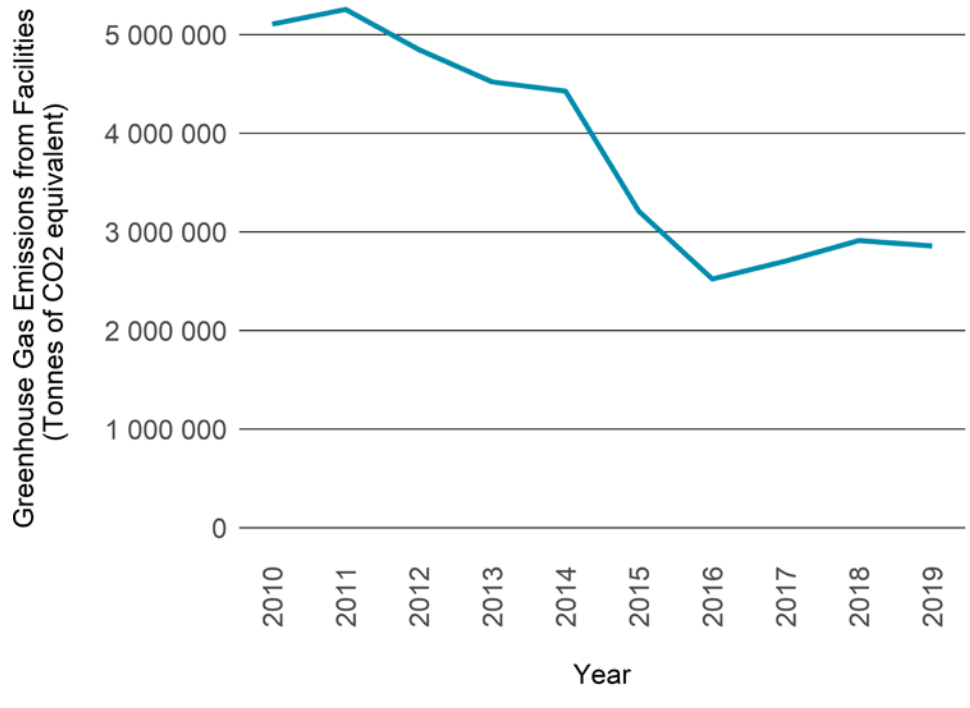


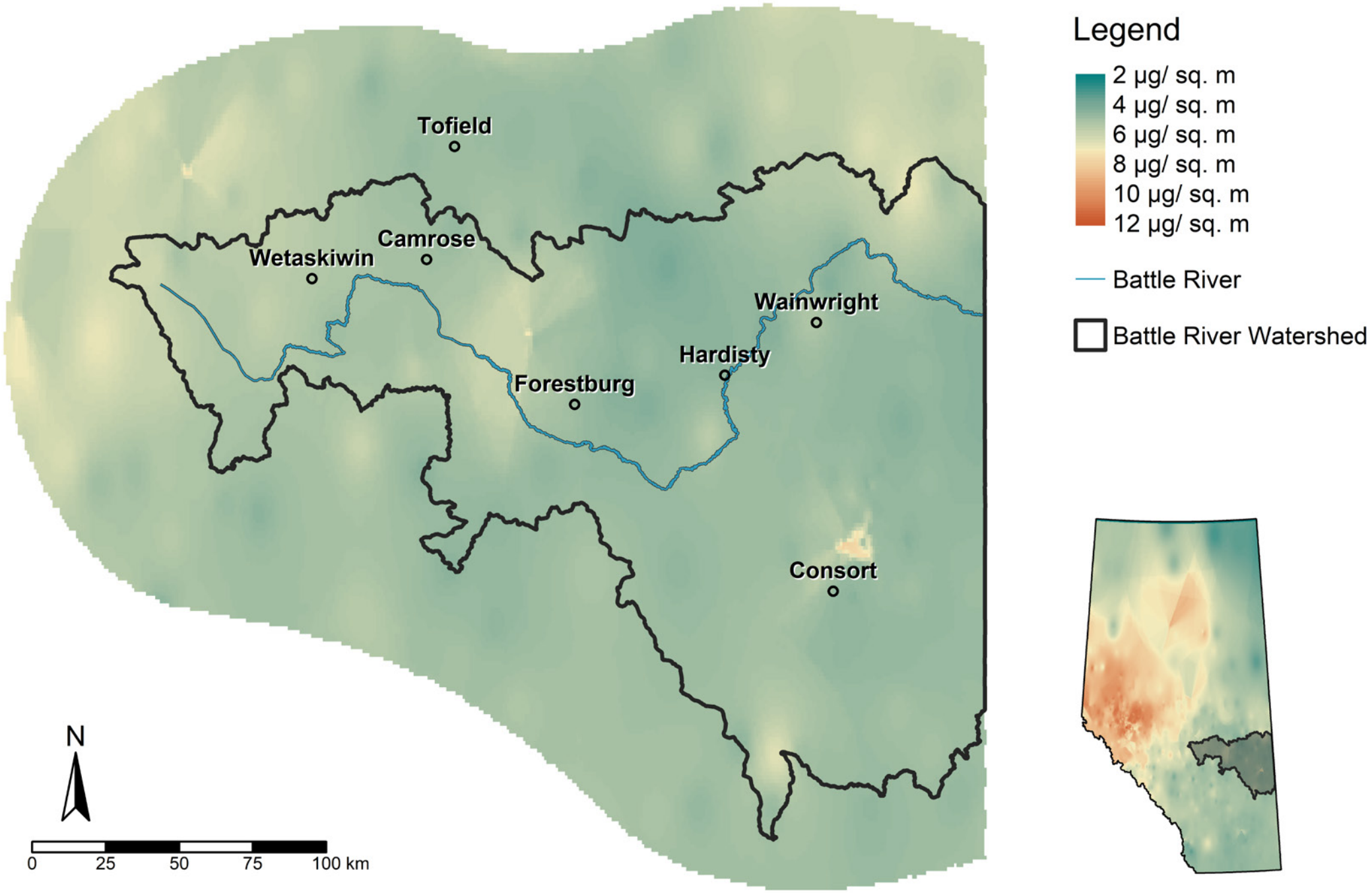
Figure 3.2: Total greenhouse gas emissions (in tonnes of CO_2 equivalent) from large industrial facilities within the BRW from 2010 to 2019 (Source: Canada Greenhouse Gas Reporting Program, 2019). Note: In 2017 the threshold for inclusion in the Greenhouse Gas Reporting Program program changed from at least 50 kt of emissions to at least 10 kt – as a result, the number of eligible reporting facilities may have increased.

Management Frameworks Efforts to Reduce Pollutants

There are management frameworks, such as the CAAQS, that protect the environment and maintaining good air quality. CAAQS monitors air pollutants such as those listed above. There is also the Electricity Emissions Management plan which manages the air emissions from electricity generation in Alberta (Clean Air Strategic Alliance n.d.). The Alberta Acid Deposition Management Framework, assesses the acid deposition that results from SOx and NOx pollutants which cause acidification and damage to the ecosystem (Government of Alberta 2011). There are downward trends in the emissions of air pollutants in Canada, likely due to the implementation of these management frameworks and regulations.

Fine Particulate Matter Concentration (2018)

Concentration in parts per billion (ppb) of fine particulate matter in the air, defined as particles less than 2.5 micrometers



Map 3.16: (Source: Canadian Urban Environmental Health Research Consortium (CANUE). 2018. Fine Particulate Matter (PM2.5 v3) (PM25DALC_A_YY). Compiled from North American Estimates with Ground-Monitor Based Adjustment (V4.NA.03), DMTI Spatial Inc. postal codes.)
CanMap Postal Code Suite (various years). [computer files] Markham, ON : DMTI Spatial Inc.
Hammer, M. S.; van Donkelaar, A.; Li, C.; Lyapustin, A.; Sayer, A. M.; Hsu, N. C.; Levy, R. C.; Garay, M. J.; Kalashnikova, O. V.; Kahn, R. A.; Brauer, M.; Apte, J. S.; Henze, D. K.; Zhang, L.; Zhang, Q.; Ford, B.; Pierce, J. R.; and Martin, R. V., Global Estimates and Long-Term Trends of Fine Particulate Matter Concentrations (1998-2018)., Environ. Sci. Technol, doi: 10.1021/acs.est.0c01764, 2020).

Policy Responses to Air Quality

Why do we measure it?

Measuring air quality allows a community or region to track how clean or polluted the air in a given area is. Moderate air pollution levels are unlikely to have any severe short-term effects on those in a good state of health; however, long term exposure and/or elevated levels of air pollution can lead to serious symptoms and conditions affecting human health (Government of Canada 2022a).

Elevated levels of air pollution may translate into burdens on the health care system. For example, both ozone and particulate pollution irritate the respiratory system, making it difficult to breathe, causing coughing and throat irritation, aggravates asthma and can inflame and damage the lining of the lungs over time (Health Canada 2021; Environmental Reporting BC 2021, 1; Xing et al. 2016, E69-E72; World Health Organization, Regional Office for Europe 2013). Measuring these various air pollutants helps delineate local sources of pollution, how poor air quality correlates with human health, and if the measures we are taking to improve air quality are working (Government of Canada 2022f).

How have governments responded?

Beginning in 1992 with Prime Minister Brian Mulroney's Conservative Government, Canada was the first G7 nation to ratify the treaty for the UN Framework Convention on Climate Change. At the time, Canada seemed to be at the forefront of the environmental movement among states. Canada ratified the Kyoto Protocol in 2002, which was an extension of the UN Framework Convention on Climate Change and set targets for limiting GHG emissions (Hrvatin 2016). At the 2009 UN Climate Change Conference, Canada signed the Copenhagen Accord agreeing to reduce GHG emissions to 17 percent below 2005 levels by 2020 (Hrvatin 2016).

However, in 2011, under the Harper Government, Canada officially withdrew from Kyoto. National emissions increased by over 30%, and Environment Minister Peter Kent stated that the Protocol would not be effective in solving climate change, and staying in the agreement was pointless because the Protocol did not include China or the USA, which were the world's two largest emitters of GHGs (Hrvatin 2016).

The latest international climate change protocol, the Paris Agreement, was signed in 2015 by Prime Minister Justin Trudeau. The Paris Agreement aims to limit global temperature rises to below 2 degrees Celsius, and prioritizes helping poorer nations to combat climate change (Government of Canada 2016).

Currently, all of the provinces and territories (except for Alberta and Saskatchewan) have reduced their emissions rates by 15%; however, Alberta and Saskatchewan have increased their rates by 17%. As a result, Canada as a whole has seen a mere 2% reduction rate (Saxifrage 2019).

What is being done?

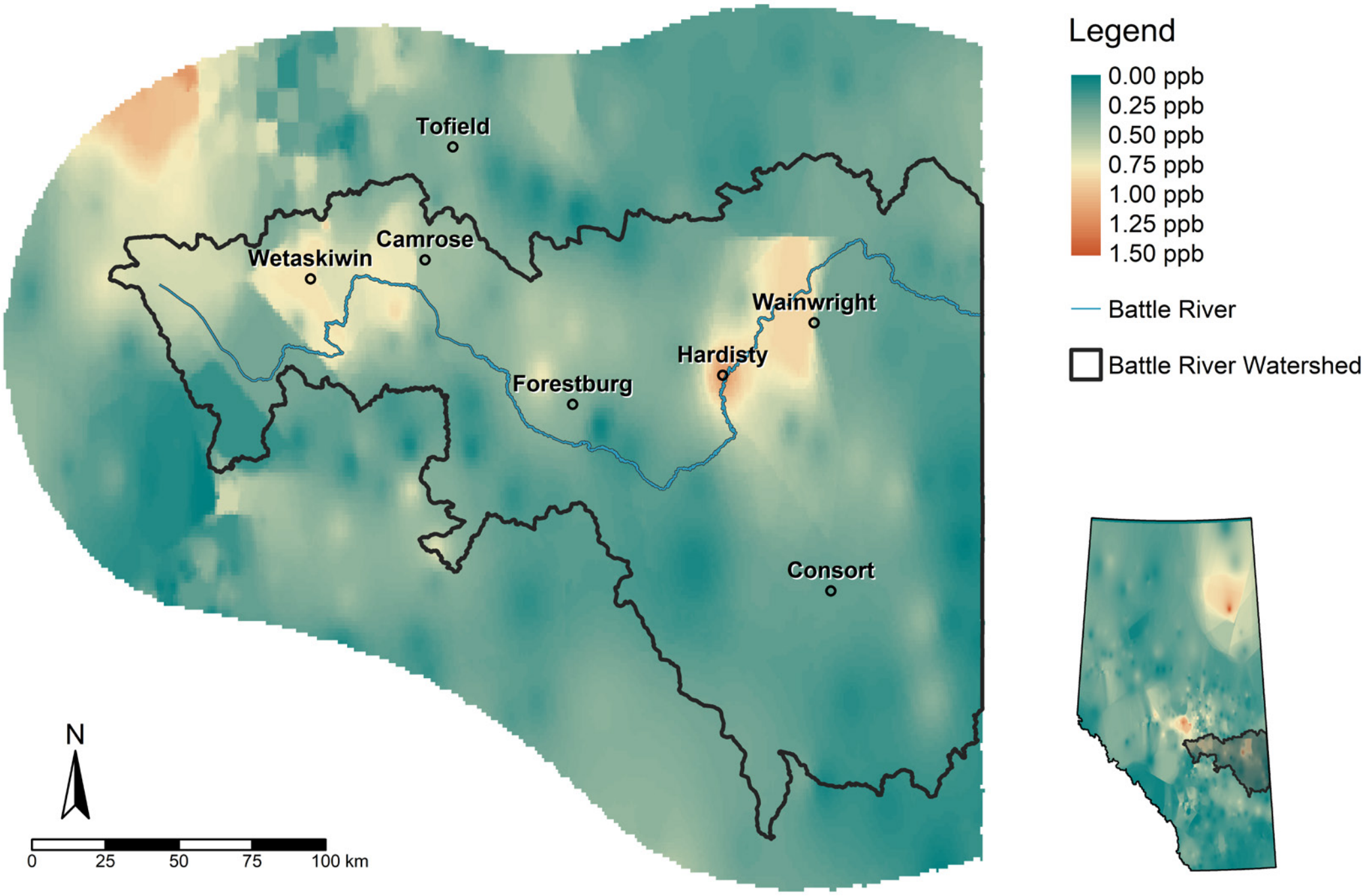
CO_2 Equivalent Emissions

In 2015, the provincial government announced that it would phase out electricity generation from coal by 2030 (Government of Alberta n.d. j). Transition payments were provided to facilities that were originally set to operate their coal-fired units beyond 2030, and financial support is available for communities and workers affected by the phase-out. (Government of Alberta n.d. g, Government of Alberta, n.d. l). The Alberta Government is also trying to reduce methane emissions from oil and gas by 45% by 2025 by applying new emissions design standards to new Alberta facilities, improving measurements and reporting of methane emissions including leak detection and repair requirements, and developing a joint initiative on methane reduction and verification for existing facilities (Government of Alberta n.d. k). This initiative will include industry, environmental groups and Indigenous communities.

Alberta's CCIR continues to apply to facilities that emitted 100,000 tonnes or more of GHGs in 2003 or a following year (Government of Alberta n.d. c). The CCIR imposes an output-based benchmark on all competitors in the same emitting industry. The CCIR offers four compliance options: improvements in facility operating efficiency, emission performance credits, emission offsets, and fund credits (Government of Alberta 2019a, 24-27). Any facility that emits "less than 100,000 tonnes of GHGs may be eligible to opt-in to the CCIR if it competes against a facility regulated under the CCIR or has more

SO_2 Concentration (2015)

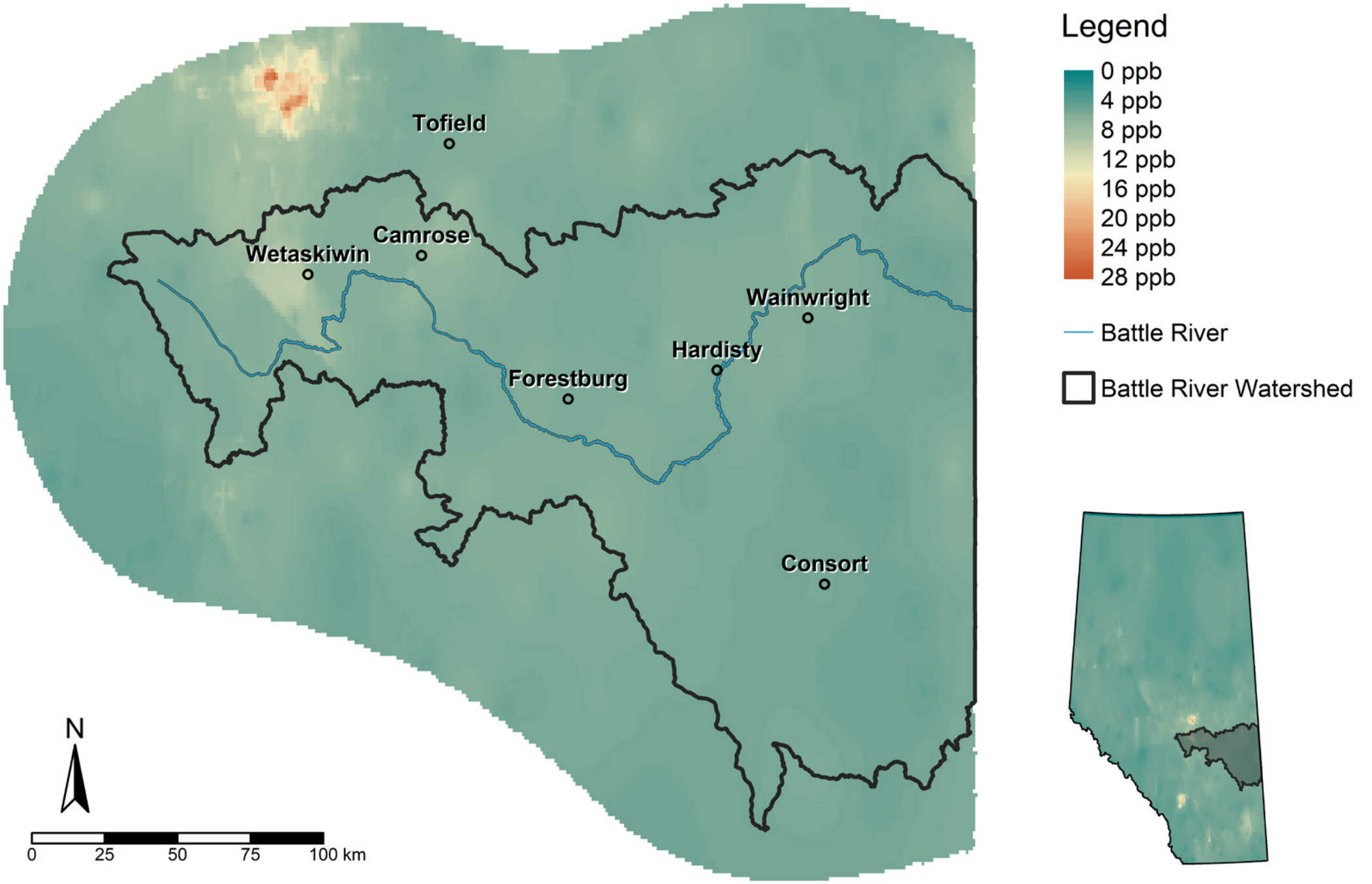
Estimated concentration in micrograms per cubic meter (µg/ cubic m) of sulfur dioxide in the air



Map 3.17: (Source: Canadian Urban Environmental Health Research Consortium (CANUE). 2016. Sulfur Dioxide (SO_2) (SO2OMI_A_YY). Compiled from Environment and Climate Change Canada, Air Quality Research Division data, DMTI Spatial Inc. postal codes.
CanMap Postal Code Suite v2015.3. [computer file] Markham: DMTI Spatial Inc., 2015.
Environment and Climate Change Canada, 2017. Air Quality Research Division, Toronto, Canada. Data files: OMI_Ground-Level_SO2_NA_2005.nc to OMI_Ground-Level_SO2_NA_2015.nc inclusive, generated 2017-07-05.
Kharol, S. K., McLinden, C. A., Sioris, C. E., Shephard, M. W., Fioletov, V., van Donkelaar, A., Philip, S., and Martin, R. V.: OMI satellite observations of decadal changes in ground-level sulfur dioxide over North America, Atmos. Chem. Phys., 17, 5921-5929, doi:10.5194/acp-17-5921-2017, 2017.
McLinden, C. A., Fioletov, V., Boersma, K. F., Kharol, S. K., Krotkov, N., Lamsal, L., Makar, P. A., Martin, R. V., Veefkind, J. P., and Yang, K.: Improved satellite retrievals of NO_2 and SO_2 over the Canadian oil sands and comparisons with surface measurements, Atmos. Chem. Phys., 14, 3637-3656, doi:10.5194/acp-14-3637-2014, 2014).

NO_2 Concentration (2016)

Estimated concentration in parts per billion (ppb)
of nitrogen dioxide in the air



Map 3.18: (Source: Canadian Urban Environmental Health Research Consortium (CANUE). 2016. Nitrogen Dioxide (NO_2) (NO_2LUR_A_YY). Compiled from National Air Pollution Surveillance (NAPS) monitoring data, DMTI Spatial Inc. postal codes.
CanMap Postal Code Suite v2015.3. [computer file] Markham: DMTI Spatial Inc., 2015.
Hystad P, Setton E, Cervantes A, Poplawski K, Deschenes S, Brauer M, et al. 2011. Creating National Air Pollution Models for Population Exposure Assessment in Canada. Environ. Health Perspect. 119:1123–1129; doi:10.1289/ehp.1002976.
Weichenthal S, Pinault L, Burnett RT. (2017) Impact of Oxidant Gases on the Relationship Between Outdoor Fine Particulate Air Pollution and Nonaccidental, Cardiovascular, and Respiratory Mortality. Scientific Reports 7, Article number: 16401. Doi:10.1038/s41598-017-16770-y).

than 50,000 tonnes of annual emissions, high emissions-intensity and trade-exposure" (Government of Alberta n.d. c). In addition to the CCIR, the Oil Sands Emissions Limit Act sets an annual GHG emissions limit on oil sands of 100Mt, with provisions for cogeneration and new upgrading capacity (Government of Alberta 2020b).

Air Quality Parameters

Alberta's Ambient Air Quality Objectives and Guidelines set the standard all current Acts and Regulations aim to fulfill. Guideline values are used in setting release limits for industrial facilities, for airshed planning and management, as a general performance indicator, and to assess local concerns. If facilities cannot comply with the ambient air quality based discharge limits, three alternatives may be considered: (1) a site-specific consideration of the applicable ambient air quality guidelines, (2) a scheduled implementation of the ambient air quality based limits over some reasonable time frame, or (3) approval for operation of the facility may be denied until the air quality issue can be addressed (Government of Alberta n.d. a).

The Environmental Protection and Enhancement Act was established in 2000 and protects the water, land, air, and biodiversity by creating and managing regulatory requirements for them. Additionally, the Act designates that certain activities require registration or approval in order to protect and preserve the environment (Government of Alberta, 2021a). Under this Act, the Industrial Release Limits Regulation was established to protect the environment and human health, to ensure the most appropriate pollution prevention, and control technologies are adopted and to seek continuous improvement through using the most effective pollution prevention and control technologies (Alberta Environment 2000).

In 2013, the Responsible Energy Development Act established the Alberta Energy Regulator (AER) to monitor oil sands, upstream oil, gas, and coal projects in Alberta. The Public Lands Act, Environmental Protection and Enhancement Act, Water Act and Part 8 of the Mines and Minerals Act allow the AER to regulate energy resource developments along the entire process from opening application to reclamation (Government of Alberta 2021c). The Act also creates a registry for landowners to register private surface agreements and ensure companies comply with commitments set out in the agreements (Government of Alberta 2021c).

The AER administers several acts to regulate the energy resource sector, including the Coal Conservation Act and Regulation and the Environmental Protection and Enhancement Act, both of which provide guidance for conservation and reclamation of disturbed land (Government of Alberta 2013a, Government of Alberta 2021a). The Gas Resources Preservation Act and Regulation creates restrictions regarding propane and gas produced in Alberta by demanding a permit for transporting it out of province (Government of Alberta 2013b). The Oil and Gas Conservation Act and Rules promote efficient conservation and development of Alberta's gas and oil reserves through production and licensing standards (Government of Alberta 2022d).

The Oil and Gas Conservation Rules govern numerous aspects of oil and gas production such as well licenses and abandonment, and administration standards for collecting, record, and reporting well data (Government of Alberta 2022d). While some of these Acts do not relate directly to air quality, they all include some environmental regulation that aims to limit environmental degradation.

Opportunities for intersectoral action

In Canada, large-scale commitments to climate action are undertaken by the federal government. The federal government is the official signatory to international protocols and agreements, with the expectation that the provinces will implement legislation specifically intended to give international treaties effect in provincial law. Our federal system means provincial governments and the federal government have differentiated powers (or different jurisdictions), and the federal government has limited power to force a provincial government to implement legislation. However, international treaties have tended to set the policy design for reducing GHG emissions and overall air pollution.

Thinking differently about reducing GHG emissions and air pollution may require us to look more to local governments for opportunities to reduce emissions. Local governments

do not have authority or jurisdiction with which to facilitate change in large-scale GHG emissions; however, local communities are becoming increasingly attentive to the interrelationship among social, economic, and environmental issues when making decisions about the physical form and social and economic quality of urban regions (Selin and VanDeveer 2009; Dale et al. 2020).

Local municipalities can implement practical measures that produce several benefits, including the reduction of GHG emissions (Selin and VanDeveer 2009; Burch 2010, Boyer 2013). For example, local governments can develop building standards and codes to improve energy and water efficiency, facilitate energy and water audits, and retrofits of municipal buildings and they can procure and install energy-efficient infrastructures such as streetlights, parking meters, and pumping equipment. They can also procure low emission and alternative fuel fleet vehicles, develop district heating and cooling systems, develop active transportation infrastructures such as bike lanes and pedestrian-friendly neighbourhoods, and develop public transport (Selin and VanDeveer 2009).

Municipalities also have a certain amount of power over land-use planning and waste management, and can use their power over zoning to implement strategies including landfill gas capture (Selin and VanDeveer 2009). They can also develop adaptation plans that respond to their particular environmental needs and vulnerabilities; for example, mapping, flood control, and planning that protects water quality and natural spaces (Boyer 2013).

Perhaps most important is leadership and organizational structure. Burch (2010) finds that the major barriers to climate action by Canadian municipalities are not so much technical or financial, but rather are a matter of effectively applying existing resources and creating an institutional structure that prioritizes sustainability.

Environmental education can also be a strategy for younger generations to understand the complex nature of climate change and their own potential to contribute to a sustainable climate. Several aspects of climate change make it a challenging topic to teach. Teaching about climate change encompasses climate science and scientific literacy, social policy, critical thinking, coping with uncertainty and negative emotions including fear and anxiety, and teaching for individual action and advocacy (Monroe et al. 2019; Stevenson, Nicholls, and Whitehouse 2017).

Anderson (2012) argues that environmental education has the most positive effects on individual behaviour, skills, and attitude when it focuses on personally relevant and meaningful information and using active and engaging teaching methods. In their literature review, Monroe et al. (2017, 791) identify four themes specific to effective environmental education about climate change: "(1) engaging in deliberative discussions, (2) interacting with scientists, (3) addressing misconceptions, and (4) implementing school or community projects."

What could be done?

The AER is a provincial corporation created to provide safe, efficient, orderly, and environmentally responsible development of energy resources in the province. The AER describe their mandate as: holding industry accountable, giving Albertans a voice, protecting the environment, and reporting on their progress (Alberta Energy Regulator n.d.).

In recent years, the AER has come under criticism and review because of concerns that the organization fails to credibly and effectively regulate Alberta's oil, gas, and coal industries, among other reasons, leaving the environment at risk. The AER has been subject to a number of formal and informal reviews that aim to improve the organization's capacity to act effectively and credibly as a regulator (Nikiforuk 2019). A 2019 Pembina Institute report found some progress towards these goals have been made, but there are still clear areas for improvement, particularly on higher level direction for the AER through a provincial Integrated Resource Management System (IRMS), meaningful public engagement, and mechanisms for landowner protection.

The province of Alberta and the country of Norway have similar profiles when it comes to their resource sectors. Norway is ranked 36th of significant emitters of GHG on a per capita basis, while Canada is ranked 12th. Norway produces and consumes significantly

more renewable energy than Canada, particularly in the form of large-scale electricity generating hydropower projects, which have provided energy for the residential and commercial sectors for several decades (Lauerman 2019).

Norway is on the leading edge of decarbonizing the major sources of its energy-related GHG emissions such as oil and gas production, transportation, and manufacturing. Additionally, in the first half of 2019, half of the automobiles sold in Norway were fully electric, giving the country the highest rate of electric car adoption in the world (Lauerman 2019). These gains in electric vehicle adoption are a result of the full range of government measures designed to assist electric car sales in Norway. This includes funding necessary infrastructure such as charging stations, free public parking, taxes on gasoline or diesel based vehicles, and discounts or exemptions on road tolls (Lauerman 2019).

Norway is not at the forefront for reducing domestic emissions, but has instead opted to use a carbon trading scheme to pay other nations to cut their emissions (Climate Action Tracker 2019; Neslen 2016). In order to continue to profit from their own non-renewable natural resources while also contributing positively to the environment, Norway has leveraged its financial capacity to support reducing GHG emissions in developing countries (Lauerman 2019).

Norway has also invested heavily in research for carbon capture and storage technology. The non-renewable natural resource sector is a strong contributor to the Norwegian economy and has, with government support, began pilot projects to build full-scale carbon capture plants at both a waste incinerating facility and a cement factory by 2024 (Bevanger 2018).

Norway serves as an example of policies and initiatives that the Alberta government could adopt to improve our global GHG emissions and our overall impact on the environment. Such initiatives would require government and industry investment, but would not result in the shutdown of the oil and gas sector. Because of Norway's similar industrial profile to Canada, particularly in its oil and gas sector, the Alberta government could learn from Norway's approach to industrial emissions: investing in carbon capture and storage technologies, and using a portion of oil and gas profits to support emissions reduction programs and research.

Air Quality

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CHAPTER FOUR

ECONOMY AND LAND MANAGEMENT

TABLE OF CONTENTS

INTRODUCTION

The Economy and Land Management chapter examines the relationship between economy, quality of life, and land-use in the watershed. The economy has a major influence on quality of life, as a thriving economy provides opportunities for employment, increases access to consumer goods, and helps to support governments in providing public services. Alberta's economy is dynamic, but heavily dependent on revenue from oil and gas and other natural resource industries. Newer economic sectors such as information technology, health and human services, tourism, real estate, and construction exist alongside more traditional industries including agriculture, mining, and forestry. While agriculture contributes a smaller share to the province's economy than it has in the past, agriculture remains important as a source of employment and as a way of life for many people in the province.

Measuring Economy and Land Management

1. Economic Wellbeing

This measure focuses on the economic determinants of health, which include income and social status (Health Canada 2022). There are two indicators used in this measure: (1) Income and (2) Labour Force Participation Rate. Income is an important dimension of quality of life, as low income poses a risk factor for greater health risks and increased life stress (Lazar and Davenport 2018, 29). Sufficient income gives people the ability to pay for necessities such as adequate housing, food, and clothing, and also helps people to have leisure time and access opportunities for growth and social mobility. Labour Force Participation Rate is the proportion of the working-age population that is either employed or actively looking for work (International Labour Organization 2020, 5). A low participation rate is indicative of a high unemployment rate. This may be due to barriers to employment in certain communities, or reduced economic opportunities.

2. Economic Development

Economic Development can be defined as "programs, policies or activities that seek to improve the economic well-being and quality of life for a community" (Government of British Columbia n.d. b). Business Incorporations and Gross Domestic Product (GDP) by Industry are the two indicators included in the measure Economic Development (Government of Alberta n.d. h; Government of Alberta n.d. i).

Business incorporations contribute to economic growth by employing workers, creating investments, and generating profit (Manyika et al. 2021). GDP is the monetary value of goods and services produced within a country in a given period of time (Callen 2020). An increase in GDP over time is an indicator of economic growth (Callen 2020).

3. Ecosystem Services

Economic value is created by environmental processes such as water and air filtration, carbon sequestration, or beneficial wildlife habitat. Ecosystem services quantifies the direct or indirect benefits wildlife or ecosystems provide to people (Value of Nature to Canadians Study Taskforce 2017, 11). For example, provincial parks contribute to ecosystem services by providing recreational opportunities, helping conservation efforts for wildlife populations, and contributing to the preservation of intact ecosystems (Canadian Parks and Wilderness Society n.d.; Alberta Parks 2020). The value of ecosystem services can be compared to the value that might be extracted from a given area through resource extraction or other land-uses, allowing communities to make more informed decisions around the trade-offs between land preservation and land development.

4. Land Management

Land management is defined as "programs and services that support the long-term management of land and natural resources" (Government of Alberta n.d. l). The Land-Use Framework (LUF) in Alberta informs the management of public and private lands (Alberta Land Use Secretariat 2008, 33-34). The LUF seeks to balance the different values at stake in land management, including protection and conservation, economic development, and access to land (Alberta Land Use Secretariat 2008). In this Atlas, the Land Management measure includes three indicators: (1) Land Development, (2) Linear Development, and (3) Agricultural Land-Use.

Understanding the Political Context of Economy and Land Management

Economy and Land Management are tied together through the centrality of land for Alberta's political identity and economy. The centrality of land is emphasized in numerous government documents and is especially prominent in the language used by documents associated with Alberta's LUF.

The Minister's Introduction to this document states that "Albertans have a special relationship with the land. Our prairies and parklands, our forests and foothills, our majestic Rockies — each shapes how we live and work on a daily basis. Our land is big, beautiful and bountiful, and we are grateful for the opportunities it has given us. Over the last 10 years, we have enjoyed unprecedented prosperity.

But with this prosperity have come new challenges and new responsibilities. Now is the time to ensure that this land— and all the activities it sustains — is managed responsibly so that our children and grandchildren can enjoy the same quality of life that we have" (Alberta Land Use Secretariat 2007, i).

Work and employment in the BRW, and in rural Alberta more generally, is often tied to the land-based sectors of agriculture and resource extraction. However, this is beginning to change (even in rural Alberta) as service-sector employment begins to overtake employment in goods-producing industries. Data from Statistics Canada shows, as of 2021, over 221,000 people were employed in healthcare and social assistance in Alberta, second only to the number of people employed in trades, just over 335,000 people (Statistics Canada 2022h).

Even as the picture of employment in rural Alberta changes, the province continues to promote itself to potential investors, business owners, and employees as an economy based on resource extraction, manufacturing, and, increasingly, real estate and financial services (Alberta Economic Development and Trade 2017). The province's rich and diverse ecosystems also support other resource-based industries such as coal mining and tourism. All of these industries are directly connected to ecosystem services because people make their living from the land and also depend on their environment's continued capacity to sustain their livelihoods.

Overall Policy Design

In the last few decades, the provincial government has been fairly consistent in their approach to economic development and regulation. Since the mid-1990s, the province's budgets have emphasized high employment, low taxes, and cutting government spending (Alberta Treasury 1997, 23). This approach is more pronounced under governments headed by conservative or right-of-centre parties than it has been under more left-leaning governments, but aside from a brief reign by the NDP from 2015 to 2019, Alberta has been led by conservative parties for most of the past century, and by a single party, the Progressive Conservatives, from 1971-2015 (Thomas 2019, 57; Elections Alberta n.d.).

The NDP introduced policies, such as Alberta's Climate Leadership Plan (the Alberta CLP), that were notably more conscious of issues like climate change, and used taxation as a means to promote environmental causes and sustainable economic development (Bratt 2020). With the 2019 election of the UCP, the province has seen a shift back to more familiar approaches to the economy and the environment. Notable among these pendulum swings are the UCP's repeal of the carbon tax, the financial pillar of the CLP (Bratt 2020, 4).

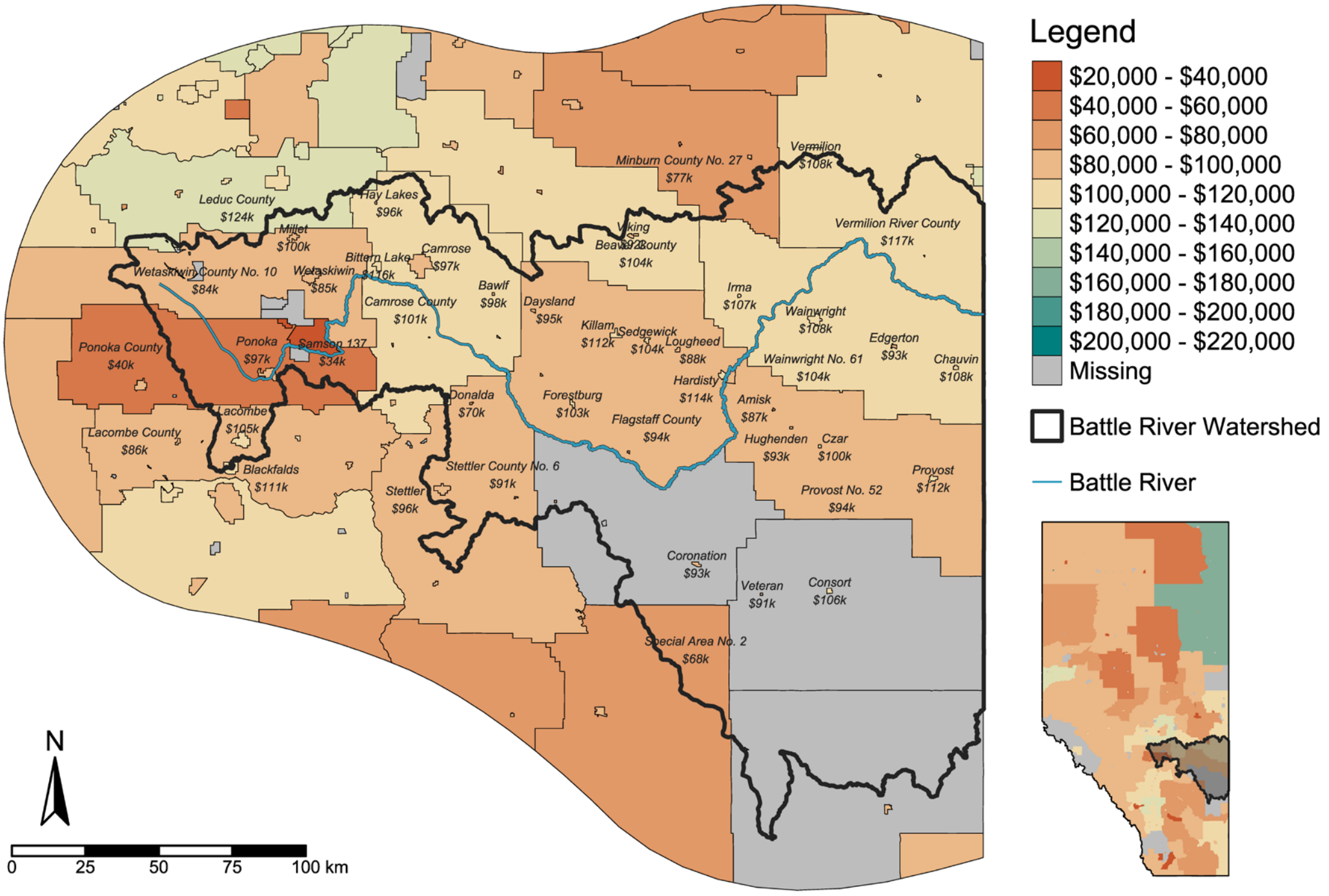
Since 1947, natural resources (particularly oil and gas) have been the cornerstones of Alberta's economy (Alberta Culture and Tourism n.d.). There is a long list of provincial legislation created to attract business and encourage development based on these natural resources. Specific legislation will be addressed in the chapter, but a current example is Alberta's Recovery Plan (2020), implemented both to protect the economy from the COVID-19 pandemic and to address the economic downturn the province has experienced in the last decade because of a collapse in global oil prices (Government of Alberta n.d. d). The plan commits to diversifying Alberta's economy but argues that this diversification can only happen through renewed investment in the province's oil and gas sector (Government of Alberta n.d. d). At the same time, Alberta's resources are primarily non-renewable, and the government must also create legislation that attempts to protect the environment and ensure that there is a long-term vision for the economy.

Land-use policy in the province that attempts to address this balance includes such legislation as the Alberta Land Stewardship Act (ALSA), the LUF, and the regional land-use plans (RLUPs).

Agricultural land-use is, of course, central to the communities of central and southern Alberta. Land-use planning in the province also has a long history, dating back to the Natural Resource Act of 1930, which sought to "secure provincial jurisdictional authority over [C]rown lands" (Alberta Wilderness Association n.d.). Shortly after this, oil was discovered at Leduc in 1947 and, as a result of this discovery, Alberta implemented a land-use plan that saw Crown land in the province divided into White Areas and Green Areas (Roth and Howie 2011, 473). Green Areas were to be managed for

Median Family Income (2019)

Annual family income, after-tax



Map 4.1: (Source: Government of Alberta, Economic Development and Trade. 2016. Median Income by Municipality).

natural resources and environmental conservation, while White Areas were primarily defined as the settled and agricultural lands in the central, south, and Peace River regions (Alberta Land Use Secretariat 2008, 10). The BRW lies within the White Area, meaning that agriculture is a recognized, protected, and managed type of land-use in this region. In the 1970s, the province introduced Integrated Resource Planning (IRP) to land management. Current legislation, the ALSA, builds on and integrates previous approaches to land-use planning in Alberta (Roth and Howie 2011).

Land-use planning in Alberta currently applies to both public and private lands, and the ALSA brings ecologically-oriented management to both types of land (Alberta Land Use Secretariat n.d. a). The overarching strategy laid out by the provincial government seeks to balance conservation, natural resource development, and access (Alberta Wilderness Association n.d.). For agricultural land-use planning, this strategy is supplemented by a few other important considerations. Alberta's LUF strongly encourages the efficient use of agricultural land to reduce unnecessary human impacts on the landscape (Alberta Land Use Secretariat 2008, 4). The LUF also envisions more diverse agricultural operations and works to reduce the fragmentation of farmland (Alberta Land Use Secretariat 2008, 45).

The LUF envisions the creation of seven RLUP based on seven land-use regions (Alberta Land Use Secretariat 2008, 3). The regions specified in the LUF are based on Alberta's watersheds, similar to the division of the province into regional Watershed Planning and Advisory Councils (WPACs). In addition to the regional plans, the LUF consists of seven strategies designed to further the province's stewardship goals. These strategies are:

- Develop seven RLUP based on seven new land-use regions,
- Create a Land Use Secretariat and establish a Regional Advisory Council for each region,
- Cumulative effects management will be used at the regional level to manage the impacts of development on land, water, and air,
- Develop a strategy for conservation and stewardship on private and public lands,
- Promote efficient use of land to reduce the footprint of human activities on Alberta's landscape,
- Establish an information, monitoring, and knowledge system to contribute to continuous improvement of land-use planning and decision-making, and
- Inclusion of aboriginal peoples in land-use planning (Alberta Land Use Secretariat 2008, 3-4).

Alberta's economic and land-use policies are defined by a dual commitment to promoting the development of its natural resources while also managing those resources for future development (Alberta Land Use Secretariat 2008, 15-16). Albertan governments also tend to court investment from large firms with the capital to develop large projects, while also acknowledging the important role that small and medium-sized businesses play in industries like agriculture, and in servicing and supporting the oil and gas industry (Government of Alberta 2020b, 20; Government of Alberta 2014a).

Economic Wellbeing

Income

In contemporary economies where most working people make a living through some form of waged labour, income is a significant social determinant of health (SDOH) (Bryant et al. 2011; Health Canada 2022). Income is what allows us to access nearly all of the items necessary for survival. Income, or income supports, are also needed to pay for a home, utilities, healthy food, child care, clothing, post-secondary education, transportation, repairs, maintenance, and recreation. If a person or household has insufficient income, unstable income, or no income at all, this can have repercussions for their health and wellbeing. For example, if a family is primarily supported through low-wage earnings, they may find themselves living 'paycheque to paycheque,' with barely enough money to pay monthly bills and living expenses. That family will not be able to do anything beyond a bare minimum of activities without going into debt. In this situation, expenses beyond the bare minimum may include buying a new pair of work boots, paying for a mandatory school field trip, paying for car or home repairs, or purchasing more expensive food items like fresh fruits and vegetables. Many of these "extras" are items that people need in order to maintain physical health and mental wellbeing, to be able to safely do their jobs and continue their education (About Families 2012).

Median Before-Tax Family Income (2019)

Region	Median Family Income	Five Year Change (2014-2019)
Camrose (pop. = 19,232)	$97,120	3.37%
Wetaskiwin (pop. = 12,895)	$85,290	5.70%
Lacombe (pop. = 13,816)	$105,480	0.84%
Edmonton (pop. = 1,004,947)	$97,800	5.24%
Battle River Watershed (pop. = 136,284)	$91,363.40*	3.1%
Alberta Average (pop. = -4,244,000)	$104,597**	2.5%

Table 4.1: Median family income (before-tax) for select communities, the BRW, and Alberta in 2019 (Source: Alberta Regional Dashboard. Median family income, before-tax. Adapted from Statistics Canada, Annual Income Estimates for Census Families and Individuals (T1 Family File)).
* Population-weighted average includes communities listed in Appendix Table A-1
** Population-weighted average

Not only does low or unstable income negatively affect people's ability to participate fully in their society, but it can also have tangible health effects, including an increased risk of type 2 diabetes, food insecurity, and more frequent and more expensive use of healthcare services (Dinca-Panaitescu et al. 2011, 116; Men et al. 2020, 1377). Indeed, economic inequities are responsible for a variety of poor health outcomes, including higher rates of mental illness, shorter life expectancy, higher infant mortality, higher rates of disease, and increased incidence of injuries (Mendenhall et al. 2017; Raphael 2010, 41).

Table 4.1 shows median family income in the BRW and compares it to median income in Alberta. The table also shows the five-year change in income between 2014 and 2019. From the table, we can see that median income in the BRW ($91,363) is lower than the Alberta average ($104,597). It is also slightly lower than median family income in Edmonton ($97,800). There are also variations in income levels between different communities within the BRW (Map 4.1). Median income in Lacombe ($105,480) is essentially

level with median income in Alberta, but income in Wetaskiwin ($85,290) is substantially below the provincial median.

Looking at the five-year change, we can see that income in the BRW has increased at a slightly higher rate (3.1%) than in the province as a whole (2.5%), and at a significantly slower rate than in Edmonton (5.24%). However, several communities within the BRW have seen income increases that are much higher than the provincial increase. Camrose (3.37% increase), and Wetaskiwin (5.70% increase) have seen increases. In Lacombe, however, growth is only 0.84%, well below the Alberta rate (Table 4.1).

Low income

Median income is defined as the income amount that divides a population into two equal groups, with half the population having an income above the median and the other half below the median. Using the low-income measure (LIM), the Government of Canada defines low-income status based on whether their adjusted after-tax income falls below 50% of the median adjusted after-tax income (Government of Canada 2016, 1).

Low-income cut-offs (LICOs) are a threshold in which a family will spend 20% or more of their income on food, clothing, and shelter than the average family (Statistics Canada, Income Statistics Division 2012, 7). In 2015, 7.0% of Albertans were classified as low-income after tax (Statistics Canada 2017d). Some regions in the BRW have higher rates of low-income families than the Alberta average, such as Wetaskiwin (with 25.6% of residents classified as low-income (Alberta Health 2019, 11). LICOs are also based on community and family size. In a rural community with a family of 4 persons, the after-tax LICO is $27,085 in 2019 (Statistics Canada 2022e). The LICO increases with both family and community size. For example, the LICO for a five-person family in a community with a population over 500,000 has $47,148 in 2019 (Statistics Canada 2022e).

Median Family Income by Community (2009-2019)

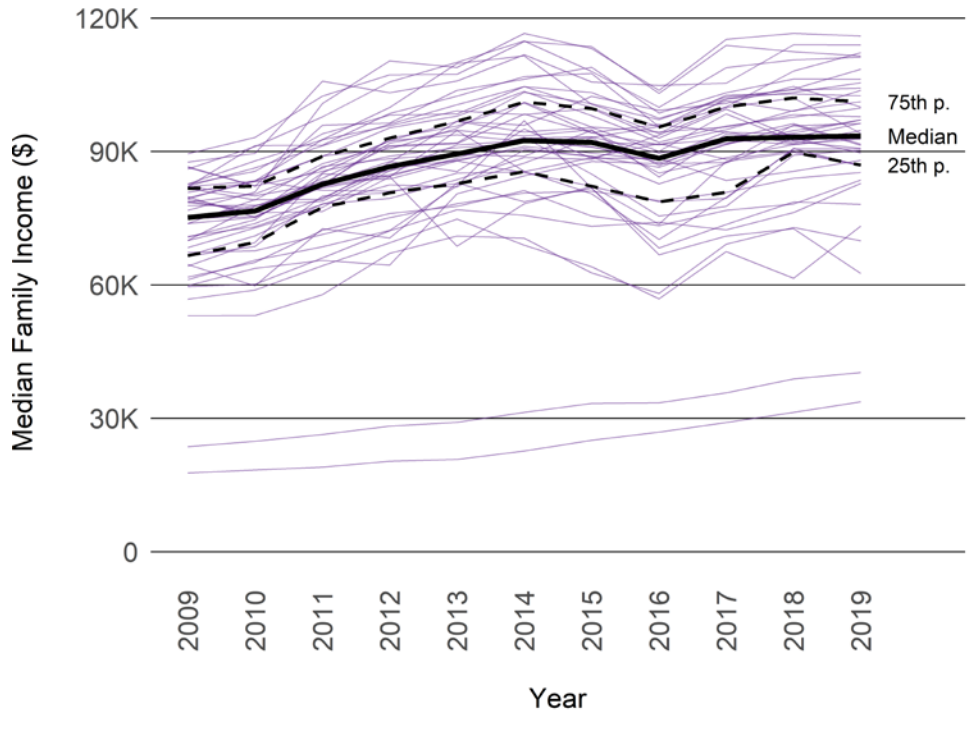


Figure 4.1: Median annual family income (after-tax) for each census subdivision (CSD) within the BRW from 2009 to 2019; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Government of Alberta, Economic Development and Trade, 2016, Government of Alberta, Economic Development and Trade. 2016. Median Income by Municipality).

Understanding Income

Cost of Living

Food, shelter, and clothing all need to be considered when analyzing income. Housing in urban regions is often more expensive.

Families that are classified as low-income are likely to be spending most of their income on housing, regardless of the community in which they live. Those in low-income households may feel more strain in terms of living expenses and necessities, especially when they have a larger family. Grocery expenditures have also been rising every year. A

family with two children was predicted to spend $13,907 annually on food in 2021 (Sylvain et al. 2021, 5). Average expenditures per household on food in Alberta has risen from $8,887 in 2010 to $11,322 in 2019 (Statistics Canada 2021c).

Income Inequalities

Income inequality is defined as an unequal distribution of wealth within a country, creating a 'gap' between those who are high-income vs. low-income (The Conference Board of Canada n.d. a). Income inequality can be measured by the Gini Index, which ranges from a value of 0 (exact equality; every person has the same amount of income) to 1 (total inequality) (Organisation for Economic Co-operation and Development n.d.). Inequality, as measured by a high Gini Index, means individuals of high-income status receive a much larger percentage of the total income of the population (University of Waterloo n.d.). The Gini Index of Canada, based on adjusted after-tax income, was 0.299 in 2019; this value has decreased from 2018, which was 0.304 (Statistics Canada 2022d). The decrease in the Gini index value demonstrates that in 2019, a minor, but positive, shift was made toward income equality. The Alberta Gini index in 2019 was 0.291, similar to the Canadian rate (Statistics Canada 2022d).

Income inequality in Canada has been slightly improving. The incomes of the fifth (richest) category of Canadians have been decreasing, while the other four categories of Canadians have had their incomes increase by an average of 1.6% per year since 2000 (Statistics Canada 2021a, 3). While measuring income does not provide a holistic account of an individual's wellbeing, income is a common and important component of individual economic wellbeing. The influential Whitehall studies in Britain have shown significantly worse health outcomes among lower-income civil servants, outcomes which could not be attributed to differences in risk factors such as diet, exercise, and smoking (Clark 2021). These results highlight the physical, social, and health effects of income inequality. Measuring income can also give us an insight into how many individuals in a given area will be able to meet their basic needs through employment alone, and how many will be in need of income supports or other forms of social assistance to meet their needs (The Conference Board of Canada n.d. b).

Income also has ripple effects within a community. Having more disposable income (income that is not required to pay for necessities) means individuals are able to put more of their income toward purchasing goods and services that fuel the economy both locally and further away. (Burchardt 2010; Williams and Shaw 2009).

In a similar vein, income is related to other variables for economic wellbeing including consumption and leisure time. For the last four decades, trends in North America have shown increasing inequalities in consumption, income, and leisure time, with high-income individuals and individuals increasing their share of economic wealth, yet also showing declining leisure time. Lower- income individuals, conversely, are showing declining wealth and purchasing power but an increasing share of leisure time (Sevilla, Gimenez-Nadal, and Gershuny 2012, 939; Attanasio, Hurst, and Pistaferri 2012).

The wage gap between men and women in Canada is an example of income inequality. Females aged 25 to 54 earned $4.13 less per hour, or 13.3% less compared to their male counterparts in 2018 (Statistics Canada et al. 2019, 4). This wage gap has decreased by 5.5% since 1998; however, the gap is still significant (Statistics Canada et al. 2019, 4). For example, women aged 25-54 earned an average of $52,500 in 2014, while their male counterparts earned an average of $70,700 (Moyser 2017, 26). Sixty percent of women in Alberta make minimum wage, are more likely to work part-time, and are overrepresented in low-paying careers even though Albertan women tend to be highly educated (Government of Alberta n.d. u). Women also need to have greater educational attainment for the same career to be paid close to what men make in that career. For example, women with a Master's degree can make an average of $83,000 annually, which is still lower than the $87,000 average annual earnings of men with a Bachelor's degree (Carnevale, Smith, and Gulish 2018, 12).

Labour Force Participation Rate

Labour force participation rates are gathered by Statistics Canada through the Labour Force Survey (Statistics Canada 2022b). The Labour Force Survey is a comprehensive survey that investigates information about total employment estimates (including full- time and part-time) and unemployment. Information from the survey is used to calculate the national unemployment rate, as well as to guide the planning and evaluation of employment programs and other social assistance programs at the national and provincial levels (Statistics Canada 2022b).

Labour force participation rates also tell us about the demographics of the community: for example, a higher-than-average unemployment rate might indicate the community has a high number of people who are not of working age (either children or retired). For working people, a low rate of unemployment is preferable to a high rate, because a low rate of unemployment is more likely to mean that they have a job. Being unemployed is associated with a variety of negative outcomes, including decreased mental health, family disruption, and, when the person does re-enter employment, lower quality or lower paid jobs (Brand 2015, 359).

Low unemployment also tends to indicate there are jobs available in the community, and the community has a good balance between numbers of younger, older, and working-age residents (Axelrad, Malul, and Luski 2018).

Labour Force Participation Rate (2016)

Region	Participation Rate	Five Year Change (2011-2016)
Camrose (pop. = 19,223)	65.2%	-1.66%
Wetaskiwin (pop. = 12,953)	65.6%	3.47%
Lacombe (pop. = 13,365)	68.2%	-3.54%
Edmonton (pop. = 964,258)	71.8%	-1.24%
Battle River Watershed (pop. = 136,284)	68.4%*	-2.03%
Alberta Average (pop. = -4,244,000)	71.7%**	1.70%

Table 4.2: Labour force participation rate (the share of the working-age population that is working or looking for work) for select communities, the BRW, and Alberta in 2016 (Source: Alberta Regional Dashboard. Labour-force participation rate. Adapted from Statistics Canada, National Long form Census (1981-2006) and National Household Survey (2011)).
* Population-weighted average includes communities listed in Appendix Table A-1
** Population-weighted average

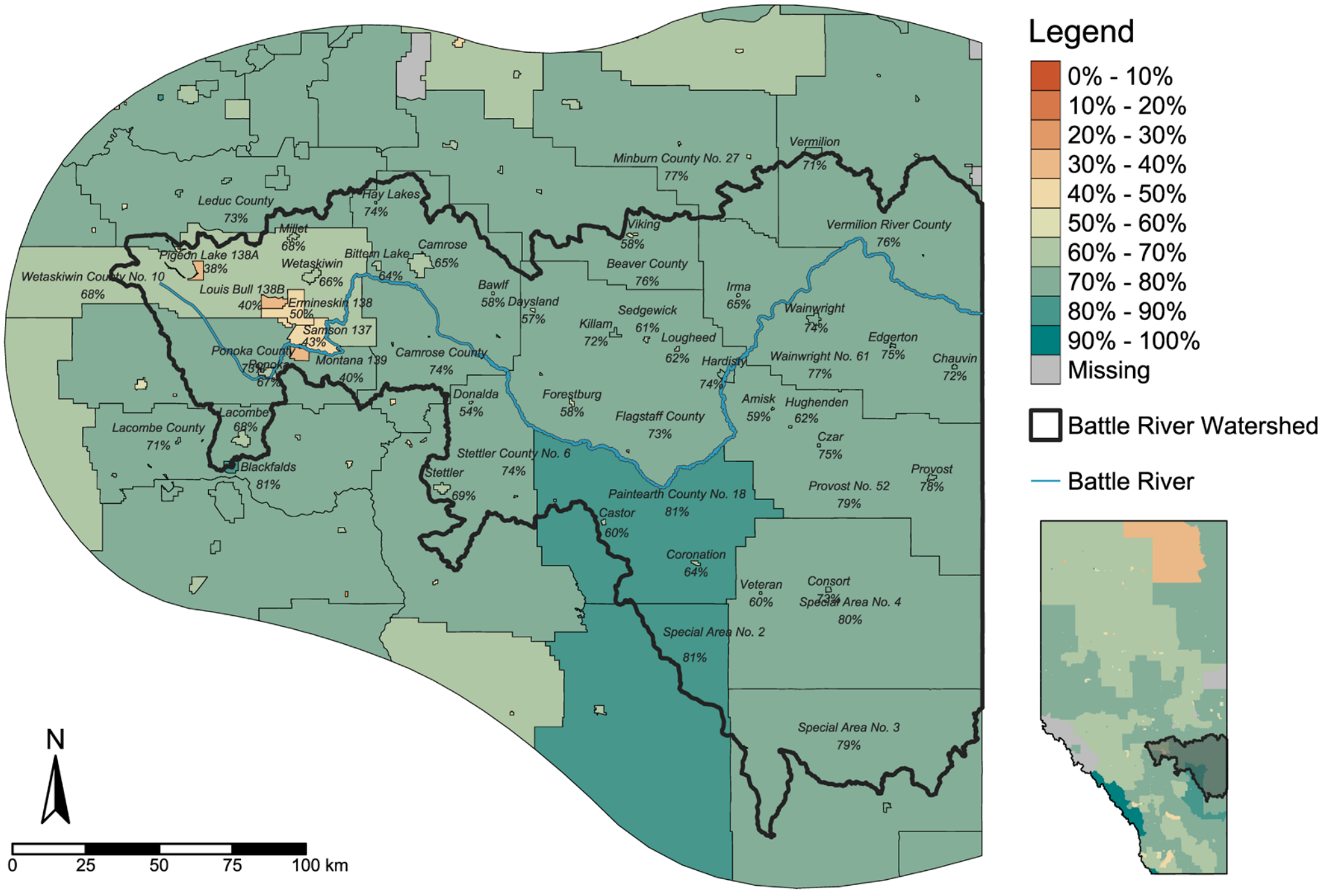
Low unemployment also tends to be an indicator of economic prosperity, decreased homelessness, and increased self-perceived health and mental health (The Conference Board of Canada n.d. c; Institute for Work and Health 2009). However, many factors influence labour force participation and unemployment. Access to employment is not evenly distributed across the country, and some communities face significant barriers to employment. In Alberta, and across Canada, Indigenous peoples tend to have lower work force participation rates and higher rates of unemployment (Pendakur and Pendakur 2011).

Table 4.2 shows the labour force participation rate in the BRW and compares it to labour force participation rate in Alberta. The table also shows the five-year change in labour force participation rate between 2011 and 2016. From the table, we can see the labour force participation rate in the BRW (68.4%) is just slightly lower than the Alberta average (71.7%). It is also lower than the labour force participation rate in Edmonton (71.8%).

There is also variation in labour force participation between different communities within the BRW. The rate in Lacombe

Labour Force Participation Rate (2016), Males and Females

% of population 15 years of age and over that is working or looking for work



Map 4.2: (Source: Government of Alberta, Economic Development and Trade. 2016. Census Employment by Municipality).

(68.2%) is lower than the rate for Alberta and the BRW as a whole, but it is higher than in Wetaskiwin (65.6%) and Camrose (65.2%). Labour force participation in the BRW has declined (-2.03%), while labour force participation in the province as a whole has increased (1.70%). However, when we look at the data for municipalities, we see interesting variations. Labour force participation in Camrose (-1.66%) and Edmonton also declined over the selected period (-1.24%), and declined significantly in Lacombe (-3.54%). At the same time, labour force participation increased significantly in Wetaskiwin (3.47%) (Table 4.2).

In 2016, the BRW had a labour force participation rate just below 70%, a rate that is consistent with the provincial rate (Table 4.2; Map 4.2). This is likely due to the prevalent labour force in the oil/gas and agriculture industry in the BRW, allowing for greater employment opportunities. According to a 2010 study by Watrecon Consulting, 23.6% of the BRW labor force had experience in agriculture and other resource-based industries, 17.2% were involved in service industries, 11.5% were involved in health care, and 10.7% of employment was in retail (Watrecon Consulting 2010, 8-9).

Agriculture and resource-based industries make up a large portion of the employment for the region, however, other industries do exist to help round-out economic participation. The labour force participation rate is significantly higher in the male population, at a rate of 69.2%, compared to the 56.7%

Labour Force Participation Rate by Community (1996-2016)

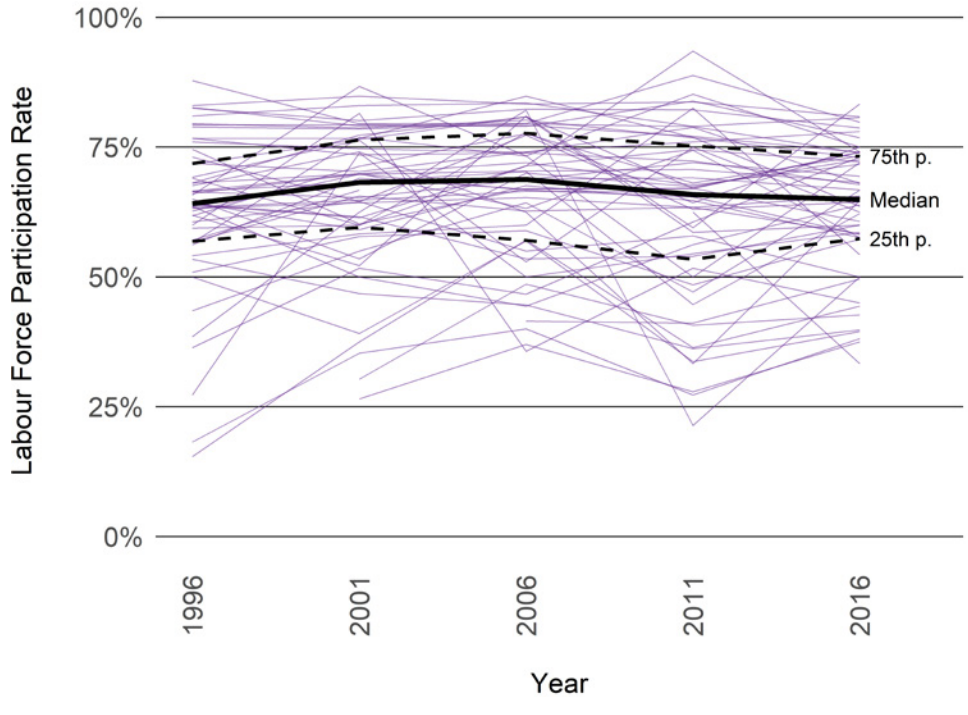


Figure 4.2: Labour force participation rate (% of population 15 years of age and over that is working or looking for work) for each census subdivision (CSD) within the BRW from 1996 to 2016; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Government of Alberta, Economic Development and Trade, 2016, Government of Alberta, Economic Development and Trade. 2016. Census Employment by Municipality).

rate of the female population in the BRW (Map 4.3; Map 4.4). 81% of health occupations are women, whereas 8.7% of employees in trades, transport, and equipment operator occupations were women (Alberta Labour and Immigration and Government of Alberta 2021, 5).

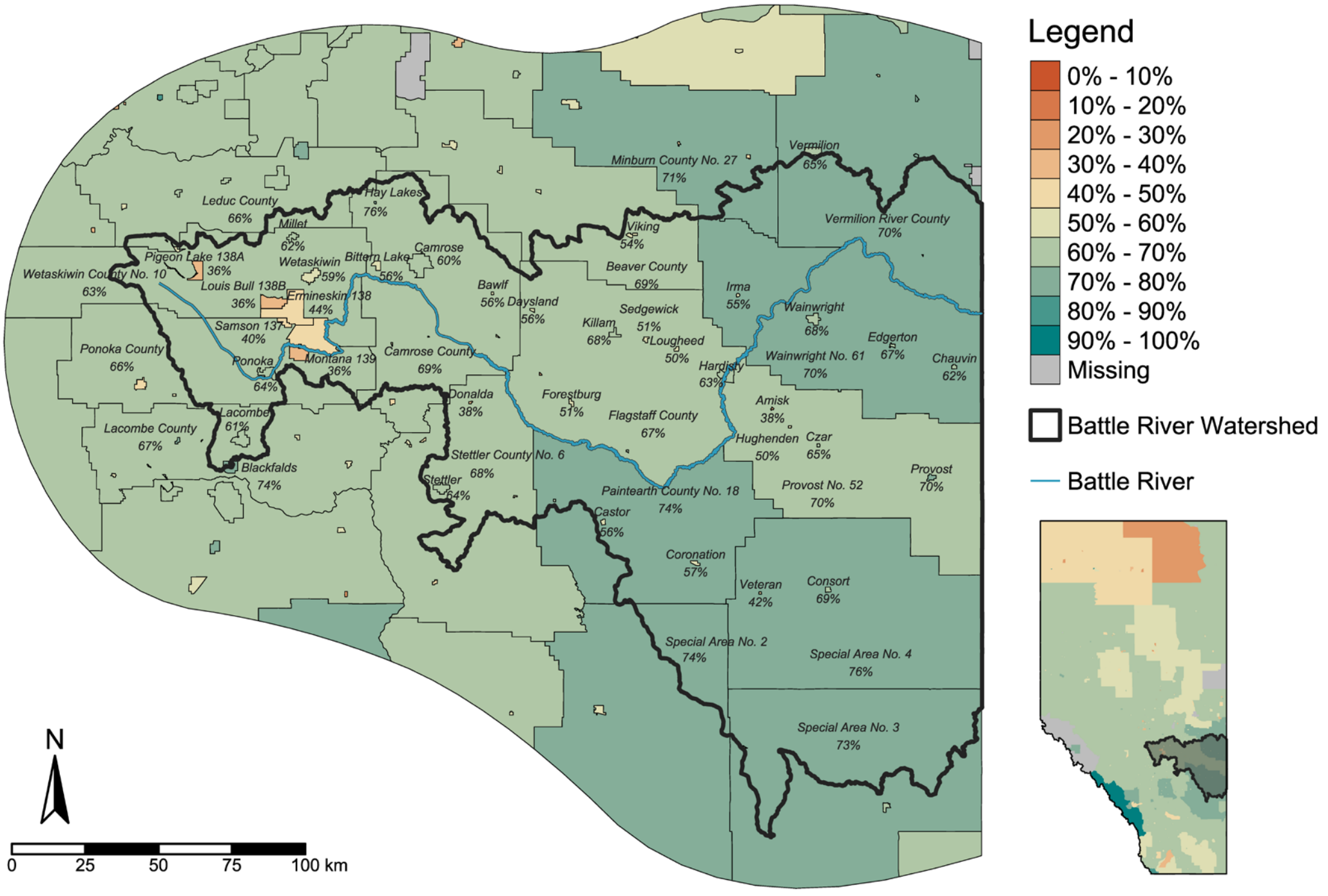
Understanding Labour Force Participation

Labour Market Highlights

- In 2019, Alberta had the highest provincial rate of labor force participation, with a rate of 70.9%. Between 1980 and 2019 the labour force participation rate remained above 70% (Statistics Canada 2022j),
- From 2016-2019, employment has continuously expanded; but at a rate of only 0.5% each year. This growth in employment is driven largely by part-time work (Alberta Labour and Immigration and Government of Alberta 2020, 12),
- In 2019, health care and social assistance occupations accounted for the highest employment, with 293,400 jobs in Alberta. The construction

Labour Force Participation Rate (2016), Female

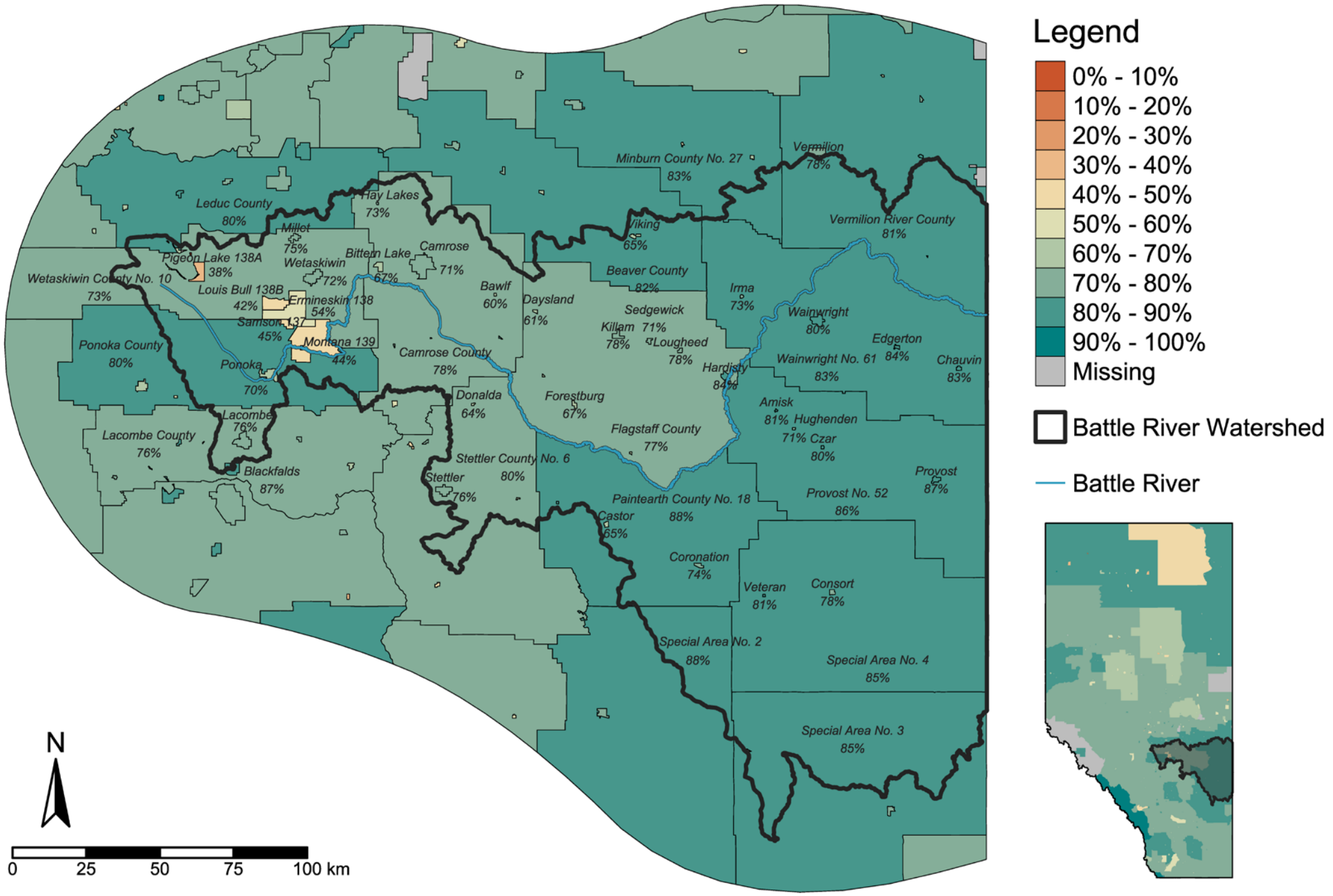
% of population 15 years of age and over that is working or looking for work



Map 4.3: (Source: Government of Alberta, Economic Development and Trade. 2016. Census Employment by Municipality).

Labour Force Participation Rate (2016), Male

% of population 15 years of age and over that is working or looking for work



Map 4.4: (Source: Government of Alberta, Economic Development and Trade. 2016. Census Employment by Municipality).

industry accounted for 236,800 jobs, with mining/oil and gas extraction accounting for 141,700 jobs and agriculture accounting for 49,200 jobs (Alberta Labour and Immigration and Government of Alberta 2020, 14),

- As of 2016, the agriculture, forestry, fishing, and hunting sector accounted for approximately 2,960 jobs in the BRW. Employment for this sector of agriculture has increased, with an employment rate of 2,515 jobs in 2011. The mining, quarrying, and oil and gas extraction sectors accounted for approximately 1595 jobs in the BRW. In 2011, the oil and gas sector had an employment rate of 2,115 jobs, indicating that employment in this industry has significantly been decreasing through the years (Government of Alberta 2016a),
- In 2019, Alberta's unemployment rate was 7.0%, the highest rate in the Prairie regions (Statistics Canada 2022j). In Alberta, the occupations related to natural resources and trades (*i.e.* construction, mining, oil/gas extraction, etc.) see the highest rates of increasing unemployment due to falling oil prices (Alberta Labour and Immigration and Government of Alberta 2020, 23),
- Educational attainment is high within Alberta's labor force. Based on the 2016 census, 86.6% of Albertans (aged 25-64) have a high-school or equivalent certificate. 28.2% of Albertans (aged 25-64) hold a bachelor's degree or higher, 22% have a college certificate or diploma, and 7.5% have an apprenticeship certificate (Statistics Canada 2017c).

Policy Responses for Economic Wellbeing

Why do we measure it?

Labour Force Participation Rates

Labour Force Participation Rates are a measure of an economy's active workforce. The formula for determining the Labour Force Participation Rate consists of the sum of all workers who are employed or actively seeking employment divided by the total non-institutionalized (not incarcerated, not living in psychiatric facilities or other care homes) civilian working-age population (Parkinson 2018). This metric provides useful information as it captures employment and unemployment data by measuring the number of people who are actively job hunting as well as those who are currently employed (Parkinson 2018). The Labour Force Participation metric helps analysts to determine when the economy has entered a recession because the labour force participation rate declines.

The Alberta government creates policies that are intended to encourage high employment and to support entry into the workforce for women, Indigenous people, new immigrants, and other people who may experience one or more barriers to employment including disabled people and older people seeking to return to work. Some of these documents include the Department of Labour Business Plans and the Ministry of Human Services Business Plans, which will be discussed below. Other organizations contributing to labour participation in Alberta include community service providers like Alberta Works and Alberta Service Centres which support people in Alberta who are seeking employment or skills training (Alberta Human Services 2022).

Income

For the whole of Canada in 2019, the median income was $62,900.00 (Statistics Canada 2021a). In the BRW, median household income in 2019 was $91,363.40, while in Alberta, for the same year, median income was $104,482.00. While people in the BRW earn above the Canadian median, they also earn about $13,000.00 less than the provincial median. Such a discrepancy can have repercussions for different regions within the province. For example, cost of living expenses such as shelter, food, and transportation may be more burdensome for people living in lower-income regions if there isn't a corresponding reduction in prices between different regions. Statistics Canada data shows people living in rural areas tend to have lower incomes than people living in urban areas. This gap can be quite large across Canada. In 2019, a low-income family of four in a rural region had an income of $27,085 after tax, while a low-income family of four in an urban region with a population over 500,000 had an after-tax income of $41,406 (Statistics Canada 2022e).

The Market Basket Measure (MBM) was developed to approximate the threshold of poverty. Food, clothing, shelter, transportation, and

"other items for individuals and families representing a modest, basic standard of living" make up the costs included in the MBM (Heisz 2019, 5). According to Statistics Canada, "[a] family with disposable income less than the poverty threshold appropriate for their family's size and region would be living in poverty" (Heisz 2019, 5). As of 2019, rural Alberta residents have a market basket cost of $46,561, while residents of Edmonton and Calgary have a market basket cost of $49,457 and $50,006, respectively (Statistics Canada 2022c).

The data shows us that rural residents have only a slightly lower MBM than urban residents, meaning it is almost as expensive to live in a rural area in Alberta as it is to live in an urban area. At the same time, rural Alberta residents earn substantially less than urban Albertans.

How have governments responded?

Labour Force Participation Rates

Every few years the Government of Alberta releases a business plan detailing the goals and outcomes the Government wants to achieve in terms of work force participation. In 2016, the Department of Labour released the Business Plan 2016-2019. This plan envisions several outcomes including: ensuring Alberta's labour laws and labour environment are fair and balanced through updating Alberta's labour and workplace legislation and policies to be family-friendly, increasing the minimum wage, and developing an essential services model for the Alberta public sector (Government of Alberta 2016b, 100-101). The framework seeks to ensure that Alberta's collective bargaining laws are fairly and equitably applied through continuing to provide services to the Alberta labour relations community, promoting the use of alternative dispute resolution methods rather than formal hearings to solve issues, continuing to make clear and timely decisions, and enhancing information technology resources (Government of Alberta 2016b, 101). Another envisioned outcome was ensuring that Alberta has safe, fair, and healthy workplaces that protect the status of all employees and workers through better protecting farm and ranch workers, providing better quality, fast and fair services for employment standards, preventing injury and illness in workplaces, increasing workplace compliance with occupational health and safety and employment standards legislation, and performing a review of the province's worker compensation process to ensure workers and employers are treated fair and equitably (Government of Alberta 2016b, 102).

Other desired outcomes include ensuring that Albertans have "timely, fair, and independent appeal services through the Appeals Commission for Alberta Workers' Compensation," and continuing to ensure that Albertans have the skills required by Alberta's labour market through funding training and employment programs, building targeted initiatives, and assisting young Albertans to join the work force (Government of Alberta 2016b, 103-104). The focus of the plan is a commitment to ensuring that Alberta is able to attract and retain a skilled, resilient. and productive workforce to support a diversified economy through skills training, developing labour market information, and targeting labour attraction, retention, and mobility strategies. Lastly, the Business Plan also commits to implementing recommendations identified by the Truth and Reconciliation Commission and the United Nations Declaration on the Rights of Indigenous Peoples (Government of Alberta 2016b, 104).

Income

As with the policy framework for labour force participation, the Government of Alberta highlights the importance of income across different ministries. Alberta's Social Policy Framework (2013), also discussed in the People and Communities Chapter of this Atlas, addresses the growing gap between the rich and the poor in Alberta and how certain populations struggle because of growing inequality (Government of Alberta 2013, 6). For instance, the report recognizes the link between income inequality, poor health outcomes, and social problems. The Framework further argues that low income reduces social cohesion (Government of Alberta 2013, 6). This policy framework envisions the outcome of granting Albertans access to effective income support when in financial need.

Other policies addressing income include the Skills Investment Strategy, released in 2003, which set the direction for adult training and employment programs under Alberta Human Resources and Employment (AHRE). The Strategy lays out plans for programs that are

designed to assist Albertans to "prepare for, train for, find and keep employment" (Alberta Human Resources and Employment, Labour Force Partnerships and Skills Policy Branch 2003, 1). The stated goal of these training programs is to "reduce the dependency of Albertans on income support programs and increase sustained employment over time" (Alberta Human Resources and Employment, Labour Force Partnerships and Skills Policy Branch 2003, 2).

Another strategy is the Alberta 2030: Building Skills for Jobs Strategy. This plan aims to ensure that Alberta's post-secondary system provides students and graduates with the job skills needed to succeed in the workforce (Alberta Advanced Education 2021, 5). Research does show links between employment training and health equity. However, these links are strongest when training connects workers with positions where there are opportunities for career advancement. In other words, the quality of the jobs for which workers are being trained matters when it comes to the connection between skills training, employment, and health (Tsui 2010).

What is being done?

Labour Force Participation Rates

Along with favouring low taxes and low provincial debt, Alberta places a high value on having a low unemployment rate (Adkin 2016, 78). This economic approach is part of the province's overall goal of appearing 'business-friendly,' a term that appears both in scholarly assessments of the province's business climate and in the province's own policies and marketing strategies (Moré 2013; Invest Alberta n.d.). In theory, low unemployment means the province will spend less on social assistance programs like illness and disability benefits and housing support.

While Alberta has the highest labour participation in Canada, Alberta's labour force and unemployment rates show some trends that may be cause for concern. For example, Albertans who lose their jobs now are unemployed for almost three times as long as unemployed Albertans were in 2008 (Wilkins and Kneebone 2018). Some researchers argue that the increasing periods of unemployment in Alberta are a result of changes in global economic trends around the production and consumption of energy, and provincial policies which support Alberta's energy industry at the expense of other industries (Adkin 2016, 92-93). However, the province continues to strive for a high labour force participation rate among all ages of the working population, a claim that appears in several current government documents, including the Restoring Balance in Alberta's Workplaces Act (2020) and Alberta's Recovery Plan (2020) (Government of Alberta n.d. r; Government of Alberta 2020b).

Besides private sector employment, many people are also employed in the public sector as government employees, in educational services, health care, and public utilities. Public service employment is governed by the Labour Relations Code and the Employment Standards Code, but these employees are also subject to the Public Service Employee Relations Act, which outlines the rights and responsibilities of employers, trade unions, and employees in Alberta's public sector (Government of Alberta 2022h, 1). While the number of people employed in the public sector has not grown significantly in several decades, public sector employment accounts for more than 10% of Alberta's workforce, and public sector workers in Alberta generally earn more than public sector workers in any other jurisdiction in Canada (Mueller 2019, 1-2).

Communities can play a key role in helping individuals with disabilities feel included, make use of their abilities, and access opportunities for education, recreation, employment, and volunteer participation (Soresi et al. 2011). The community can help facilitate the necessary conditions to prioritize the happiness and positive emotions of people with disabilities, along with helping to develop their strengths (Soresi, Nota, and Wehmeyer 2011, 25). Schools, extra-curricular activities, and community events are key places where communities can foster inclusiveness. Disability is no longer considered to prohibit people from participating in the labour force, but people with disabilities experience a variety of barriers to employment.

A recent study has found that barriers to employment for people with developmental disabilities are multi-factorial, including individual barriers such as impairments in verbal communication and external barriers such as employer attitudes (Khayatzadeh-Mahani et al. 2020, 2699). The study suggests policy

solutions to address these barriers require stakeholder engagement and collaboration from multiple sectors, including government and business leaders. Policies designed to improve the labour force participation of people with disabilities should consider employers and the workplace, specific needs of persons with developmental disabilities, and broader social factors including stigma and preconceived expectations about the capabilities of people with disabilities (Khayatzadeh-Mahani et al. 2020).

The Government of Canada also has legislation and policies pertaining to employment and labour force participation. The relevant documents here are:

- The Canada Labour Code: The objective of the Code is to facilitate productivity by controlling strikes and lockouts, occupational safety and health, and some employment standards. This Act also acknowledges employment standards are mostly in the hands of provincial legislation for each province of employment (Government of Canada 2022b), and
- The Canadian Human Rights Act: Provinces and territories establish and enforce their own employment and human rights standards and the federal government enacts and upholds the Canada Labour Code and the Canadian Human Rights Act (Government of Canada 2021).

Income

When we try to define 'income,' wages from employment may be what comes first to mind. Income also encompasses money from investments, income tax returns, tax credits and tax rebates, health care benefits, and income support (Statistics Canada 2006, 123-128). The Alberta Personal Income Tax Act levies the personal income tax on individuals who are resident in Alberta, and establishes tax rates and methodology for calculating taxes owing, as well as any refundable tax credits for individuals. The Act also includes relevant administrative and enforcement provisions related to tax collection (Government of Alberta 2022a). The Income and Employment Supports Act provides the authority for programs for Albertans requiring financial assistance to obtain food, shelter, personal items, medical, and other benefits essential to their health and wellbeing. This legislation also provides the authority for training programs and other measures to help Albertans gain independence and self-sufficiency through entry into the labour force (Government of Alberta 2021a, 5).

There are several other forms of income support in Alberta, including Assured Income for the Severely Handicapped (AISH) which provides a living allowance, child benefits, health benefits, and personal benefits for people with a permanent medical condition that prevents them from working (Government of Alberta n.d. g).

The Emergency Needs Allowance is available for people and families requiring immediate financial assistance to pay for basic expenses like food, clothing, and shelter. This program is also available to help cover the cost of essential home and appliance repairs (Alberta Works 2013). The Alberta Child and Family Benefit (ACFB) provides direct financial assistance to lower and middle-income families with children under the age of 18. This benefit is calculated based on income and families receive it automatically so long as they meet the criteria for the benefit (Government of Alberta n.d. c). Finally, the Alberta Adult Health Benefit program covers health benefits for Albertans in low-income households who are pregnant, who are leaving Income Support or AISH, or who have high ongoing prescription drug needs (Government of Alberta n.d. b).

The major role of the federal government in relation to income is through the levying and regulation of income tax. In Canada, there are taxes applied to personal income, business income, corporate income, trust income, and separate income taxes for non-resident people and corporations (Government of Canada 2022e). Federal programs and policies relating to income include the Income Tax Act, the Tax Rebate Discounting Act, the Income Tax Conventions Interpretation Act, and income tax folios.

The Income Tax Act outlines the rules and regulations for income tax, which include tax liability, the computation of income, computation of taxable income, taxable income

earned in Canada by non-residents, computation of tax, special rules applicable in certain circumstances, deferred and other special income arrangements, exemptions, returns, assessments, payment appeals, and appeals to the tax court of Canada and the Federal Court of Appeal (Government of Canada 2022c).

In times of emergency, the federal government also has the authority to issue special income relief. The most recent example of such emergency relief is the Canada Emergency Response Benefit (CERB), which was available to Canadians who lost work and income because of the COVID-19 pandemic between March and September of 2020 (Government of Canada 2022a).

What could be done?

Labour Force Participation Rate

Alberta has the highest rate of labour force participation in the country (Statistics Canada 2022i). However, labour force participation rates are subject to change based on a variety of political and social factors. Some of these factors include an aging population, economic recessions, higher incarceration rates, increasing rates of disability and chronic illness, less-generous maternity and child-care policies, and less spending on on-the-job retraining and job-search assistance programs (Parkinson 2018). Data from Statistics Canada shows although the proportion of women in the labour force has risen significantly since the 1950s, women are still less likely to participate in the labour force than men (Statistics Canada 2015, 3). Labour force participation among people without a high school diploma has declined significantly since 1990 (Statistics Canada 2022g).

From 1990 to 2020, the proportion of women aged 25 years and older in the labour force without a high school diploma declined from 31.4% to 19.5% (Statistics Canada 2022g). Over the same time period, something different occurs for women with a bachelor's or graduate degree. Although their rates of employment are much higher overall than the rates among women with less education, rates of employment for university educated women have declined by almost 8%, from 77.4% in 1990 to 69.6% in 2020 (Statistics Canada 2022g). In other words, women's rates of labour force participation have slowed down or even declined since 1990, even among very educated women.

There are a number of reasons for this decline in participation, including declining government income support, reductions in the size of the public sector, and something called the 'double burden.' The double burden refers to the dual responsibilities of paid work and caring responsibilities, which are disproportionately shouldered by women over their life course (Payne and Doyal 2010, 172). Women are also more likely to be employed in the public sector, which has seen increasing cuts and outsourcing to private sector employment for the past three decades and especially since 2010 (Abramovitz 2012, 30; Rubery and Rafferty 2013, 421).

For both men and women, Canada's labour force has become more and more educated. In 2006, 60.8% of the population aged 25 to 64 had a post-secondary diploma or degree (Statistics Canada 2017a). That number rose to 64.7% in 2016 (Statistics Canada 2017b). The data show this increase was largely due to increasing numbers of women attaining higher education, and as of the 2016 Census, more women than men now attain post-secondary degrees (Statistics Canada 2017b). However, people with less education are now more likely to become unemployed, with unemployment rates almost double for people without a high school diploma (about 12%) in comparison to people with a bachelor's degree or higher (about 6%) (Statistics Canada 2022f).

Other factors affecting employment and labour force participation include race and ethnicity, illness and disability, marital status, and parental status. Canada's 2016 Census shows the visible minority population of Canada participated in the labour force at a slightly higher rate (66.5%) than the non-visible minority population (64.8%) (Statistics Canada 2019).

However, there are significant differences in participation rates among visible minorities. Canadian citizens and immigrants of Filipino heritage had a labour force participation rate of 77.5% (the highest participation rate), while Canadian citizens and immigrants of Chinese heritage had a labour force participation rate of 59.4% (the lowest participation rate) (Statistics Canada 2019). The reasons

behind these differences are complex, including factors such as age, retirement status, and immigration status. People with disabilities generally have lower labour force participation than people without disabilities. As of 2012, the labour force participation rate for working age adults with a disability was 55.5% in Canada (Statistics Canada 2017e).

Income

Changes to the minimum wage also affect income and employment. Raising the minimum wage is increasingly seen as a tool for poverty reduction (Kosiorek 2018, vi). Not all researchers agree about the beneficial effects of minimum wage increases, however, and many studies point to possible increases in unemployment as well as increased taxpayer costs which affect the government's willingness to spend on social assistance programs (Kosiorek 2018, vi).

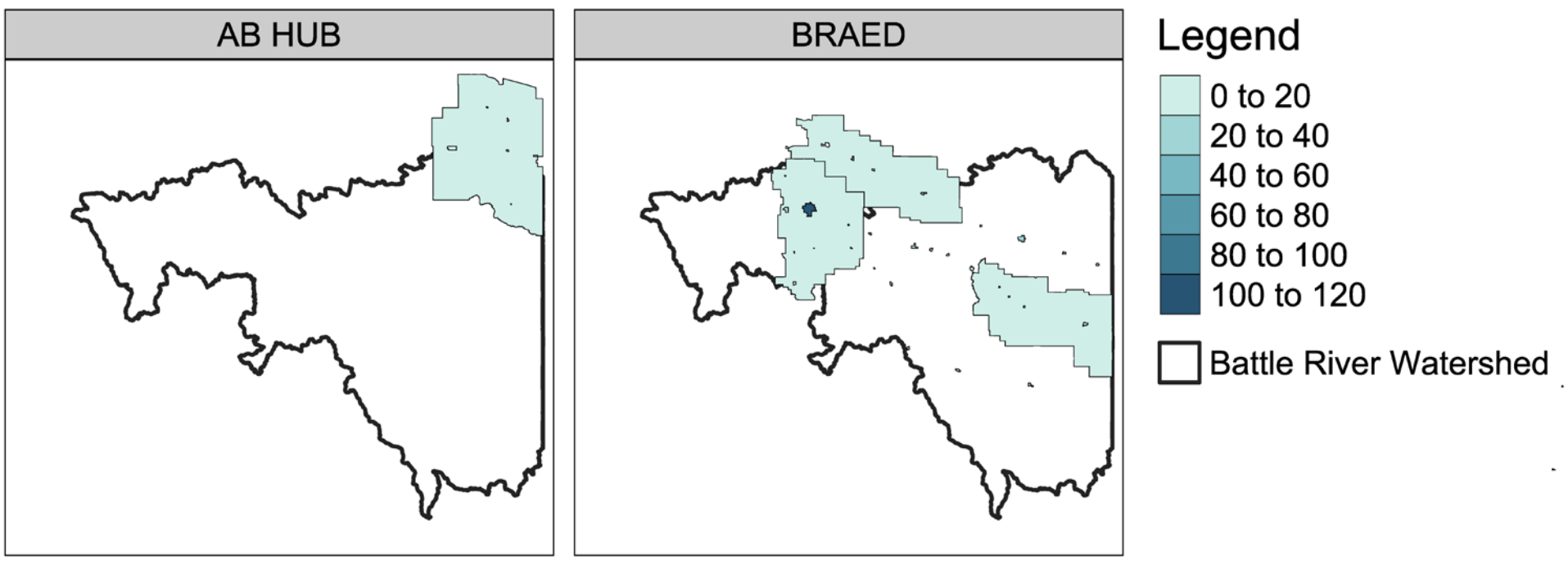
In 2015, the Government of Alberta implemented a new $15 per hour minimum wage which was not tied to the cost of living, and Kosiorek's study finds that this increase did indeed correlate with an increase in unemployment in Alberta (2018, vi). In Saskatchewan over the same period of time, there was no major increase to the minimum wage, and no rise in unemployment (Kosiorek 2018). However, this was also the beginning of a more far-reaching economic downturn in Alberta which was tied to lower global oil prices, so the increase in unemployment is unlikely to be due primarily to wage increases and is more likely to be a result of the effects of the global economy on Alberta's economic base (Statistics Canada et al. 2016, 1).

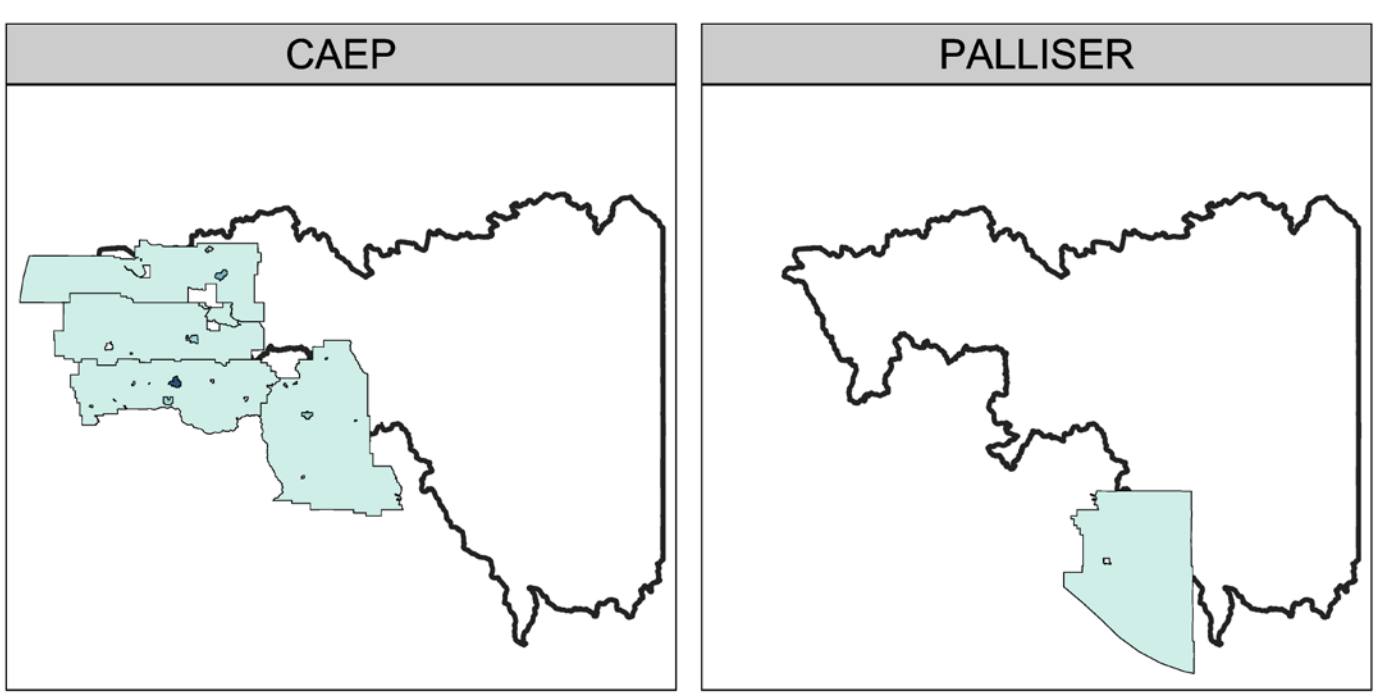
The Government of Alberta has since reduced the student wage to $13 per hour for workers under 18 years old, which is important because almost 50% of the people working for minimum wage in Alberta are between the ages of 15 and 24 (Government of Alberta n.d. j; Alberta Labour and Immigration 2021, 7). Rybczynski and Sen (2018) specifically identify teens aged 15 to 19 and immigrants aged 25 to 54 as groups in Canada whose employment is negatively affected by increases to the minimum wage. Data gathered by Marimpi and Koning (2018) suggests a large difference in the employment rate for 20-24 year olds in countries with and without minimum wages, with 10% more young adults employed in countries without minimum wages. While a higher minimum wage may put more money in the pockets of those working, a higher minimum wage also reduces the number of jobs available as employers seek to reduce expenses by reducing numbers of employees (Marimpi and Koning 2018, 9).

As of September 2020, Alberta has the country's highest rate of workers earning minimum wage (Alberta Labour and Immigration 2021, 6). Unless there is also a policy effort to reduce the numbers of people working for minimum wage, and to move people into higher wage brackets, dramatic increases to the minimum wage seem unlikely to reduce poverty, particularly among young people, immigrants, and women. Without such policies, wage increases not tied to the cost of living may, in fact, harm minimum wage workers since these wage increases result in a reduction of the number of available jobs.

Business Incorporations by Alberta Regional Economic Development Alliances (2020)

of new businesses incorporated





Map 4.5: AB HUB = Northeast Alberta Information HUB Ltd.; BRAED = Battle River Alliance for Economic Development; CAEP = Central Alberta Economic Partnership; PALLISER = Palliser Economic Partnership (Source: Government of Alberta, Economic Development and Trade. 2020. Incorporations by Municipality).

Economic Development

Business Incorporations

The process of incorporating a business legally separates the owner of a business from the business. Legally separating the owner from the business comes with several benefits such as liability protection, reduced taxes, and the ability to transfer shares in the company (Innovation, Science and Economic Development Canada 2020).

Business incorporations in Alberta reached their highest number in 2007 (Government of Alberta 2022b). Shortly after this, the global housing market crash and economic downturn saw a dramatic reduction in incorporations, from about 4,700 per year to just over 2,500 in early 2009 (Government of Alberta 2022b). After 2009, incorporations began to recover, and even reached a new high of 5,500 in 2011 (Government of Alberta 2022b). In the past 10 years, the number of incorporations has held at an average of 3,500, but the COVID-19 Pandemic saw another drastic contraction, with incorporated businesses falling to just over 2,000 in 2020. The latest data shows a recovery in the number of incorporations, which now again sit at about 3,500 (Government of Alberta 2022b).

Table 4.3 shows the ten-year change in business incorporations for a selection of cities in the BRW compared with business incorporations in Edmonton and Alberta as a whole. Cities in the BRW are substantially smaller than the population of Edmonton, and the number of business incorporations are thus also smaller. However, the table shows business incorporations in the BRW have been falling (sometimes substantially, as in Wetaskiwin) over the same time period in which business incorporations in Edmonton have grown, and business incorporations in Alberta overall have declined only slightly.

New Business Incorporations (2020)

Region	Number of Incorporations	Ten Year Change (2010-2020)
Camrose (pop. = 19,232)	102	-15.7%
Wetaskiwin (pop. = 12,895)	44	-33.3%
Lacombe (pop. = 13,816)	102	-13.6%
Edmonton (pop. = 1,004,947)	9,815	11.0%
Alberta (pop. = 4,307,110)	34,111	-2.6%

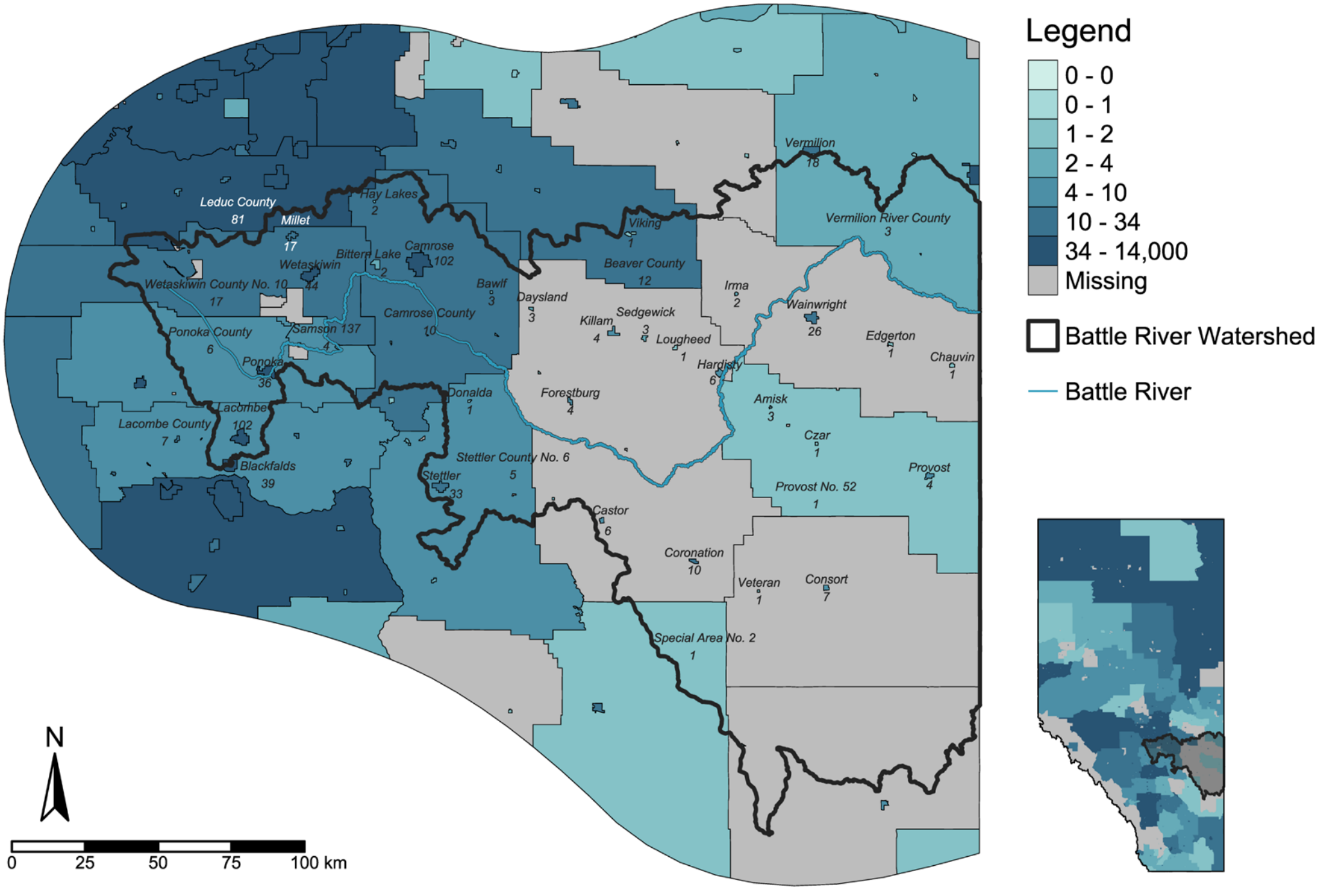
Table 4.3: Number of new business incorporations for select communities and Alberta in 2020 (Source: Government of Alberta, 2020).

Understanding Economic Development

New business incorporations are not significant in the BRW, which is consistent with the rest of rural Alberta (Map 4.6; Map 4.7). Business incorporations are typically attracted to more urban regions due to the greater variation of skill sets and ease of transportation. A greater population will then promote greater exposure for these businesses. However, some rural regions within the watershed (Beaver County, Samson 137, and Lacombe County)

Business Incorporations (2020)

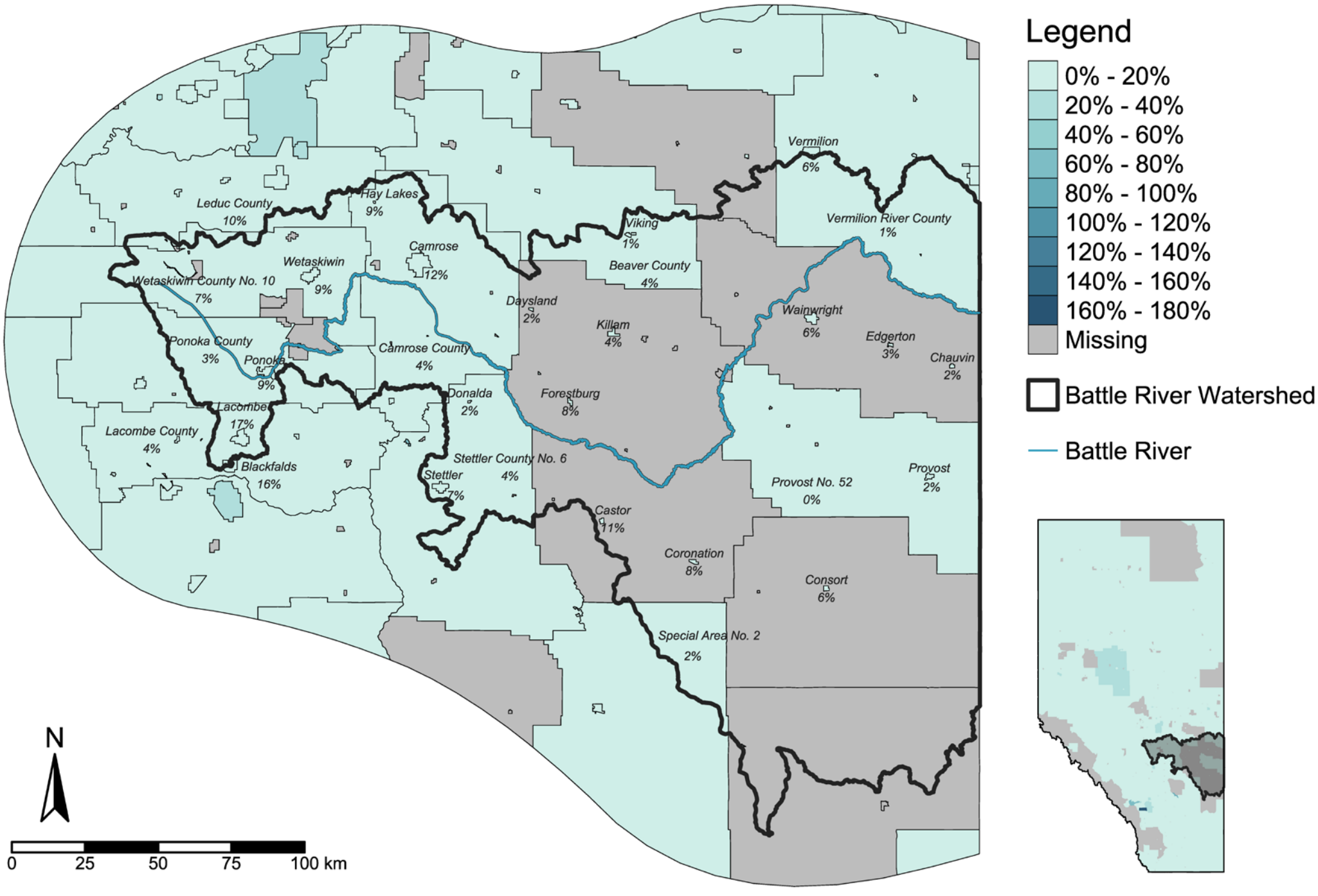
of new businesses incorporated



Map 4.6: (Source: Government of Alberta, Economic Development and Trade. 2020. Incorporations by Municipality).

New Business Incorporations as a Percentage of Total Businesses (2020)

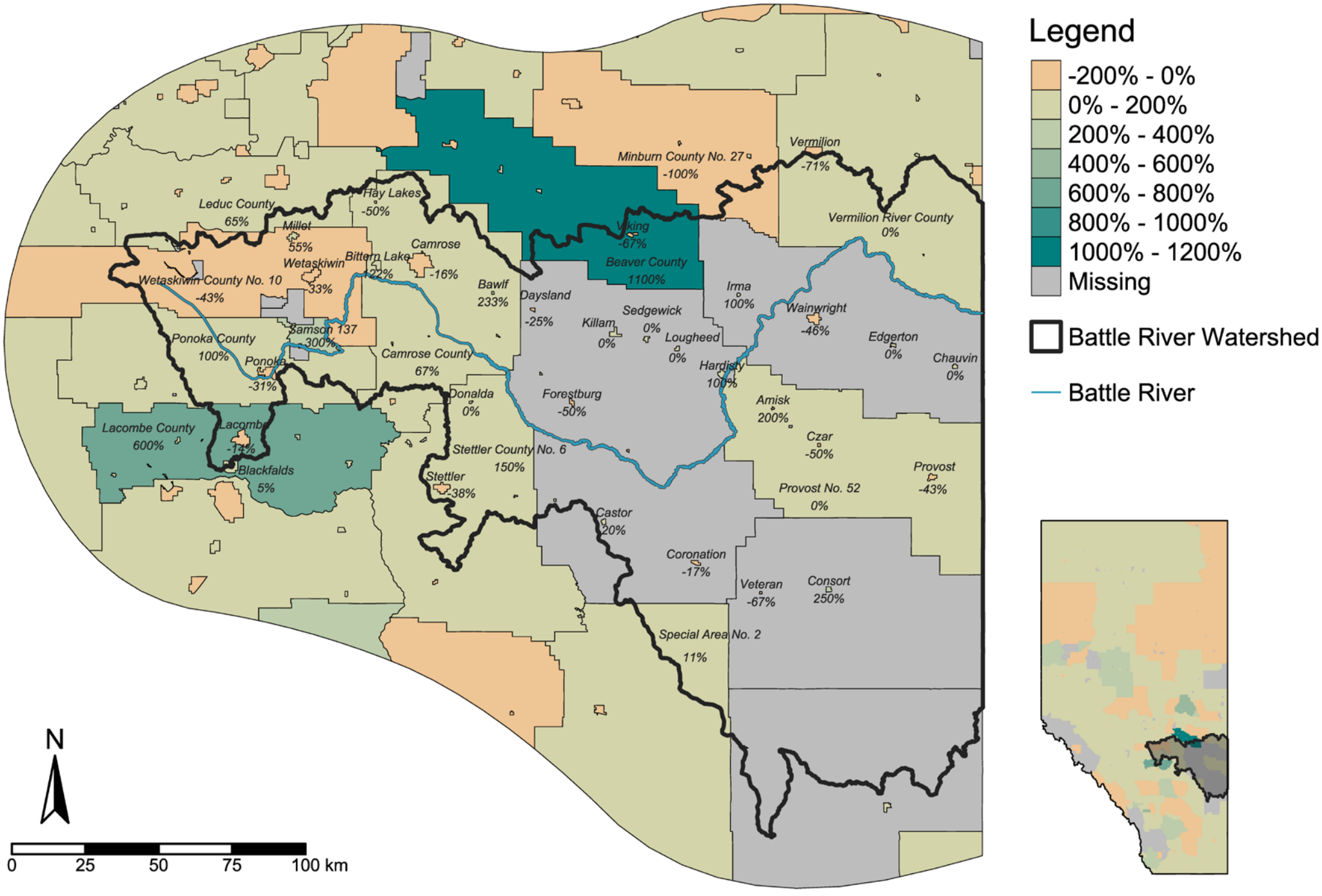
% of new incorporations relative to all businesses



Map 4.7: (Source: Government of Alberta, Economic Development and Trade. 2020. Businesses by Municipality).

Change in Business Incorporations (2010 to 2020)

% increase/decrease in number of business incorporations



Map 4.8: (Source: Government of Alberta, Economic Development and Trade. 2020. Incorporations by Municipality).

show large growth in business incorporations since 2010 (Map 4.8; Government of Alberta n.d. f)

Small Businesses

A small business is defined as a business with between 1 and 49 employees (Government of Alberta 2014a, 3). Small businesses employ 68.8% of Canada's total private labor force whereas large businesses employ 11.5% (Innovation, Science and Economic Development Canada, Small Business Branch, Research and Analysis Directorate 2020, 7). From 2012-2016, small businesses contributed 51.1% of Canada's GDP (Innovation, Science and Economic Development Canada, Small Business Branch, Research and Analysis Directorate 2020, 32). Agriculture and Forestry are significant industries of small businesses in Alberta (Government of Alberta 2014a, 5).

New Business Incorporations by Community (2011-2020)

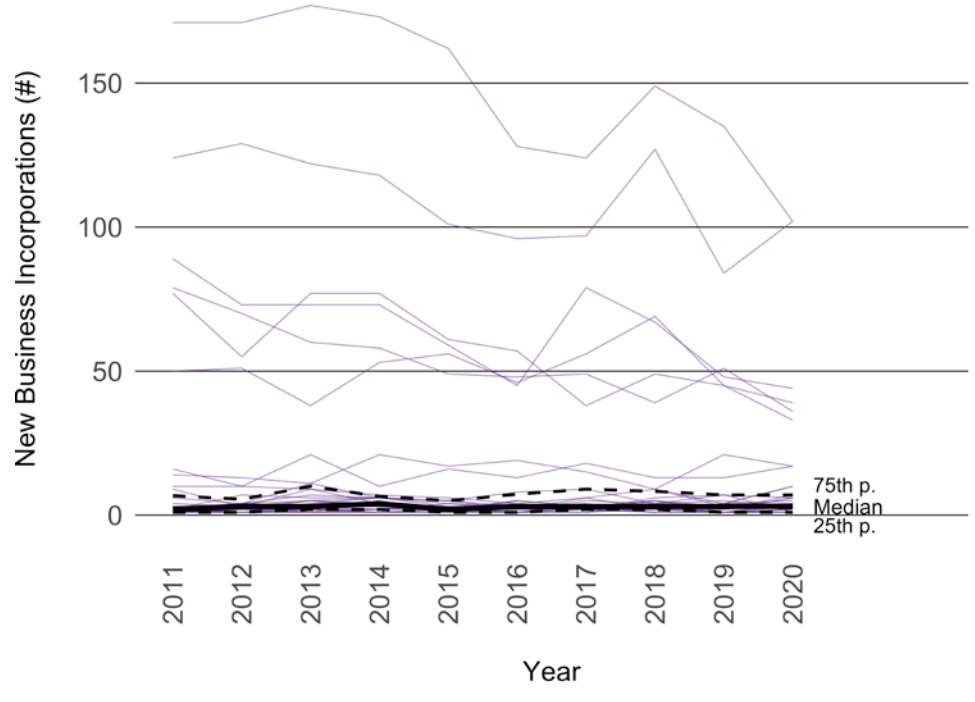


Figure 4.3: Annual new business incorporations for each census subdivision (CSD) within the BRW from 2009 to 2019; median, 25th percentile, and 75th percentile illustrate overall trends in the watershed (Source: Government of Alberta, Economic Development and Trade, 2020).

GDP by Industry

GDP is one of several key indicators of economic health (Callen 2020). GDP officially applies only to countries, but in this section we will also be discussing the GDP of Alberta and the BRW, focusing on the most economically important industries for the region. According to the International Monetary Fund (IMF), GDP measures the monetary worth of final goods and services produced in a country in a certain time period (Callen 2020). It counts all output that is produced inside of a country's borders. GDP is made of both goods along with services that are created to be sold in the market. Its composition also includes non-market production, like education services or defense (Callen 2020).

GDP can be further parsed into GDP by industry. When we look at GDP by industry, we are ranking industries according to their percent contribution to the total GDP (Statistics Canada 2021b). GDP by industry is also known as 'value added,' which, according to Statistics Canada, refers to the value an industry has "contributed to…its output over and above the value of intermediate inputs" (2022a). A healthy economy will tend to see a rise in GDP yearly, but a closer look at that economy will also reveal how many industries contribute to the GDP, and/or whether the economy is dominated by a single industry. If an economy is built with the majority of investment in one industry, that economy will be vulnerable to boom and bust cycles, and to economic shocks resulting from natural disasters, increased competition from other economies, or changes in production and consumption patterns that mean reduced demand for that industry's products (World Bank Group 2019, 136).

This has been common in Alberta since oil and gas became the dominant economic sector for the province. These relationships between industry and economy suggest that a healthy economy is more likely to be a diverse economy that is experiencing annual growth across all sectors, where more than one sector is capable of generating growth and supporting the economic health of other sectors. This will make the economy more stable, and less likely to suffer when one dominant industry is suffering (World Bank Group 2019, 139).

Understanding GDP by Industry

The most recent estimate for the GDP of the BRW comes from Anielski Management Inc. (2011). This study found that the BRW's GDP was approximately $9.6 billion (Anielski Management Inc. and Watrecon Consulting 2011, i). In 2007, the BRW only produced 3.7% of the provincial GDP (Anielski Management Inc. and Watrecon Consulting 2011, i). Fifty-four percent of the economic output was centred in the Bigstone sub-basin of the BRW, which is home to over 60% of the population. The rest of the sub-basins made up the remaining 46% (Anielski Management Inc. and Watrecon Consulting 2011, i).

The most critical part of the calculation for this work was the breakdown of GDP contribution by industry. Anielski Management found that oil and gas accounted for the largest portion of the BRW's GDP at 44.6% (Anielski Management Inc. and Watrecon Consulting 2011, 5). The next largest contributor was finance, insurance, and real-estate at 6.8%. This sizable difference between the highest and second highest contributors to GDP point to an economy that is largely reliant on oil and gas. The agriculture industry contributed only 5.8% of the GDP for the BRW; however, 23.6% of the work-force in the BRW was experienced in agriculture or other resource-based industries (Anielski Management Inc. and Watrecon Consulting 2011, 5; Watrecon Consulting 2010, 8).

Alberta's Top Five Contributors to GDP by Industry in 2020 (Alberta Economic Dashboard):

- Mining, quarrying, and oil and gas extraction ($77.9 billion contribution),
- Real estate and rental and leasing ($35.2 billion contribution),
- Manufacturing ($22.7 billion contribution),
- Construction ($21.7 billion contribution), and
- Health care and social assistance ($18.3 billion contribution) (Government of Alberta n.d. h).

In 2020, Alberta's GDP was $307.5 billion (Government of Alberta 2022e). The mining, quarrying, and oil and gas extraction industry has been the most significant, contributing $77.9 billion to Alberta's GDP; however, this industry experienced a 12.5% decline from 2019 to 2020. (Government of Alberta 2022e). This decline translated into a 7.9% decrease in Alberta's total GDP from 2019 (Government of Alberta 2022e). In 2020, the price of crude oil dropped significantly to approximately $11 USD (Government of Alberta 2022f), but in 2022 rebounded to over $100.

Policy Responses for Economic Development

Why do we measure it?

Business Incorporations

The number of business incorporations is one of the indicators we can use to measure regional economic development. As we track the number of businesses starting up, expanding, and staying open for a given region, we get a sense of what kinds of businesses people are involved in (the economic profile of the area), and whether or not there is demand and available capital to support these businesses (Wilson and Altanlar 2014).

Surveying the number and growth of business incorporations in multiple regions allows us to see differences and similarities between regional economies. Comparing regions with similar social profiles but differing economic success can give us insight into the kinds of policies and initiatives that can support sustainable economic development. In terms of smaller municipalities across Alberta, including the communities of the BRW, measuring economic development through assessing business incorporations can be part of a strategy for allowing these municipalities to share their success stories and to learn from one another to achieve the best outcomes (Groeneveld 2018).

GDP by Industry

GDP is an important gauge for economic development. Measuring GDP tells us about the health of a country's economy in terms of the overall size of the economy, or in terms of the distribution of economic output per capita (Callen 2020; Statistics Canada and Wang 2022, 1). For example, Canada's GDP in 2021 was $1.99 trillion (USD), and its per capita GDP was $52,051.4 USD (World Bank Group n.d.).

GDP does not tell us everything we might want or need to know about an economy. GDP is a measure of the size of an economy, but it does not tell us about equity, sustainability, or well-being (Bleys 2012). Because GDP focuses on the overall size of an economy or the average distribution of economic output, it cannot tell us how wealth is distributed within that economy and what the gap between rich and poor looks like (Kapoor and Debroy 2019). All economically productive activities are counted in GDP, meaning the polluting effects of environmentally destructive activities are counted as contributing to economic growth. Since GDP only counts activities that are considered to be economically productive, it does not account for other kinds of activities people value and contribute to their quality of life, such as leisure time, and social connection (Kapoor and Debroy 2019; Department of Finance Canada 2021, 4).

How have governments responded?

Business Incorporations

The Business Corporations Act provides a mechanism for businesses in Alberta to incorporate, register records, change a corporate name, file annual returns, and list directors and shareholders of a company. The regulations laid out in the Business Corporations Act stipulate rules for businesses with respect to matters including annual returns, exemptions, corporate name rules and timelines, forms, disposal of records, financial statements and auditor's reports, as well as obligations regarding registration of Alberta corporations in designated Canadian jurisdictions and rules for extra-provincial corporations registered in Alberta (Government of Alberta 2022c).

Another piece of provincial legislation, the Companies Act, sets out the rules governing non-profits in relation to incorporation and organization, alteration of constitutions, membership and shares, management and administration, dissolution, provisions relating to special limited companies, and provisions applying to companies with objectives other than profit (Government of Alberta 2022d).

In Alberta, most not-for-profit organizations incorporate under the Societies Act. The Societies Act permits "five or more persons to become incorporated for any benevolent, philanthropic, charitable, provident, scientific, artistic, literary, social, educational, agricultural, sporting or other useful purpose," but explicitly prohibits incorporated societies from carrying on a trade or business (Government of Alberta 2022i, 4). The legislation for cooperatives is slightly different, since cooperatives may engage in business activities. Cooperatives in Alberta incorporate under the Cooperatives Act (Government of Alberta n.d. k).

Opportunities for intersectoral action:

Economic Development

While typically the federal and provincial governments are responsible for economic development, the Canadian Community Economic Development Network (CCED Net) argues for the role of community-based economic development in building local economies, and especially in building economies that are inclusive and sustainable (Canadian Community Economic Development Network n.d. c).

CCED Net is a national organization with regional chapters for B.C./Yukon, Alberta, Saskatchewan, Manitoba, Ontario, Québec, and the Atlantic (Canadian Community Economic Development Network Net n.d. b). Community economic development (CED) or local economic development (LED) is a community-driven process where communities identify and initiate their own solutions to economic, social, and environmental issues to build healthy, economically viable communities (Canadian Community Economic Development Network n.d. a).

CED is based on a grassroots approach to development where a community or organizations within the community chooses deliberate actions to influence the local economy and improve the life of local residents (Canadian Community Economic Development Network n.d. a). CED principles include mobilizing local resources (people, capital, institutions, organizations, etc.) to meet local needs and a re-investment of profits into the local economy (Enns 2018, 5). The goals of current CEDs typically include creating employment, renewing, stabilizing, and improving the community and local economy, developing local economic links, and improving the physical environment of the community (Enns 2018, 5). This framework can be implemented by forming a CED agency or organization to address common development issues, working with neighbours in a region to address common development issues, collecting and analysing data to determine appropriate strategies and activities, and lastly, deciding on a strategic focus such as focusing on local development, human resource development, sector development, or business development (Enns 2018).

What could be done?

Business Incorporations

Albertan governments tend to approach economic growth through a fairly consistent strategy, especially evident under the current conservative government. This approach might be called neoliberal: governments promise to create the conditions for economic growth through attracting investment, reducing regulation, and keeping taxes low (Adkin 2016, 80). At the same time, the province also promises that this approach is compatible with respecting public health, safety, and the environment. Many are critical of this approach, cautioning that actions like cutting minimum wages for youth, reducing corporate income taxes, and reducing regulations are likely to have negative consequences for Alberta's environment, worker rights and worker health and safety, and, in the long run, economic sustainability (Adkin 2016; Carter, Fraser, and Zalik 2017). These critics argue that Alberta needs to take greater steps to diversify its economy away from reliance on oil and gas and other resource industries. Maintaining regulations and raising taxes would also protect the province's economy, environment, and population and would financially support social programs, debt reduction, and funding for economic diversification.

While the province's policies clearly favour attracting large employers, small businesses require different kinds of support, including access to education and coaching on running a business, financial advice and access to small and low-cost loans or grants, advice on legal issues and how to navigate provincial and federal regulations, and networks of support made up of other people with experience successfully running small businesses (Government of Alberta n.d. s). These kinds of advice and support may be especially valuable in rural Alberta. Large companies will not necessarily locate themselves in rural areas. There are also many examples of small communities fighting against the kinds of large companies that want to situate themselves in rural areas, including industrial hog barns, meat packing plants, and landfill facilities, on the grounds that these industries pollute the environment and do not offer sustainable, desirable jobs for local people (Kelly-Reif and Wing 2016, 351, 355; Broadway 2001, 40-43).

According to a 2011 Government of Alberta report, businesses with fewer than 50 employees are responsible for almost 30% of Alberta's GDP and are also the employers for 37% of the private workforce in the province (Government of Alberta 2011, 5). According to the same report, small businesses account for 97.2% of all businesses operating in the Central Zone, the region that contains the BRW. This is the highest percentage of any region in the province, meaning policy-based supports for small businesses are especially relevant in the BRW (Government of Alberta 2011, 25). The provincial government does offer resources for small businesses, including government programs and links to other service providers such as Alberta Innovates, ATB Financial, and Community Futures (Government of Alberta n.d. s). Community Futures, an organization that provides training and financial advice to small businesses, has a dedicated office for east central Alberta based in Viking and serves communities including Camrose, Forestburg, Ribstone, and Wainwright (Community Futures East Central Alberta n.d.). Government recognition of the value of small businesses, and specific support for small businesses in rural areas, might be one avenue where policy could benefit rural communities.

GDP by Industry

GDP by Industry is a broader measure than business incorporations, but in the BRW, GDP by Industry is closely linked with small business. The data show the industries which are economically dominant in Central Alberta – agriculture, construction, oil and gas, and manufacturing – are also predominantly made up of small businesses (Government of Alberta 2011, 26). These are also well-established sectors in the Alberta economy, and do not necessarily reflect more recent shifts toward sectors including tourism; retail and wholesale trade; and scientific, technical, and professional services (Government of Alberta 2014a, 19; Government of Alberta 2011, 11).

The largest proportion of small businesses now operating in Alberta is in the industries of retail and wholesale trade, scientific, technical, and professional services, construction, and other services (Government of Alberta 2014a, 9). Small communities and rural areas in Alberta probably have limited capacity to support these kinds of services, and a limited need for them. However, knowing more about the sectors that are predominant in Central Alberta, or in rural Alberta more generally, can help us to understand more about programs and policies that would benefit people working in those industries, and contribute to the sustainability or growth of those businesses.

For example, a 2017 report on new farmers and agricultural policy describes a number of provincial and federal policy initiatives that are designed to support new farmers (Wilson and Martorell 2017). Canadian farms are shrinking in numbers and farmers are aging. Attracting and keeping new farmers is essential to the sustainability of agriculture in Canada, and new farmers have specific needs that can help them become established. According to the report, new farmers' highest priorities are knowledge and training programs, seed capital, and land transfer and protection (Wilson and Martorell 2017, 1). While training and educational programs and financial assistance are available to new farmers through provincial policies in Alberta, new farmers will also benefit from programs that specifically assist them in acquiring land and in policies that conserve and protect farmland (Wilson and Martorell 2017, 9-10).

Ecosystem Services

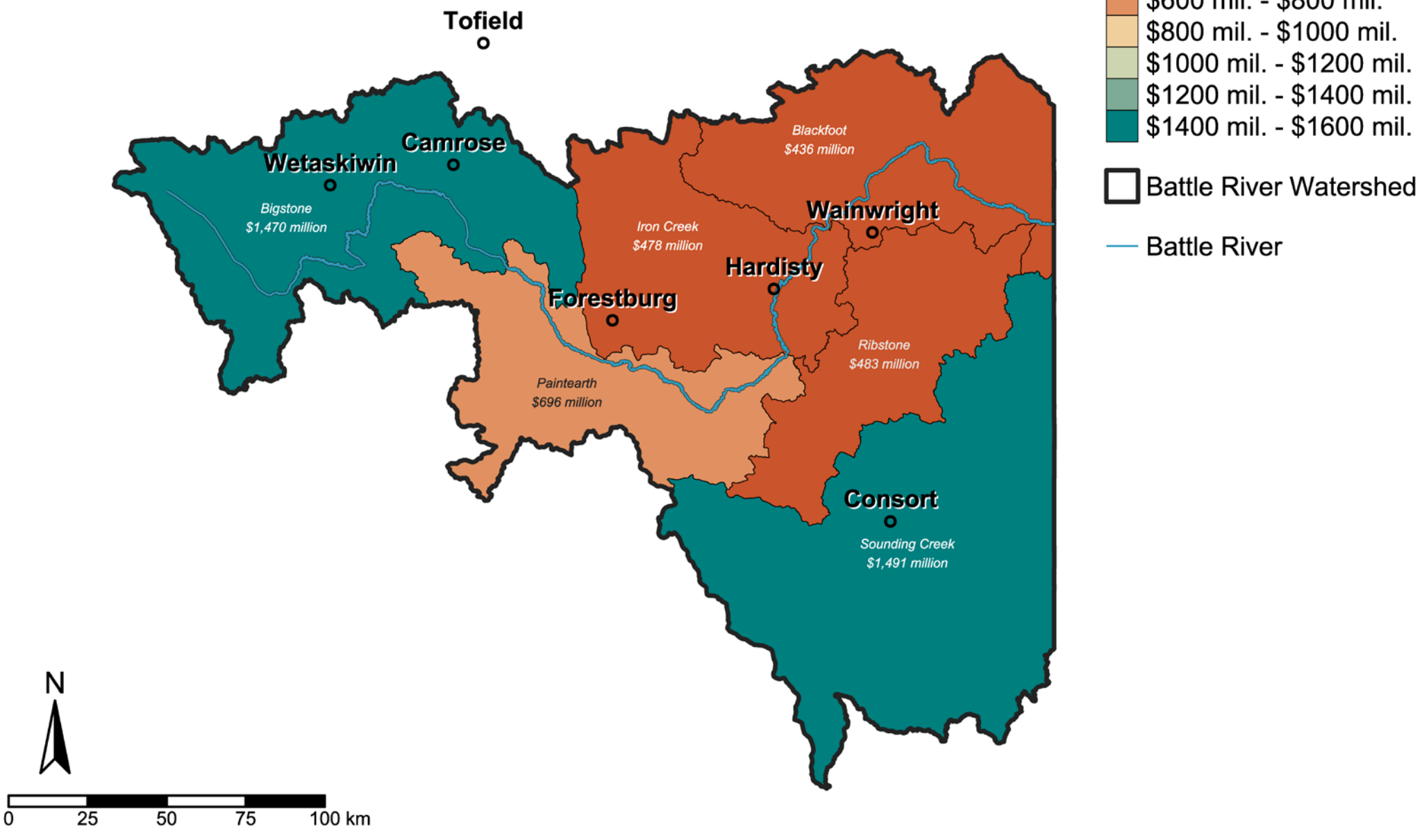
Value of Ecosystem Services

In 2005, the Millennium Ecosystem Assessment defined Ecosystem Services as "the benefits people obtain from ecosystems" (Millennium Ecosystem Assessment 2005, V). More specifically, the concept of ecosystem services allows researchers and policy makers to understand and describe environmental processes in terms of the value they have for human societies, and the costs of replacing those services with artificial (human-created or human-controlled) interventions. Conventional market economics tends to disregard the role animals, plants, and other living things and ecological systems play in supplying and renewing natural resources and mitigating the effects of resource exploitation. Putting values on ecosystem services is a tool to help researchers and policy makers set limits for sustainable use of ecological products, and stimulate accurate cost accounting for resource extraction (Millennium Ecosystem Assessment 2005).

Ecosystem services are often broken down into 'use values' and 'non-use values,' with use values denoting tangible economic value, and non-use values denoting intangible value, including cultural value (Marre et al. 2015, 1-2; Ecosystem Valuation n.d.). An example of a use value would be the ability to harvest wood for lumber or other products from a

Value of Ecosystem Services (2011)

Estimated value in millions of dollars



Map 4.9: (Source: Watrecon Consulting & Anielski Management Inc. 2011. Economic activity and ecosystem services in the Battle River Basin).

forest. An ecosystem that contains resources with direct economic value for humans, such as wood for lumber, is more obviously seen as having value than an ecosystem that does not contain things we can use. However, not all values are easily translated into economic terms. Two ecosystems with high non-use values are the habitats of the Deep Ocean and Amazon rainforests. While most people will never visit either, their existence and their biological and cultural importance imbue them with value to humans.

While non-use values are to some extent subjective, they can nevertheless be given a dollar value. When non-use value is combined with use value for a selected area, this is called the total economic value of that ecosystem's services (Ecosystem Valuation n.d.). A community that finds a high value for ecosystem services in their local environment will likely experience better community health, with the opposite also being true. A community with higher values for ecosystem services may experience increased industry and economic opportunities, tourism, well-being, and self perceived mental health, alongside increased opportunities for environmental stewardship and greater incentives for environmental conservation (Johnston et al. 2017).

Figure 4.4 shows the estimated value of ecosystem services and the value of economic activity for each subwatershed in the BRW. As we can see, Bigstone has by far the largest value for economic activity due to high amounts of mining and oil and gas extraction. Ribstone and Blackfoot have similar values for economic activity, the lowest of the subwatersheds. Although there is some variation in the value of ecosystem services between the subwatersheds (Map 4.9), these values are more similar to each other across the watershed when compared to the value of economic activity, which differs substantially between subwatersheds.

Value of Ecosystem Services and Economic Activity by Subwatershed (2011)

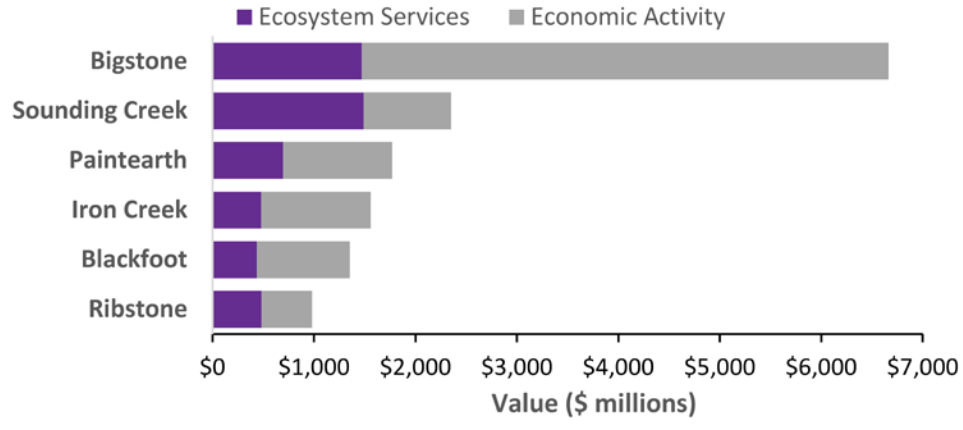


Figure 4.4: Value of ecosystem services (*i.e.*, estimated societal benefits provided by natural ecosystems, such as clean air, water, and food) and the value of economic activity (*i.e.*, regional estimate of Gross Domestic Product (GDP) based on employment by industry) for each subwatershed in the BRW (Source: Anielski Management Inc., 2011).

Understanding the Value of Ecosystem Services

The value of ecosystem services in the BRW was calculated by Anielski Management Inc. in 2011. The group found the total value of ecosystem services in the watershed was $5.05 billion or $1,408 per hectare (Anielski Management Inc. and Watrecon Consulting 2011, 20). This work also included a breakdown of ecosystem services on the sub-basin level. The watershed is broken into six sub-basins, all of which have unique ecological and environmental features. The most valuable ecosystem services were found in the Bigstone and Sounding Creek sub-basins, while the least valuable ecosystem services were in the Blackfoot and Iron sub-basins (Anielski Management Inc. and Watrecon Consulting 2011, ii). The study also found

that 65.6% of the Watershed's value came from economic activity rather than ecosystem services (Anielski Management Inc. and Watrecon Consulting 2011, 27).

Agricultural Land-Use

In 2019, an acre of farmland in the Central region of Alberta was worth $4,327. An acre in Southern Alberta was more expensive at $6,399, while the Peace and Northern regions were cheaper at $2,141 and $3,423 respectively (Farm Credit Canada 2019). Land value has not been consistent throughout the years. In 1910, an acre of land in Central Alberta was worth $10.95 or $250.02 in today's dollars (Lethbridge Board of Trade 1910). This increase by more than 17 times reflects how demand for land has led to increases in the price of land throughout the years.

Land-use is also connected to the value of ecosystem services. If a section of land is useful for more than one industry, then it will have more inherent value. For example, if a section of forest has natural gas deposits and nice scenery, then it will be valuable for forestry, natural gas extraction, and tourism. In 2011, approximately three-quarters of land in the BRW was used for perennial and annual crops as well as pasture land (Battle River Watershed Alliance 2011, 12).

Parks and Protected Areas

The non-monetary value of the BRW ecosystem can come from protected areas, parks, and other areas worth conserving. There are 21,764.7 hectares, or 217 square kilometres, of parks and protected areas in the Battle River and Sounding Creek Watersheds. In Alberta, as of 2022, there are a total of 4,550,447 hectares, or 45,504 square kilometres, of protected areas which includes provincial and wilderness parks, ecological reserves, and more (Alberta Parks n.d.). Parks and protected areas help to increase ecosystem valuation as it attracts tourism and investors to the area. Conservation efforts within parks and protected areas also allow for a thriving ecosystem with enriched wildlife and plant species.

Policy Responses for Ecosystem Services

Why do we measure it?

Ecosystem services include basic services and goods such as clean air, water, food, medicine, and fibre as well as more complex services that regulate our climate, protect us from natural disasters, and provide us with a rich heritage of nature-based cultural traditions (Millennium Ecosystem Assessment 2005). Individuals, households, businesses, and industries all rely on both tangible and intangible ecosystem services for different aspects of their well-being, prosperity, and growth.

From a health in the watershed perspective, ecosystem services are essential for individual and community health, poverty reduction, and socio-economic development through service delivery, risk-reduction, direct financial value, economic diversification, and intrinsic and cultural value (Millennium Ecosystem Assessment 2005). Measuring ecosystem services can inform our understanding and appreciation of the complex relationships between ecosystems and society, human wellbeing, and poverty reduction. An understanding of ecosystem services can also help to inform and support work in ecological monitoring and ecosystem stewardship and restoration.

How have governments responded?

The Government of Alberta introduced the LUF model in 2008 to determine how to best manage Alberta's land and natural resources while achieving long-term environmental, social, and economic goals (Government of Alberta n.d. m). The framework establishes seven new land-use regions and calls for the development of a regional plan for each. The LUF has several goals aimed to improve land management. This includes using guidelines and policy, clarifying roles and responsibilities, and creating better provincial leadership on land-use issues. Finding new approaches to managing both private and public lands such as focusing on encouraging conservation and stewardship of both types of lands. As well as increasing and improving information sharing with the public with the overall goal of promoting proper land-use. These goals extend into the industrial sphere where the LUF wants to increase industries confidence in the government through better coordination and integration of provincial policy, as well as decision making and project planning (Government of Alberta n.d. m).

The LUF allows for both biodiversity markets and ecosystem services to exist in Alberta (Alberta Innovates, and Ecosystem Services

and Biodiversity Network 2016). The LUF suggests that, in terms of ecosystem integrity and ecosystem services, the Alberta Government seeks to combine stewardship of the land with protection and enhancement of ecosystem services, while reassuring industry that they will be able to pursue resource extraction projects and create new markets based on ecological resources.

In 2014, the Alberta Government created the Biodiversity Management Frameworks and Regional Plans. This framework emphasizes reporting on the overall state of biodiversity, keeping track of key indicators to develop thresholds and management responses if thresholds are exceeded, monitoring long-term trends, and tracking all other supporting indicators through monitoring programs across the province (Government of Alberta 2014b). Unlike the LUF, this framework does not refer to industry and development, but instead seeks to support the conservation and management of biodiversity affected by land-use activity in a region.

What is being done?

Both the LUF and the ALSA promote the use of market-based instruments; however, neither emphasise the use of ecosystem services directly in the framework or legislation. ALSA does include conservation offsets, which are a one-time payment to landowners to preserve some ecosystem services. While non-governmental groups like Ducks Unlimited Canada are already using this tool, ALSA formalizes government support for these payments (Kerr and Bjornlund 2010).

The current legislation in Alberta only provides one suitable route for legal reform in support of ecosystem service markets: the ALSA. The ALSA broadly enables regulations defining and supporting the creation, security and trade of 'stewardship units' which are equivalent of tradeable ecosystem services credits, including a registry and exchange. The ALSA also permits and encourages research into market-based instruments and enables regulations to give effect to conservation offsets and the trade of development credits (Kerr and Bjornlund 2010).

However, other legislation in Alberta has the potential to play a role in the buying and selling of ecosystem services. While the Land Titles Act is a province-specific market, it could allow the ecosystem services available on individual's land titles to be transferred through the Torrens System, which is the proper name for the system of Land Titles registration used in Alberta.

The Personal Property Security Act and the Securities Transfer Act, which applies to interests in land or interests arising in connection with land. The key feature of these acts in relation to ecosystem services is that land-related goods (fixtures, growing crops, and mineral resources) can be classified as tangible personal property (Kerr and Bjornlund 2010). In the event the government defines, for example, carbon credits as personal property that can be perfected and registered, this would allow individuals to use their carbon credits as security for a loan or other obligation in Canada.

What could be done?

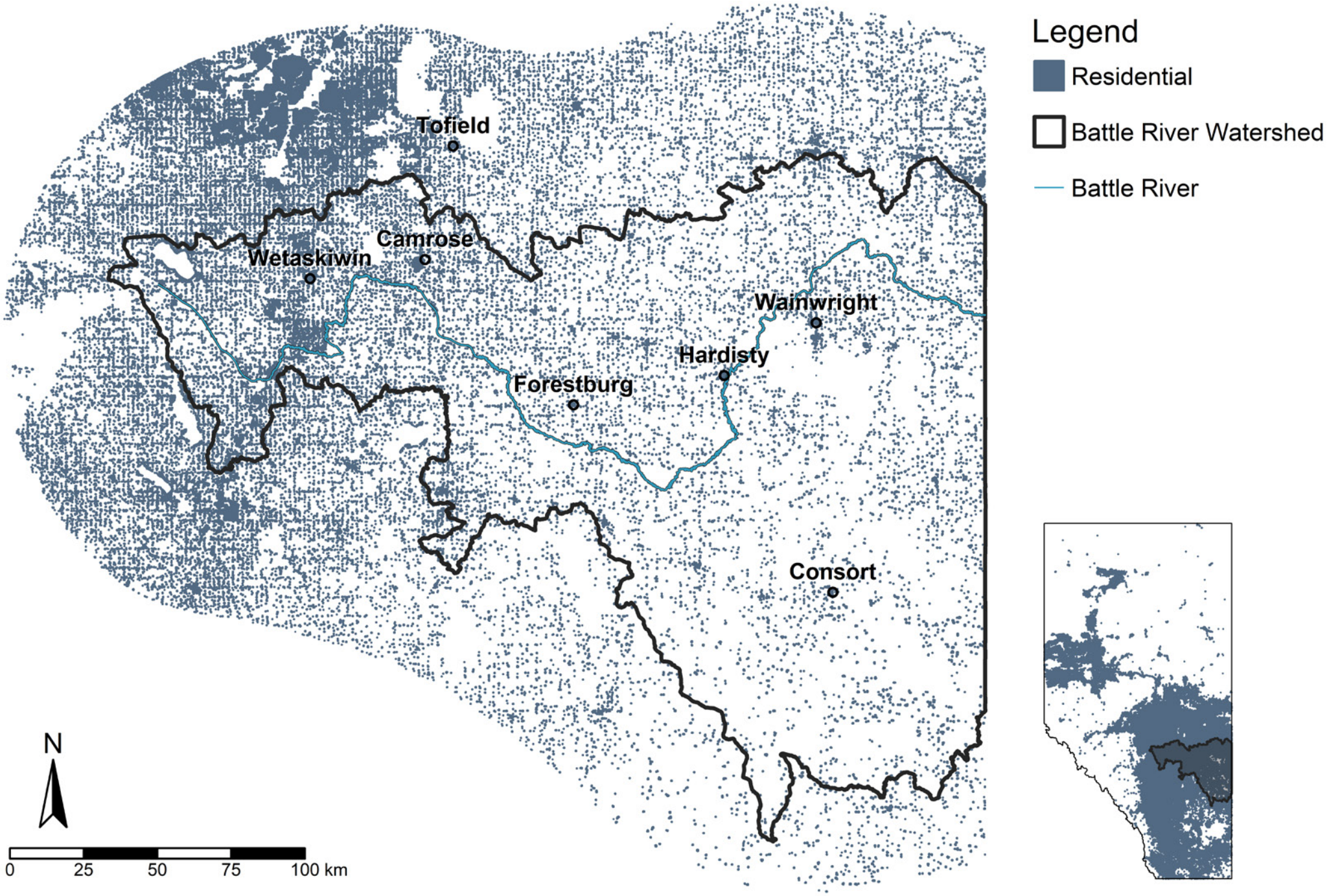
While the Government of Alberta has been moving toward using a market-based approach to the sustainable use and management of ecosystem services, the successful implementation of this type of approach is complex and more-or-less untested in the province. One measure that would likely assist the province in successfully implementing a market-based approach would be developing a clear framework for the creation and use of ecosystem services credits, including a certification system and a registry. Without this framework, Alberta-based industries, farmers, landowners, and the general public have no clear direction to provide them with the security to invest in the creation or holding of ecosystem services market-based instruments (MBIs or credits) (Kerr and Bjornlund 2010).

Well-functioning markets need transparent and consistent information and knowledge sharing, and the Government of Alberta could help to facilitate information sharing through increasing access to data and information on ecosystem services and processes, and working to standardize this information so that all parties develop a shared understanding of the data and the proposed market processes.

Critics of Alberta's proposed market-based approach also highlight a need for legal and policy reform in support of these ecosystem service markets, particularly in creating protocols and platforms to facilitate trading and regulation for lenders to attribute value to

Residential Land Cover (2018)

Land cover by development type



Map 4.10: (Source: Wall-to-Wall Human Footprint Inventory. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020).

carbon credits (Kennedy 2010). While the ALSA provides an avenue for research into the market-based regulation of ecosystem services, government-led legal reform is necessary to fill the gaps and uncertainties that industry, farmers, lenders, and investors currently have about this approach. For example, integrating research on trade-offs between ecosystem services with applied proofs of concept requires involvement from community stakeholders and decision makers. Engaging stakeholders in the process to evaluate and prioritize ecosystem services builds community understanding of what ecosystem services are and why they are so valuable. There is also a need for regional plans to clearly articulate specific environmental principles, and for these principles to be consistent across environmental legislation in the province. This will help to ensure that both legislation and market-based instruments used in Alberta are guided by a coherent and relevant set of environmental goals (Environmental Law Centre 2016).

Land Management

Land Development

Land development describes the modification

of land to suit human use. This could mean, among other actions, wetland drainage, removal of topsoil, forest removal, and excavation. Development can include building construction, the construction and installation of infrastructure including roads and water lines, or the creation of new agricultural land from a formerly undeveloped area. In this section, we focus on land development in terms of residential and industrial construction, as well as developments including landfills, human created water bodies, and high-density livestock operations. The next two sections discuses the indicators of linear development and agricultural land-use.

While building developments can and often do have a positive economic effect, and can improve the quality of life for the community by providing housing or work, they can also have a negative impact on the surrounding environment. These impacts can include loss of habitat, increased erosion, and air and water pollution. To minimize environmental damage, land development must be regulated and monitored. In Alberta, the Municipal Government Act (MGA) "[authorizes] and [expects] municipalities to manage components of the environment that are owned and managed by the [province] in the public trust," including "surface water resources and air quality, especially during land-use decision-making processes for approving development of private lands" (Stewart 2018).

Regulation of development has been, and will continue to be, the responsibility of the various levels of government, while monitoring is taken care of by governments as well as non-governmental organizations like the Alberta Biodiversity Monitoring Institute (ABMI). The ABMI has compiled datasets based on more than 115 anthropogenic disturbance types (Maps 4.10 to 4.12 and Maps 4.18 to 4.20). Their data is free and publicly accessible, and can provide a useful indication of both the number of in-process developments and the rate of establishment of new developments in a given area (ABMI n.d. b).

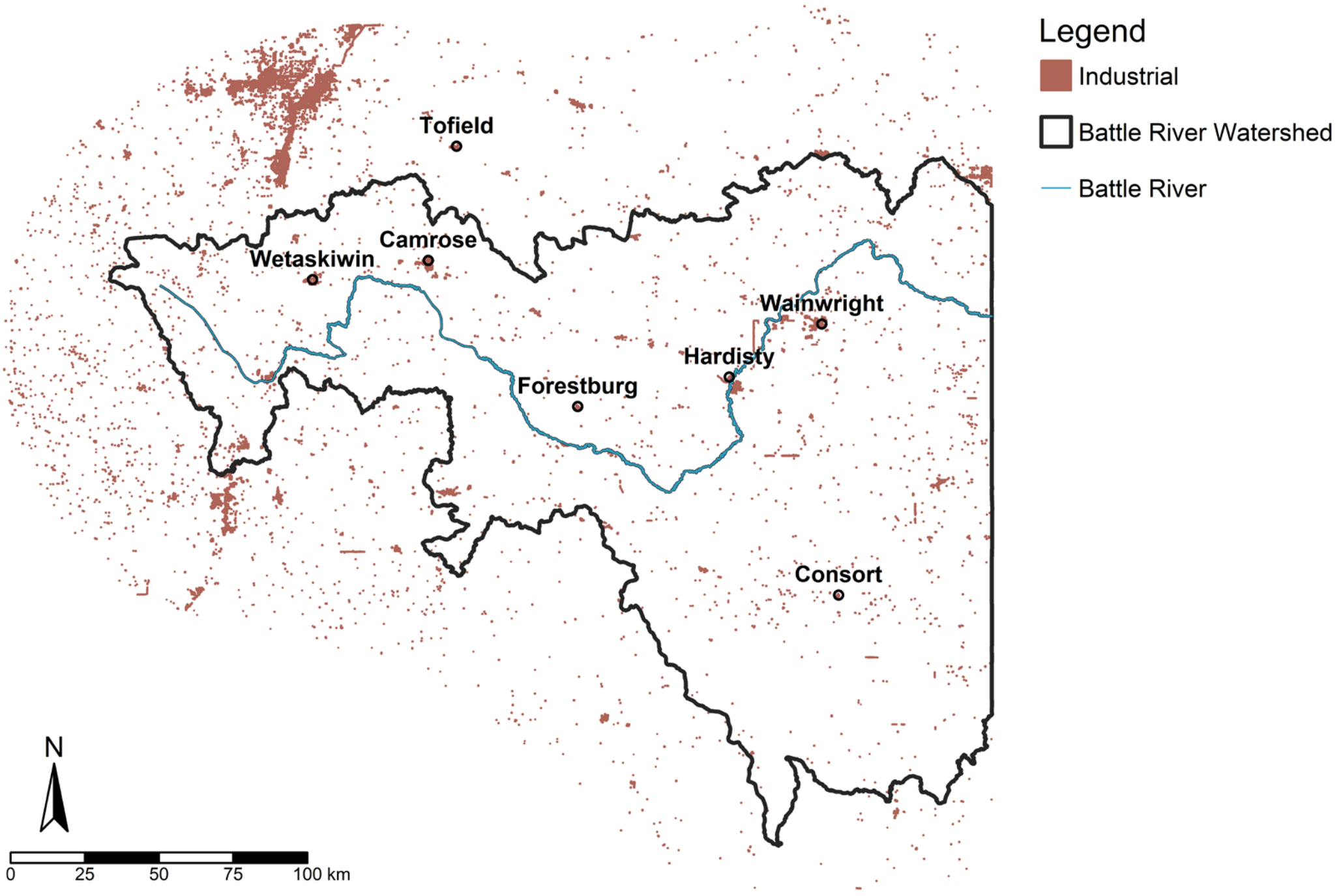
Understanding Land Development

Urbanization

Urbanization refers to the increase of people living in urban areas, often resulting in a decline in those living in rural areas. Alberta has the greatest rates of urbanization in Canada, with 83.6% of Albertans living in urban regions (Government of Alberta 2017). The shift to urbanization has increased considerably throughout many years in Canada. The 1861 Census found that of Canada's 3.2 million people, 2.7 million or 84% of them, lived in rural areas, and that Canada's economy was reliant on agriculture as well as coal and wood. By 2011, this rural population as a percentage had dropped to just 18.9% of all Canadians (Statistics Canada 2018). The appeal of developed urban areas

Industrial Facility Land Cover (2018)

Land cover by development type



Map 4.11: (Source: Wall-to-Wall Human Footprint Inventory. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020).

is likely due to the economic prosperity that is linked with industrialization and modernization. Urban expansion is not expected to decline, in fact, urban land development is expected to triple from the year 2000 to 2030 (Agrawal 2016).

As urbanization boosts the economy through industrial and commercial development, urban land expansion can also pose a threat to rural livelihood and the broader natural ecosystems. Urban expansion and development threaten the agricultural industry by the "loss of local food production, the disruption of the agricultural economy, and damage to both the environment and the communities that are organized around the rural farm culture" (Agrawal 2016, 26).

A further threat of urban development is the larger carbon footprint that expansion creates through the release of fossil fuels and greenhouse gas emissions, thus causing negative impact to the surrounding ecological system. The United Nations found that cities, while only taking up 2% of the Earth's surface, produce more than 60% of greenhouse gases while using 78% of the worlds energy (United Nations n.d.) As cities are major greenhouse gas producers, urbanization creates new carbon pools on the land through the creation of buildings and landfills (Churkina 2016). Ribeiro, Rybski, and Kropp (2019) found that an approximately 1% increase in population and area of a city is associated with at least 0.76% increase in its emissions.

Land Cover by Type and Subwatershed (2018)

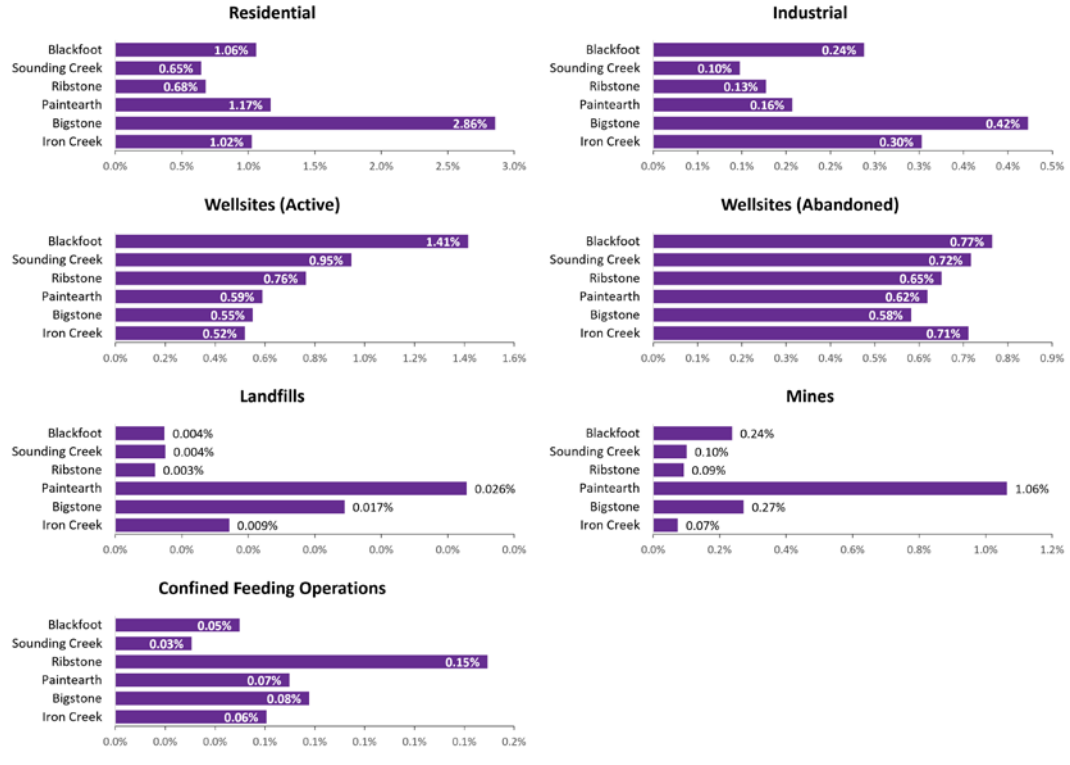


Figure 4.5: Percent of land cover that is residential, industrial, landfills, mines, cultivated, wellsites (active and abandoned), and confined feeding operations (CFOs) within each subwatershed of the BRW in 2018 (Source: Alberta Biodiversity Monitoring Institute, 2018).

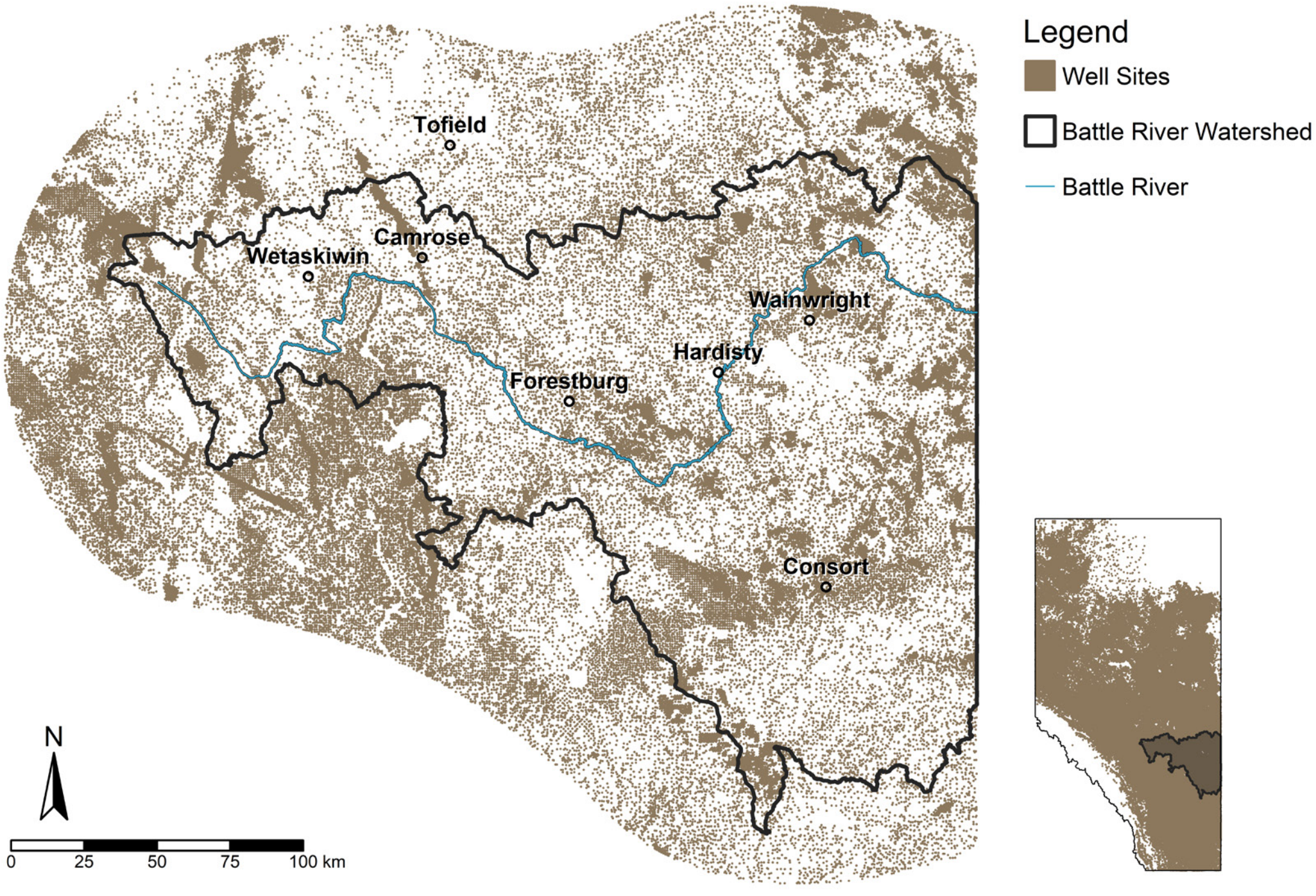
Oil and Gas Industry

The oil and gas industries are a major force in Alberta's economy and have a significant presence in the BRW area as well. This industry is the largest contributor the provincial GDP. The abundance of fossil fuels provides Alberta with its greatest energy resource. Alberta generates approximately 89% of its electricity from fossil fuels, with approximately 54% from natural gas and 36% from coal (Canada Energy Regulator 2022). Alberta oil sands are also the fourth-largest oil reserve in the world.

Conventional and non-conventional oil production in Alberta has been increasing, with production going from approximately 350 million barrels of oil in the first 6 months of 2010, to over 600 million barrels of oil in the first 6 months of 2021 (Roach and ATB Economics 2021). From August 2020 to August 2021, both conventional and non-conventional oil production, measured as thousand m3, increased by 6.1% and 21% respectively (Government of Alberta 2022g). Oil production does generally increase annually; however, production may decrease following natural disasters and market crashes.

Well Sites Land Cover (2018)

Land cover by development type



Map 4.12: (Source: Wall-to-Wall Human Footprint Inventory. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020).

For example, the 2016 Fort McMurray fires and the 2020 pandemic caused a decrease in annual oil production (Roach and ATB Economics 2021). From December 2019 to November 2020, the production limit for Alberta was 3.81 million barrels per day, but as of December 2020, there are no longer any oil production limits (Government of Alberta n.d. p).

As of 2018, Alberta had 193,149 active wells, with 19,673 of those wells being in the BRW. With the BRW being approximately 30,000 square kilometres, this is approximately 0.6 active wells per square kilometre, double the provincial average of 0.3 wells per square kilometre (Table 4.4).

Number of Oil and Gas Wells (2018)

Well Type	Alberta	Battle River Watershed	% of Alberta Wells in Battle River Watershed
Active	193,149	19,673	10.2%
Abandoned	157,090	19,340	12.3%
Total	350,239	39,013	11.1%

Table 4.4: Number of oil and gas wells (active and abandoned) within the BRW relative to Alberta in 2018 (Source: Alberta Human Footprint Monitoring Program (AHFMP), 2018).
Note: These represent number of well pads, but each well pad can contain multiple wellheads.

Linear Development

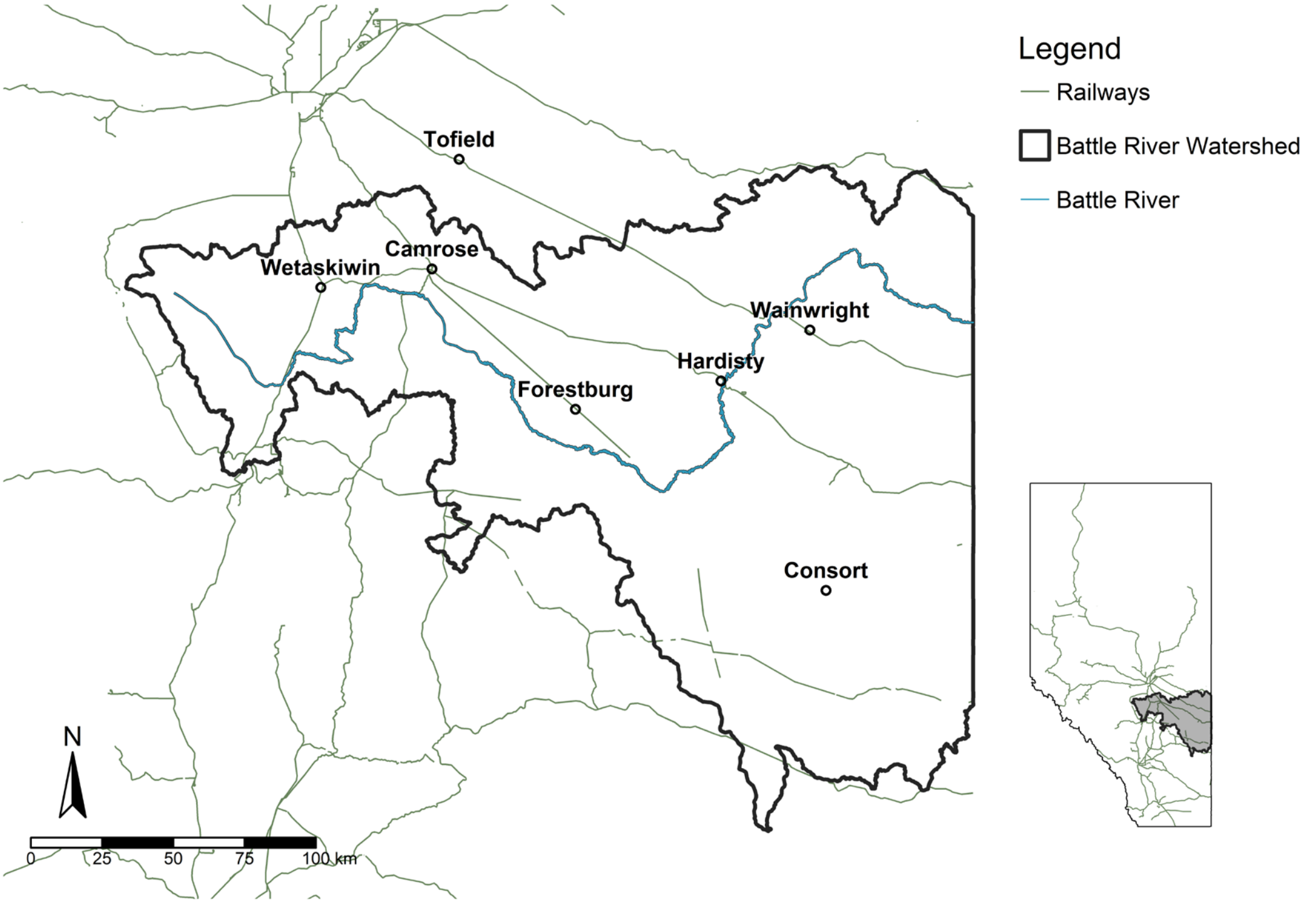
A linear development is a piece of infrastructure built with the goal of connecting two points. Linear development describes many different structures including roads, railways, pipelines, sewage lines, electrical lines, and telephone lines. 'Linear' refers to the fact that these developments often follow a straight path, which is also generally the most efficient, most cost-effective way to connect 'point A' to 'point B' (Government of Alberta 2016c).

Linear developments can be either beneficial to a community, or harmful depending on the type and number of developments. For example, an isolated community previously accessible only by plane may benefit economically and socially from the introduction of a road into the town, or a struggling community can experience an economic boom with the introduction and construction of a new pipeline. At the same time, construction and development can have social and environmental costs including pollution, habitat loss, loss or disruption of normal economic and social activities, and property damage (Gilchrist and Allouche 2004).

The 2014 Human Footprint Inventory compiled by the Alberta Biodiversity Monitoring Institute, records all of the linear developments in Alberta and organizes them into five categories: (1) Roads, (2) Transmission Lines, (3) Seismic Lines, (4) Pipelines, and (5) Railways. Using these data, an assessment can be made about the type and intensity of linear development for a given community over a specified period of time. When we look at the ABMI data, or the data presented in the maps in the following pages, we begin to get a picture of the extent and intensity of linear development in the BRW and across the province (ABMI n.d. a).

Linear Development of Railways (2018)

Linear development



Map 4.13: (Source: Wall-to-Wall Human Footprint Inventory. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020).

Much of the province is covered with linear developments, including roads, seismic lines, well sites, and pipelines (Maps 4.13 to 4.17). While the BRW is not as heavily developed as some areas of the province, the region contains a dense array of linear developments, including roads and rail lines, seismic lines, pipelines, and well sites. Based on Figure 4.6, we can see the extensive linear development within the BRW. In particular, we see the substantial density of pipelines in the Blackfoot subwatersheds as opposed to the other subwatersheds, the high density of seismic lines in Ribstone, and the high density of roads and railways in Bigstone.

Seismic lines are a type of linear development common in Alberta which merit further examination because they are specific to jurisdictions, like Alberta, with a heavily developed oil and gas economy. Seismic lines are created in the process of oil and gas exploration: vegetation is cleared from a section of land up to 10 metres wide and many kilometres long. Vehicles drive down the lines and set explosives in the ground. When the explosives are detonated, technicians measure the frequencies given off by the explosions to determine if there are significant amounts of oil or gas down below (Dabros, Pyper, and Castilla 2018). An estimate from the University of Calgary puts the total length of seismic lines in Alberta at more than 1.8 million kilometres (McCoy 2019).

Linear Disturbance by Type and Subwatershed (2018)

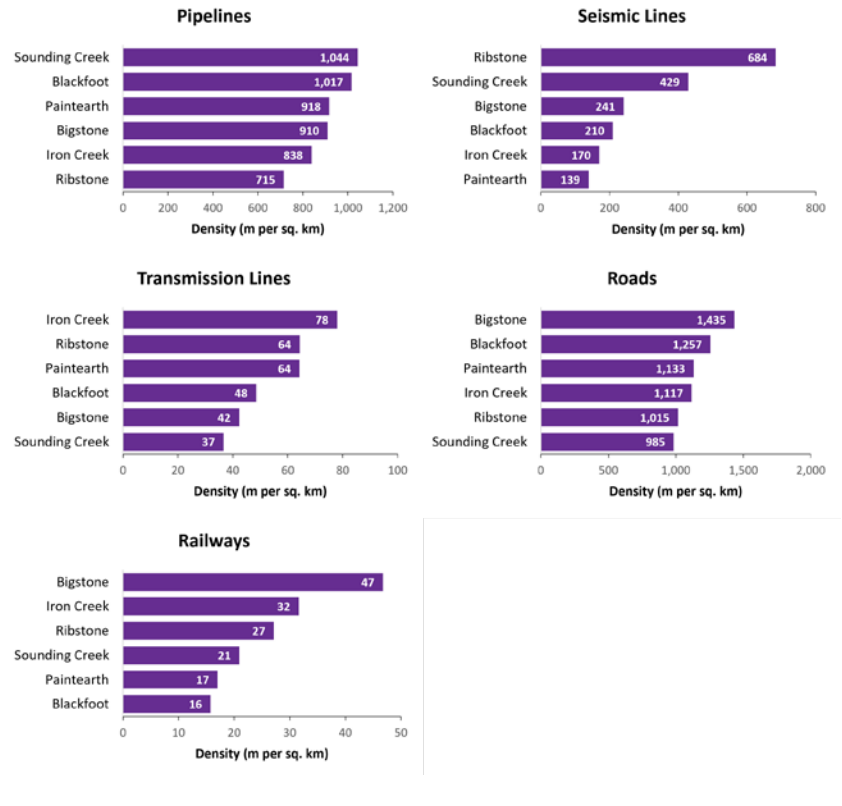


Figure 4.6: Linear density (km per sq. km) of pipelines, seismic lines, transmission lines, roads, and railways within each subwatershed of the BRW in 2018 (Source: Alberta Biodiversity Monitoring Institute, 2018).

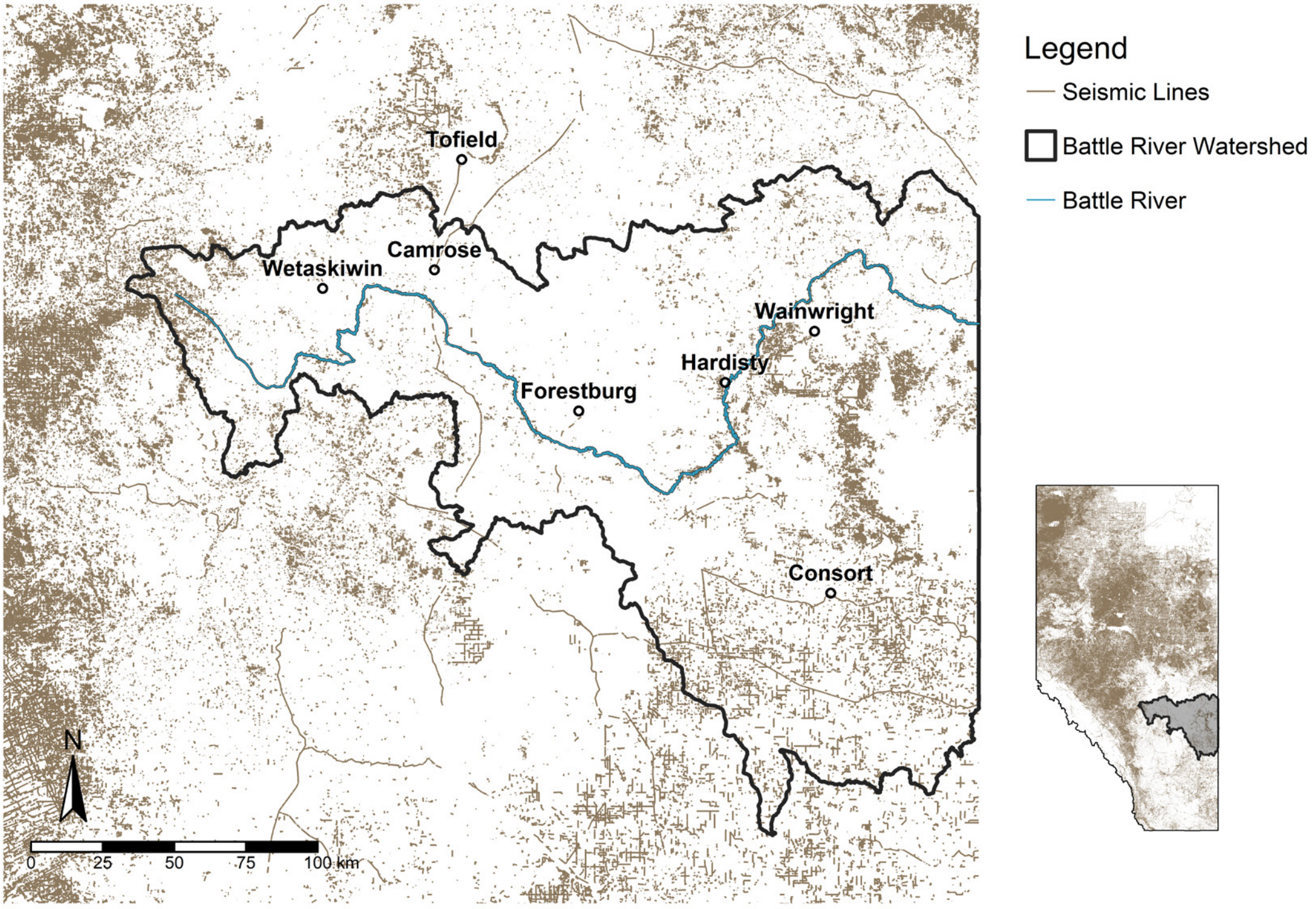
Understanding Linear Development

Linear development looks different in different parts of the province, with the north of Alberta substantially impacted by linear infrastructure associated with oil and gas exploration and extraction (McCoy 2019). However, all parts of the province are deeply affected by linear development connected to the province's origins in colonial settlement. Arguably, linear development in Alberta dates back to the Dominion Lands Survey (DLS), which, beginning in 1871, "established controlling lines on which to base... township surveys" (Alberta Land Surveyors' Association n.d.). Although settlement, and thus at least some linear development, already existed in Alberta before the 1870s, the DLS was an ambitious effort to render the entire province legible for agricultural production to serve the new Confederation.

The DLS divided land in the province along north-south and east-west lines based on latitude and longitude. The end result was a grid network of townships further subdivided into sections. Each township is six square kilometres, and contains 36 sections. Each township

Linear Development of Seismic Lines (2018)

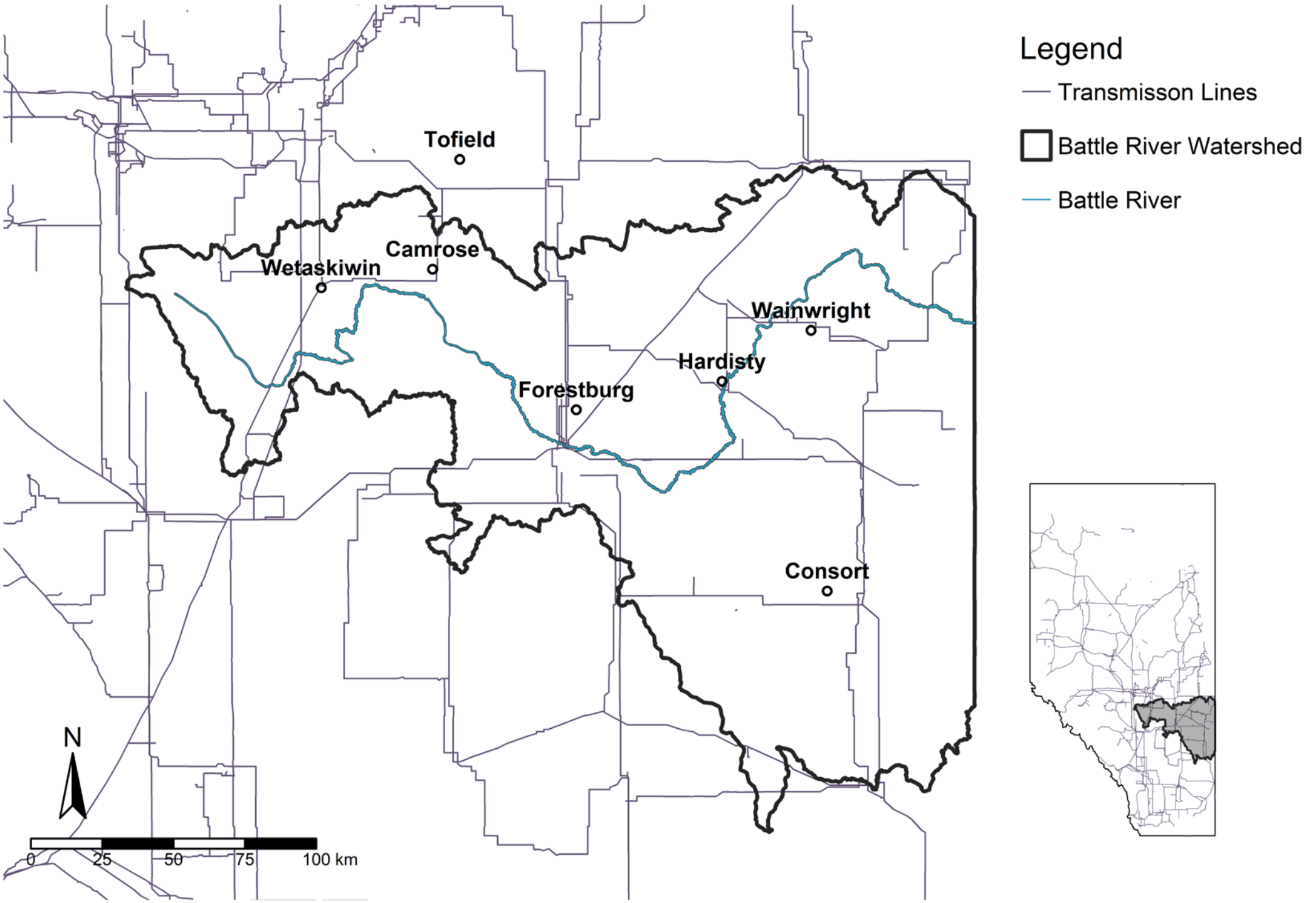
Linear development



Map 4.14: (Source: Wall-to-Wall Human Footprint Inventory. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020).

Linear Development of Transmission Lines (2018)

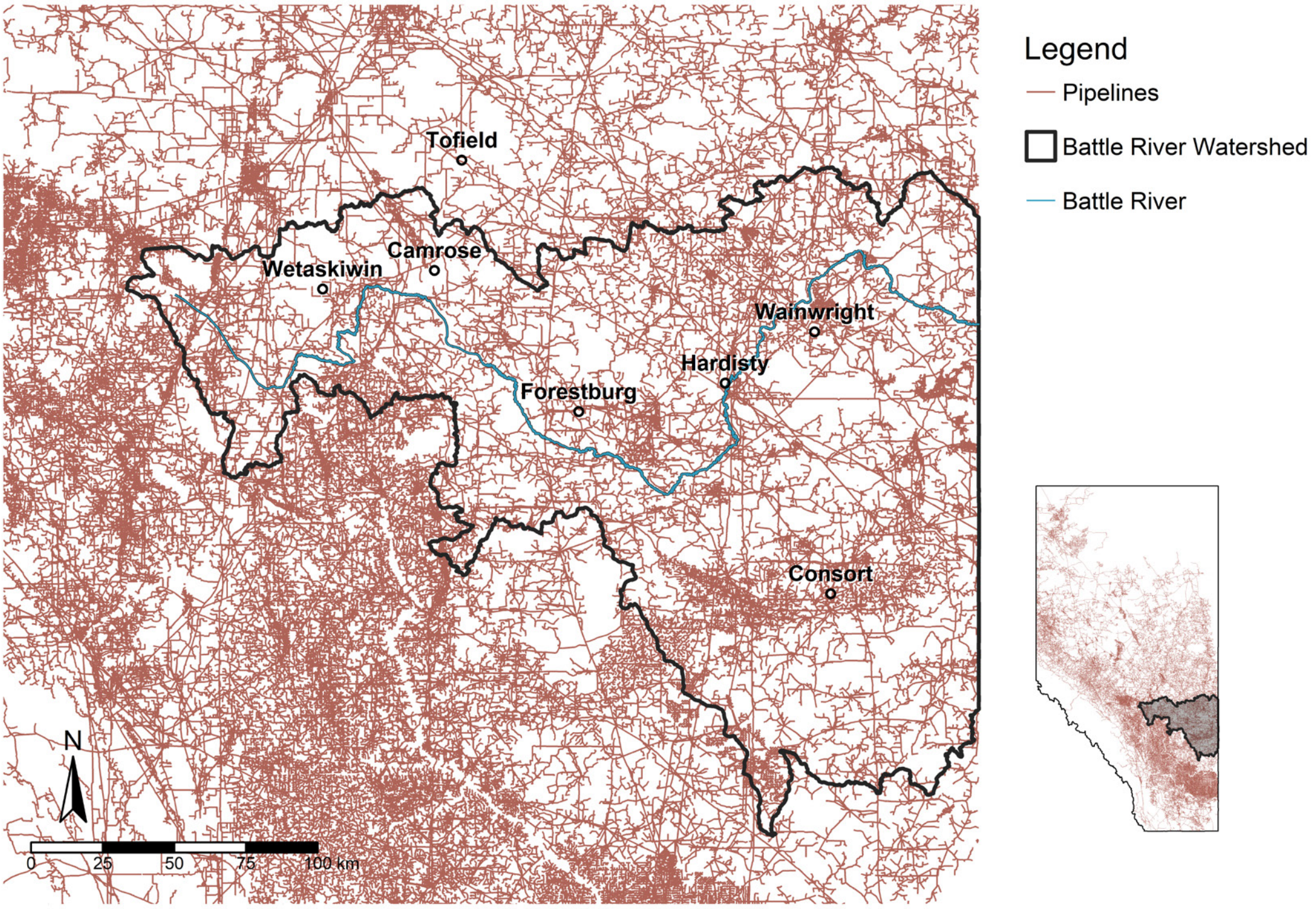
Linear development



Map 4.15: (Source: Wall-to-Wall Human Footprint Inventory. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020).

Linear Development of Pipelines (2018)

Linear development



Map 4.16: (Source: Wall-to-Wall Human Footprint Inventory. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020).

is numbered, beginning with Township 1 in the southeast corner of the province. The entire province is covered by this grid, and it continues to function as the basic description of rural property. It can be used to locate parcels of land and pieces of infrastructure on that land, including oil and gas wells (McKercher and Wolf 1986).

Alberta also contains an impressive amount of linear development, including an estimated 473,000 kilometres of single-lane equivalent roads. This number almost equals the amount of roadway in Ontario, which has twice the land mass and three times the population.

Ecological Interactions

As might be expected, ecological interactions, and particularly interactions with wildlife, are the major focus of research on the impacts of linear development. Clearing vegetation breaks up habitat and exposes animals to human activities including hunting, recreation, and resource extraction. Woodland caribou, wolves, and grizzly bears, three keystone species in Alberta's ecosystems, require large tracts of intact wilderness to thrive, and many other animals fare better in areas where there is minimal human presence.

In 1997, Jalkotzy, Ross, and Nasserden published a review of the literature on the effects of linear development on wildlife. They found linear development affects wildlife in six major ways: "individual disruption, social disruption, habitat avoidance, habitat disruption or enhancement, direct and indirect mortality, and [population] effects"

Linear Development Density by Subwatershed (2014-2018)

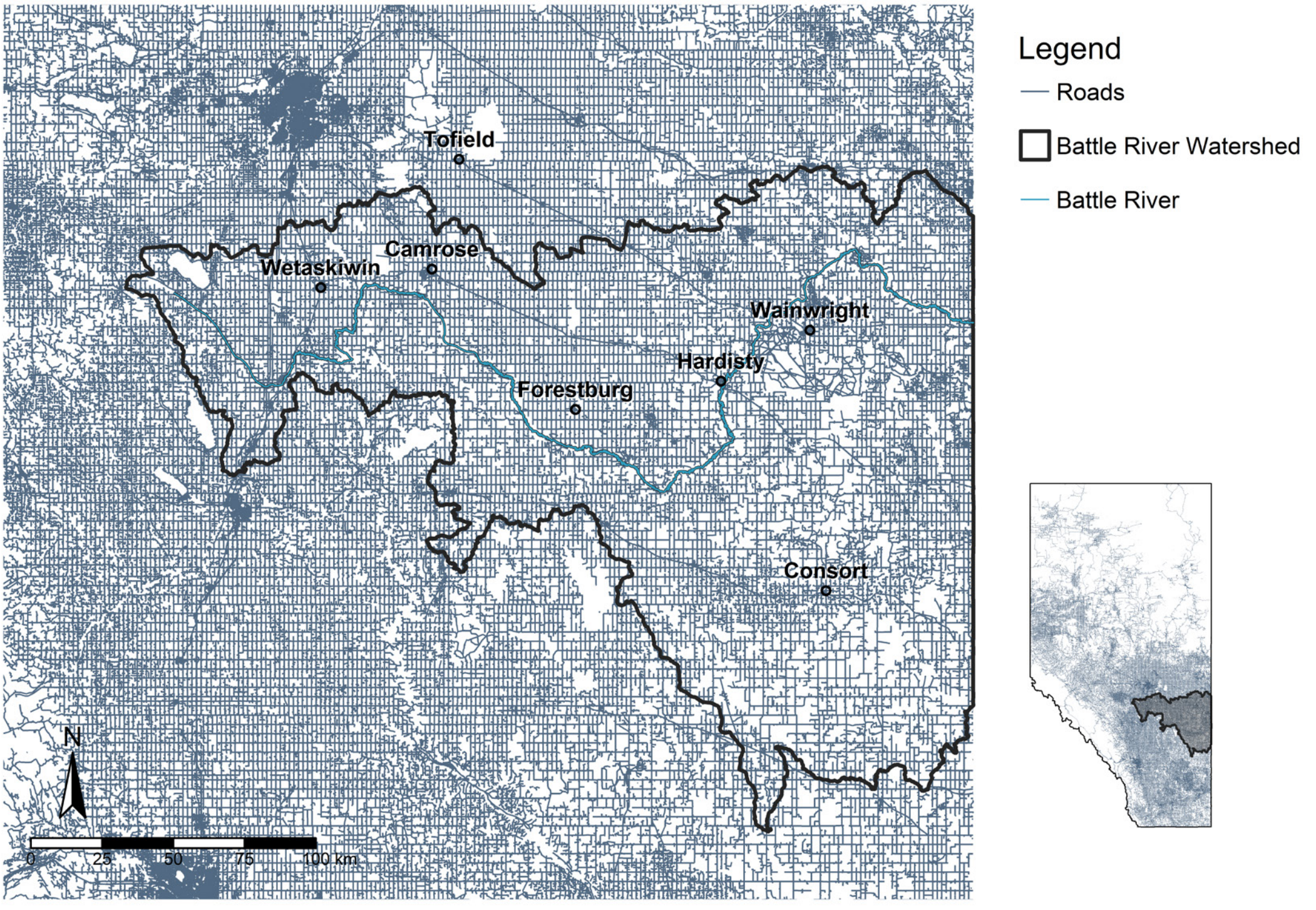
Subwatershed	2014 Density (km sq. km)	2018 Density (km sq. km)	Percent Change
Bigstone	1.76	1.77	0.5%
Blackfoot	1.53	1.54	0.4%
Iron Creek	1.38	1.39	0.9%
Paintearth	1.38	1.35	-2.4%
Ribstone	1.83	1.82	-0.8%
Sounding Creek	1.46	1.47	0.8%

Figure 4.5: Total density of linear developments (includes railways, roads, transmission lines, and seismic lines) by subwatershed in 2014, 2018, and percent change from 2014 to 2018 (Source: Alberta Biodiversity Monitoring Institute 2018).

(Jalkotzy et al. 1997, ii). More recent studies confirm these impacts: Latham et al. (2011) found changing patterns of wolf predation on already-vulnerable caribou populations as wolves use seismic lines to move through the landscape, while Oberg (2001) notes how woodland caribou avoidance of linear features contributes to shrinking caribou habitat. Cott et al. (2015) discuss the impact of linear development associated with the oil and gas industry on northern fish, finding numerous stressors on fish health including obstructions to water flow and fish passage as well as water withdrawal, loss of water way structure which reduces riparian vegetation, increased sediment to water ways, contaminants in water ways, increased fish exploitation, and even impacts from the use of explosives. Hinam and St. Clair (2008) find that habitat loss and fragmentation negatively affect the reproductive success of northern saw-whet owls. These findings about wildlife go hand-in-hand with other findings that document the negative effects of linear development on natural vegetation and wetlands (Noble, Hill, and Nielsen 2011; 2012), and the association between high road density and increased wildfire risk (Arienti et al. 2010).

Linear Development of Roads (2018)

Linear development



Map 4.17: (Source: Wall-to-Wall Human Footprint Inventory. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020).

Intersections/Interactions with Human and Community Health

Research documenting links between linear development and human and community health is more difficult to locate than research on ecological effects. We can draw inferences from the effects on ecosystems, vegetation, and wildlife populations to human health and wellbeing, and certainly effects like higher risk of wildfires associated with linear development is a concern for human communities.

Reclamation in Alberta is a complex process involving changing perceptions of environments and ecosystem vulnerability, vastly expanded resource extraction, and a dynamic set of stakeholders. Understanding the history of reclamation requirements in Alberta helps us to better understand why certain kinds of reclamation happen and others do not, and also provides insight into ways community stakeholders can leverage the reclamation process to address local environmental concerns.

The first piece of legislation mandating reclamation was the Surface Reclamation Act of 1963, which was followed in 1973 by the Land Surface Conservation and Reclamation Act, which "introduced the concept of conservation and added new regulated industries and an approvals process," and in 1993 by the Environmental Protection and Enhancement Act, which "linked reclamation and remediation in a single Act" (Powter et al. 2012, 39).

Agricultural Land Cover by Subwatershed (2010-2018)

Subwatershed	2010 Land Cover (%)	2018 Land Cover (%)	Percent Change
Bigstone	75.0	75.3	0.3%
Blackfoot	76.7	75.8	-1.2%
Iron Creek	76.6	77.4	1.1%
Paintearth	69.8	70.2	0.6%
Ribstone	53.8	54.1	0.4%
Sounding Creek	55.7	56.3	1.0%

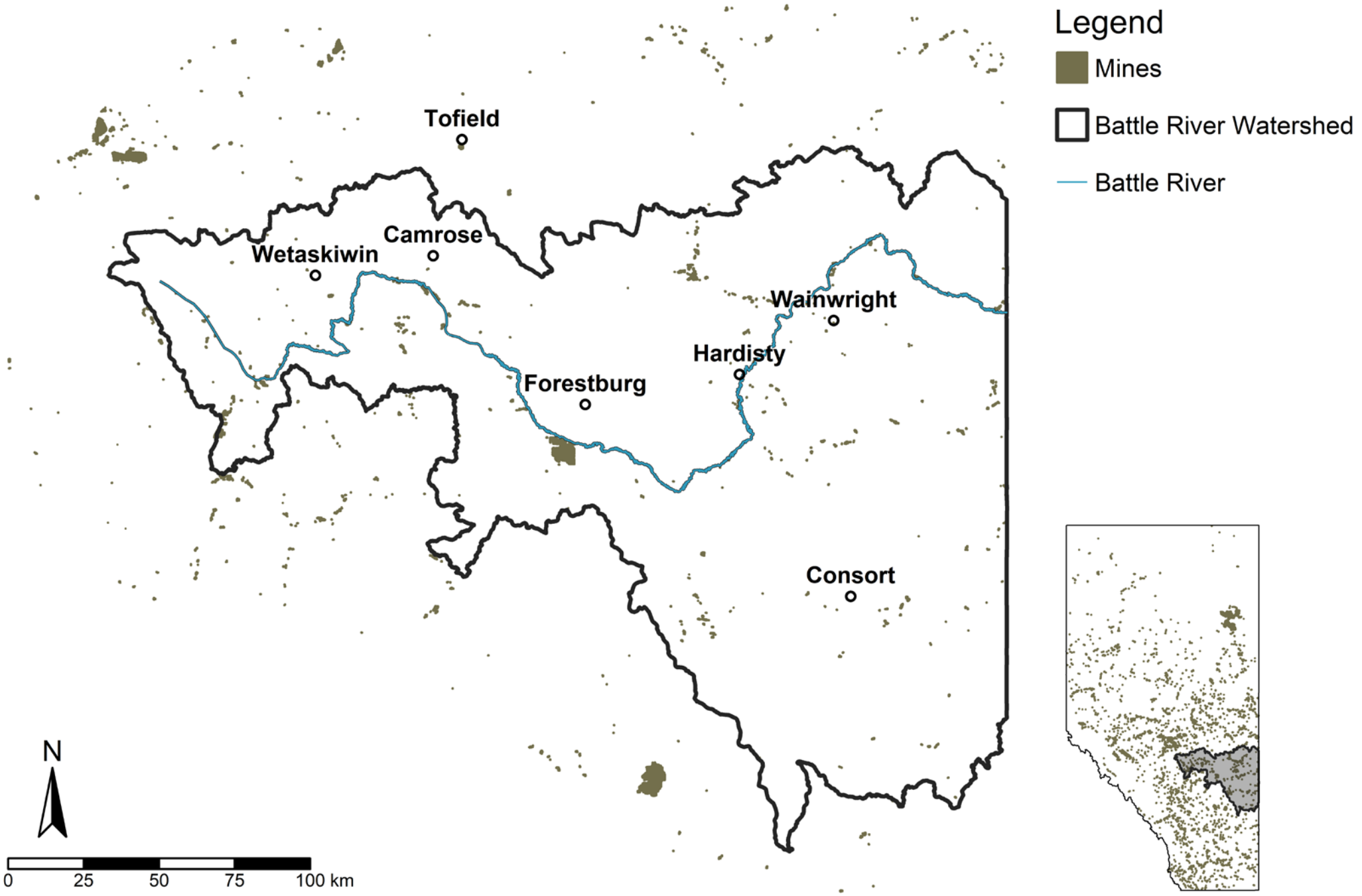
Table 4.6: Proportion of land cover used for agricultural cultivation by subwatershed in 2010, 2018, and percent change from 2010 to 2018 (Source: ABMI 2018).

Powter et al. (2012) examined Alberta's conservation and reclamation program for industrial land. Initially, the program focused on removing surface debris and making sites safe, but grew to include minimizing cumulative effects on sites and restoring ecological function. This program growth has been influenced by numerous factors such as advances in science and technology, education and expectation of both stakeholders and the public, changes to regulatory policies and objectives as well as industrial practices, the type and size of land disturbances, and others.

Noble, Nielsen and Hill wrote two articles that discuss the negative effects of road development on wetlands in prairie ecosystems, including barriers to effective protection and mitigation of damage to wetlands. Many prairie wetlands are small and seasonal, and these features mean that they fall through the cracks and are not counted during project planning. Both studies recommend improved planning guidance to better account for the small, seasonal wetlands which account for a significant proportion of the prairies' wetland area, and which are at acute risk because they are too small to be counted in development

Mines Land Cover (2018)

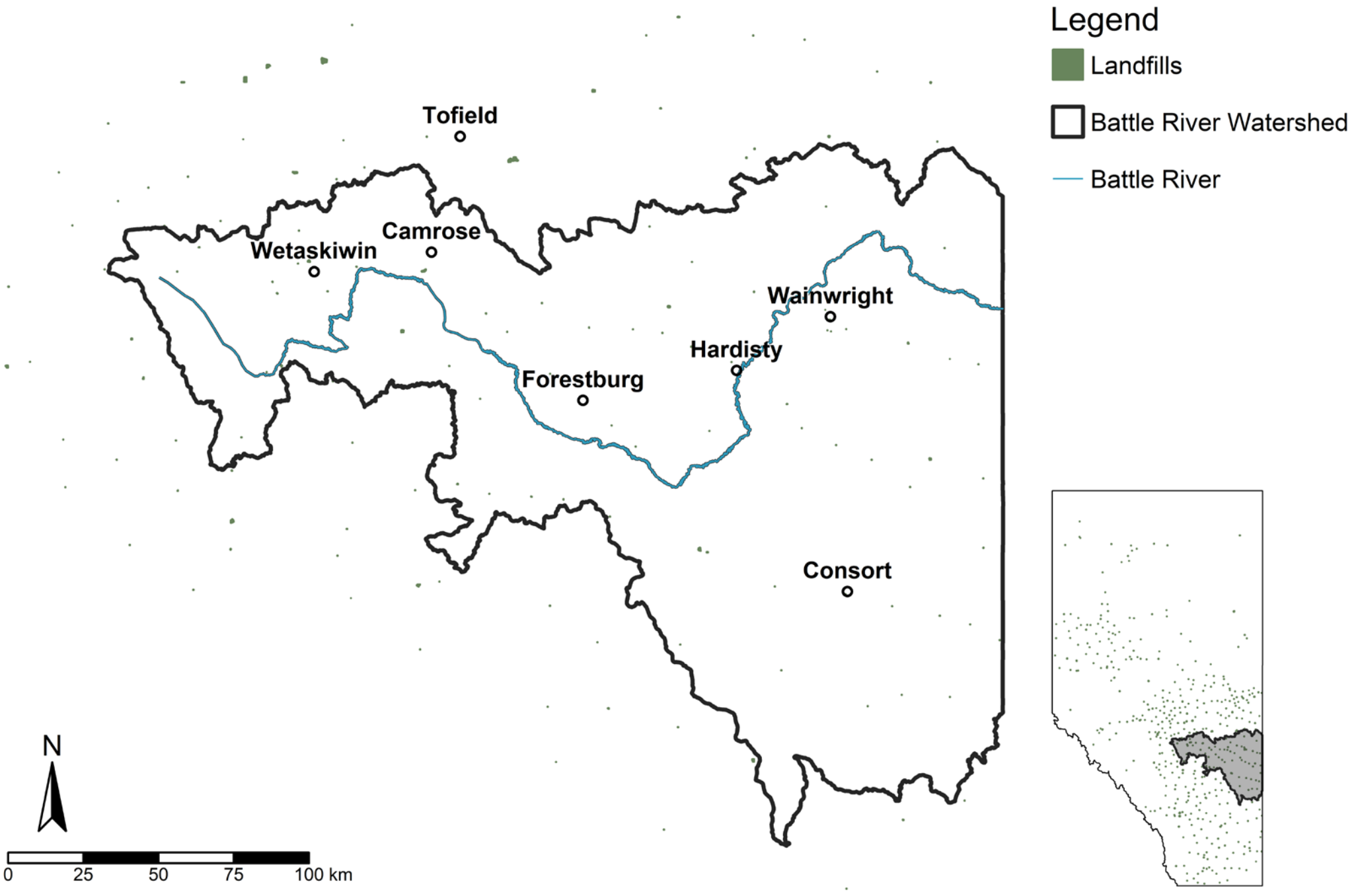
Land cover by development type



Map 4.18: (Source: Wall-to-Wall Human Footprint Inventory. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020).

Landfills Land Cover (2018)

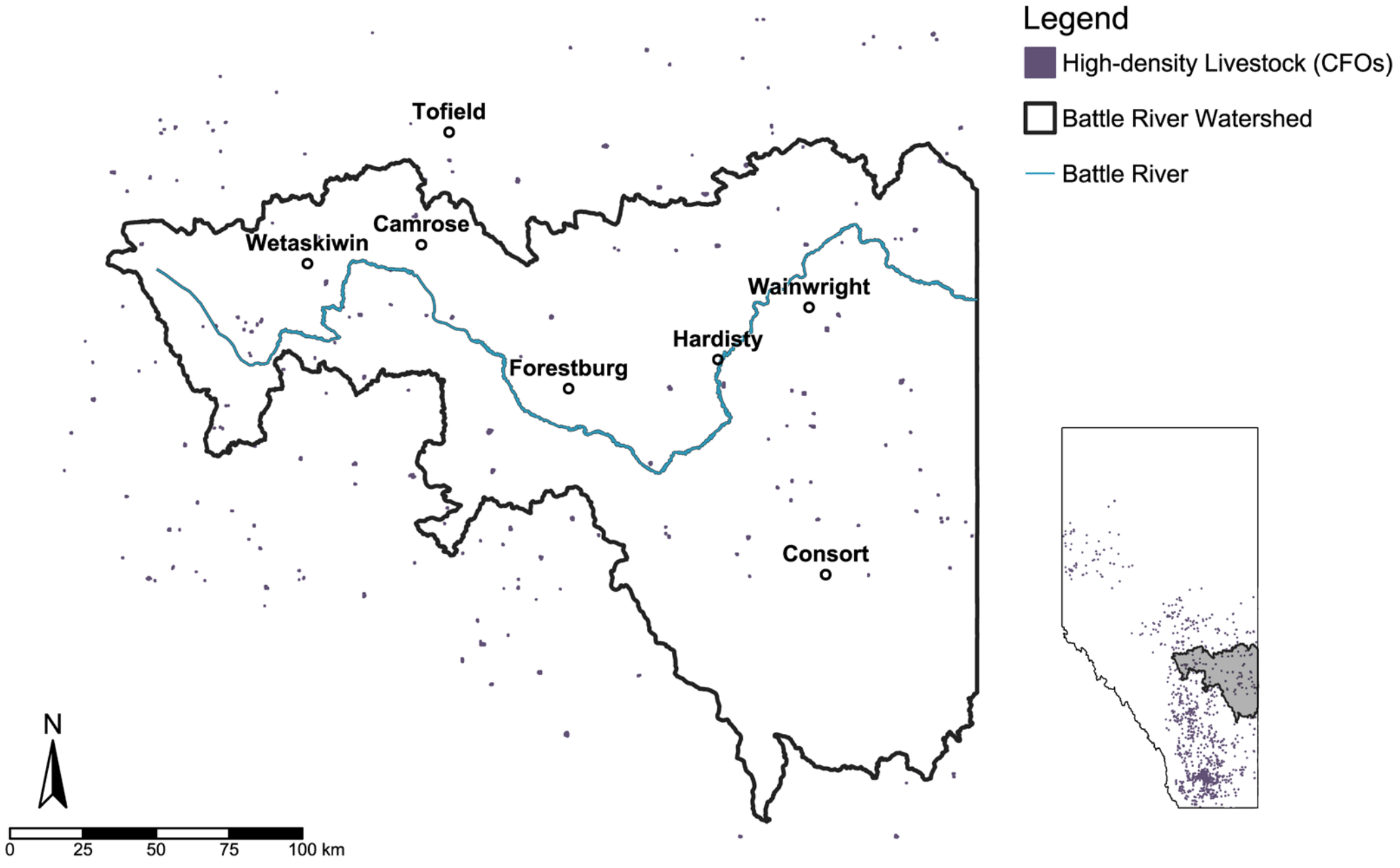
Land cover by development type



Map 4.19: (Source: Wall-to-Wall Human Footprint Inventory. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020).

High-density Livestock/ Concentrated Feeding Operations Land Cover (2018)

Land cover by development type



Map 4.20: (Source: Wall-to-Wall Human Footprint Inventory. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020).

plans. Under these circumstances, community groups can also play a role in identifying local wetland areas and advocating for their incorporation into regulation (Noble, Hill, and Nielsen 2011; 2012).

Excessive human access into sensitive areas happens both because of industrial development and as a result of recreational and other smaller-scale activities. Unreclaimed logging roads, seismic lines, and other forms of roads and trails disturb wildlife, introduce erosion, and fragment habitat (Johancsik 2016). Linear development in wetlands and peatlands, common environmental features in the Athabasca Oil Sands region, reduce the capacity of the ecosystem to hold water and contribute to erosion and flooding. Road removal and ecosystem restoration are effective at reclaiming habitat and ecosystem function if they are done correctly. However effective restoration is a significant expense and can be perceived as too costly to a project (Elmes et al. 2021). Further complications arise with legacy linear development, such as roads that were in use during a project's lifespan, but were never reclaimed, and with reclaimed areas that require periodic monitoring to assess the effectiveness of restoration (Janz, Whitson, and Lupardus 2019). In a 2016 report for the Porcupine Hills Coalition, Johancsik documents principles for minimizing surface disturbance in Alberta's prairie and parkland ecosystems with the intent "to provide government regulatory agencies and industry with a comprehensive set of principles and guidelines for all industrial activity in native grassland landscapes" (Johancsk 2016, 3).

Ultimately, the most significant obstacle to regulating, maintaining, and eventually reclaiming linear developments may be funding. Since such activities do not generate profit, they must be factored into government and corporate budgets as a project cost. Innovative measures to encourage corporations to take responsibility for reclaiming linear developments involve financial collaboration between governments and corporations (Anderson 2018). As described in Chapter 2, volunteer groups, nonprofit societies, and other civil society actors - such as Alberta's Watershed Stewardship Groups - play an important role in advocating for reclamation and performing some of the labour that reclamation and restoration require.

Agricultural Land-Use

Land-use planning in the province is conventionally dated to the discovery of oil at Leduc in 1947 (Roth and Howie 2011).

Sustainable farming requires the utmost care and planning to conserve soil and water, manage pests and diseases, and maintain profitability. Failure to treat agricultural land with care and to conserve undeveloped land may harm the local economy and food supply, lead to reduced water quality and other ecological damages, and result in fewer farms and farmers and reduced agricultural potential (Tomalty 2015).

The BRW is dominated by farmland, with the remainder of the land being covered by forest, grassland, water, or shrub land (Map 4.21). In the BRW, we can see that there is variation in the dominant agricultural vegetation cover at the level of the subwatershed, although wheat and canola are the top two agricultural crops for all the subwatersheds. Other significant agricultural crops include barley, peas, and pasture/forage (Map 4.22).

Understanding Agricultural Land-Use

Much of Alberta's land has been developed for agricultural use, with a diverse industry of livestock and crop production. Listed below are the categories of livestock and crops that make up Alberta's farms:

Alberta Livestock:

- Cattle Ranching: 68%,
- Other Animals, including bees, horses, rabbits, etc.: 27%,
- Poultry and Egg: 2%,
- Sheep and Goat: 2%,
- Hogs and Pigs: 1% (Government of Alberta 2018).

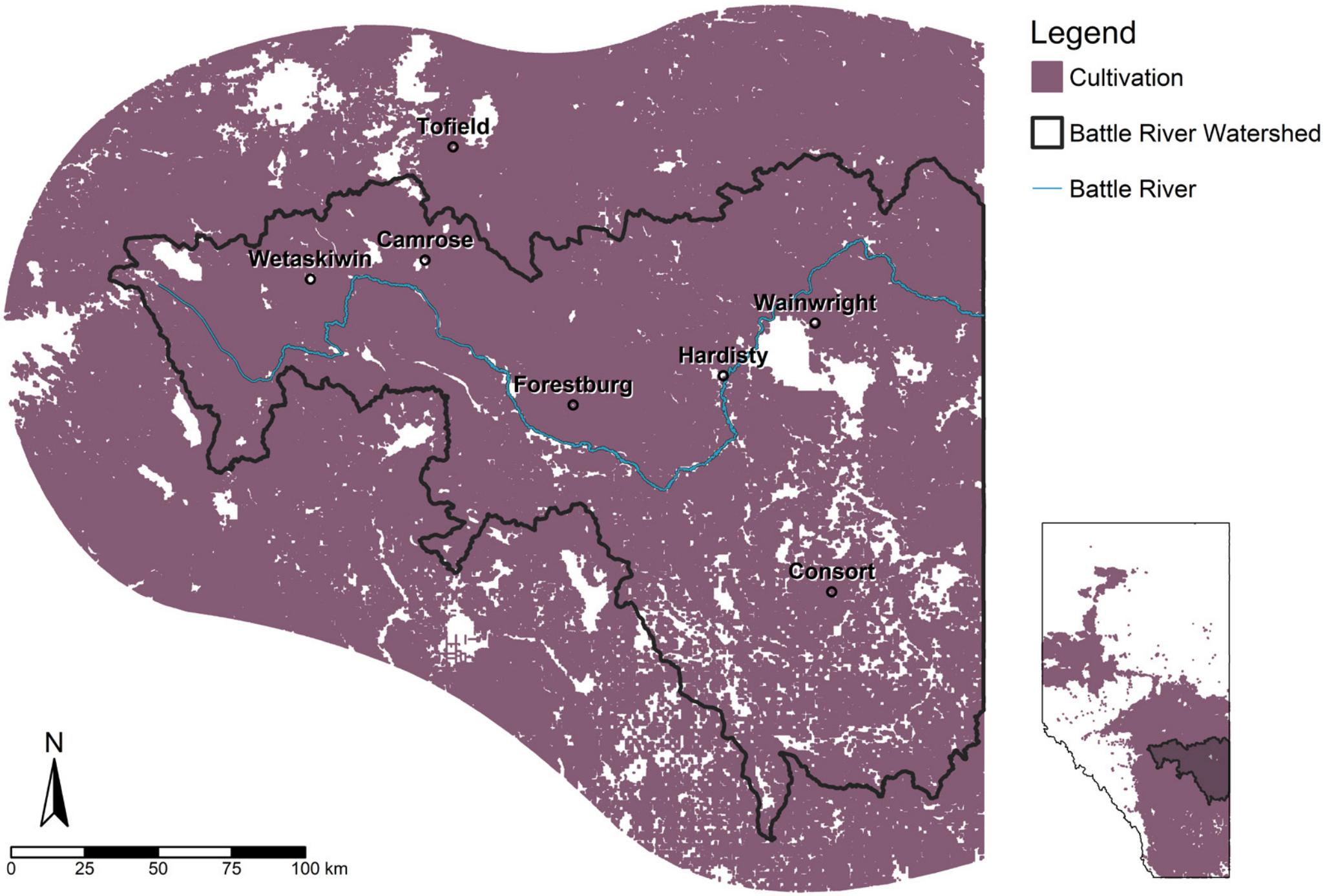
Alberta Crops:

- Oilseed and Grain Production: 61% ,
- Other Crops, including peanuts, sugar beets, cotton, sugarcane, herbs and spices: 34%,
- Greenhouse: 3%,
- Vegetable and Melon: 1%,
- Fruit and Tree-nut: 1% (Government of Alberta 2018).

In total, agricultural (farm) land in Alberta spans 50,250,183 acres (Government of Alberta 2020a). Alberta is the largest

Cultivation Land Cover (2018)

Land cover by development type



Map 4.21: (Source: Wall-to-Wall Human Footprint Inventory. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020).

beef-producing province and the third largest exporter of agriculture and agri-food products in Canada, with an agricultural product export value of $10 billion in 2016. Alberta also has the second largest number of farms in Canada, and the second largest farm area (Begam and Adilu 2017).

The Land Suitability Rating System (LSRS) groups Alberta's soil into 7 classes based on physical and chemical properties of soil. LSRS class 1-3 soil is considered prime agricultural land, with classes 6-7 defined as being unsuitable for crop production. Of the class 2-3 land, approximately 18% remains undeveloped or is currently used for non-agricultural based purposes (Alberta Agriculture and Forestry, 2017). From 2012-2016, Alberta has lost ~34,700 acres of LSRS Class 2 and 3 land to non-agricultural usage (Begam and Adilu 2017).

Agricultural land usage will adjust to temperature fluctuations annually. Apart from weather and climate, diseases linked to agriculture pose as a major threat. For example, the outbreak of mad cow disease (BSE) in 2003 caused a decline in the cattle livestock industry, again affecting the usage of agricultural land (Wang 2015). Other economic threats can include the fluctuating prices of seeds and farming tools/technologies, which may influence how land is used due to lack of resources.

Conversion/Fragmentation

In 2019, Alberta faced a net loss of over 13,700 hectares of agricultural land (Government of Alberta 2020c). Farmland conversion is a consequence of population growth in nearby cities, and is influenced by by new road construction, infrastructure improvements, market growth, improved employment opportunities, and governmental policy changes in the area (Qui et al. 2015).

Fragmentation of farmland happens through dividing the land into smaller parcels, such as through rural residential development, transportation routes, and energy and utility corridors. Farmland conversion is found to be greatest around Edmonton and Calgary due to rapid development and population growth in these areas (Qui et al. 2015).

Crop Cover by Type and Subwatershed (2020)

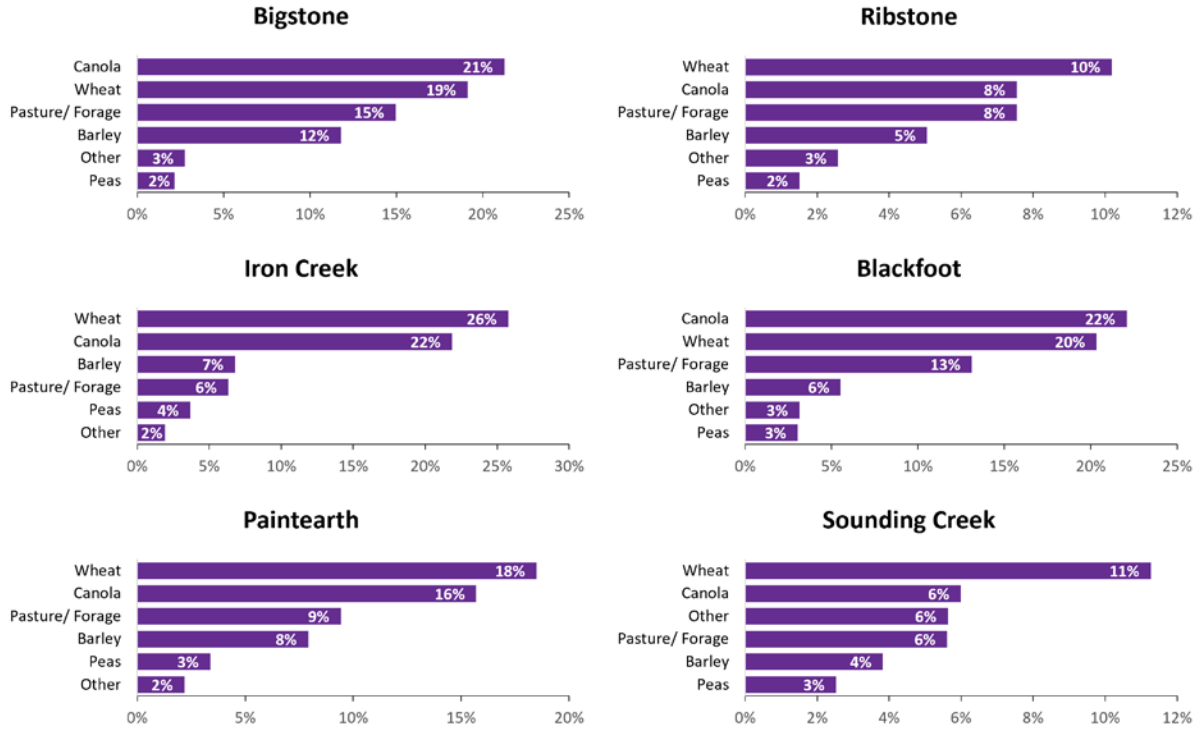


Figure 4.7: Percent of land cover for major crop types within each subwatershed of the BRW in 2020 (Source: Agriculture and Agri-Food Canada, 2020, Agriculture and Agri-Food Canada, 2020, "Annual Space-Based Crop Inventory for Canada, 2020", Agroclimate, Geomatics and Earth Observation Division, Science and Technology Branch).

Policy Responses for Land Management

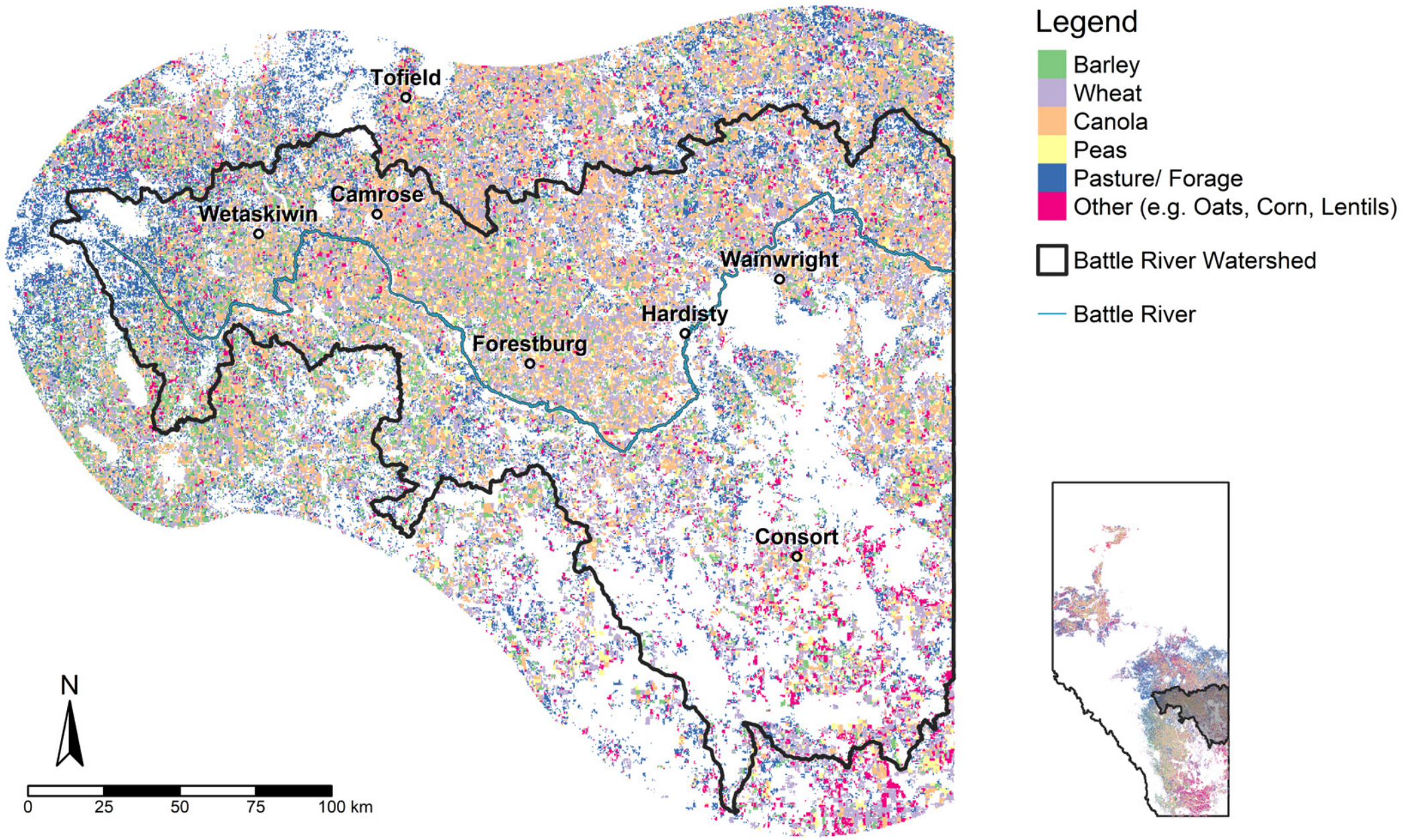
Why do we measure it?

Linear Development

Linear development means a development with the basic function of connecting two points such as a road, public walkway, railroad, sewage pipe, stormwater management pipe, gas pipeline, or electric, telephone, or other transmission line (Government of Alberta 2016c). Conducting environmental impact assessments, as well tracking and monitoring linear developments over time, enables us to understand their impact on plant

Crop Inventory (2020)

Land cover by crop type



Map 4.22: (Source: Agriculture and Agri-Food Canada, 2019, "Annual Space-Based Crop Inventory for Canada, 2020", Agroclimate, Geomatics and Earth Observation Division, Science and Technology Branch).

communities and fish and wildlife species as well as their effect on the health of individuals who reside near a given linear development (Government of Alberta 2021b). We can also assess land management practices associated with linear developments and the impacts of these management practices on our health, our environment, and our economy.

Land Development

Land development is defined as the erection of buildings or structures on land, change in the use of land including activities that prepare the land for building, or the acquisition of land for these purposes (Government of Alberta n.d. n). The land development process involves improvements or site alterations that have indefinite lifespans, such as draining, dredging, excavating, filling, grading, and paving. Measuring land development, which often goes hand in hand with land-use planning, provides a window into how the land is being used and how effective that use is (Buitelaar et al. 2012).

By measuring land development, we can learn more about how we are managing and regulating development in terms of the environment, economic and social impacts, and in terms of improving the health of individuals living and working in these areas.

Agricultural Land-Use

Understanding the extent and effects of agricultural land-use is highly relevant to BRW residents (Kanianska 2016). Some of the factors driving assessments of agricultural land-use include: measuring our ability to feed people, measuring the impact of land-use on the environment, and measuring the economic viability of our growing practices (Alberta Environmental Farm Plan n.d.; Government of Alberta n.d. a). Assessing and measuring agricultural land-use will help us to develop a clear picture of the state of the land and surrounding environment, as well as the efficiency and sustainability of this land-use (Ritchie and Roser 2019). The fragmentation and loss of agricultural land because of urban and industrial development is a matter of concern both for Albertans and for the provincial government.

What is being measured?

Agricultural Land-Use

Urban areas in the province have been expanding dramatically since the 1980s, one of the results has been an increase in the price of farmland near urban centres. The Alberta Land Institute at the University of Alberta found that the majority of land converted from agricultural use around urban centres is actually high-quality agricultural land (University of Alberta 2013). This means we are not only losing land in quantity, but also in quality, with probable repercussions for food production, water quality, vegetation cover, and the farming economy.

In 2019, the Environmental Law Centre released an overview of law and policy related to agricultural land in Alberta. The report describes the various pieces of Alberta legislation that pertain to agricultural land and agricultural activities, and closes with several recommendations that would facilitate agricultural land conservation. Overall the recommendations focus on better use of the tools available under the ALSA, from certification and labeling schemes to tax incentives to requirements for conservation easements, all of which have the capacity to encourage sustainable farming and support farmland preservation (Powell 2019).

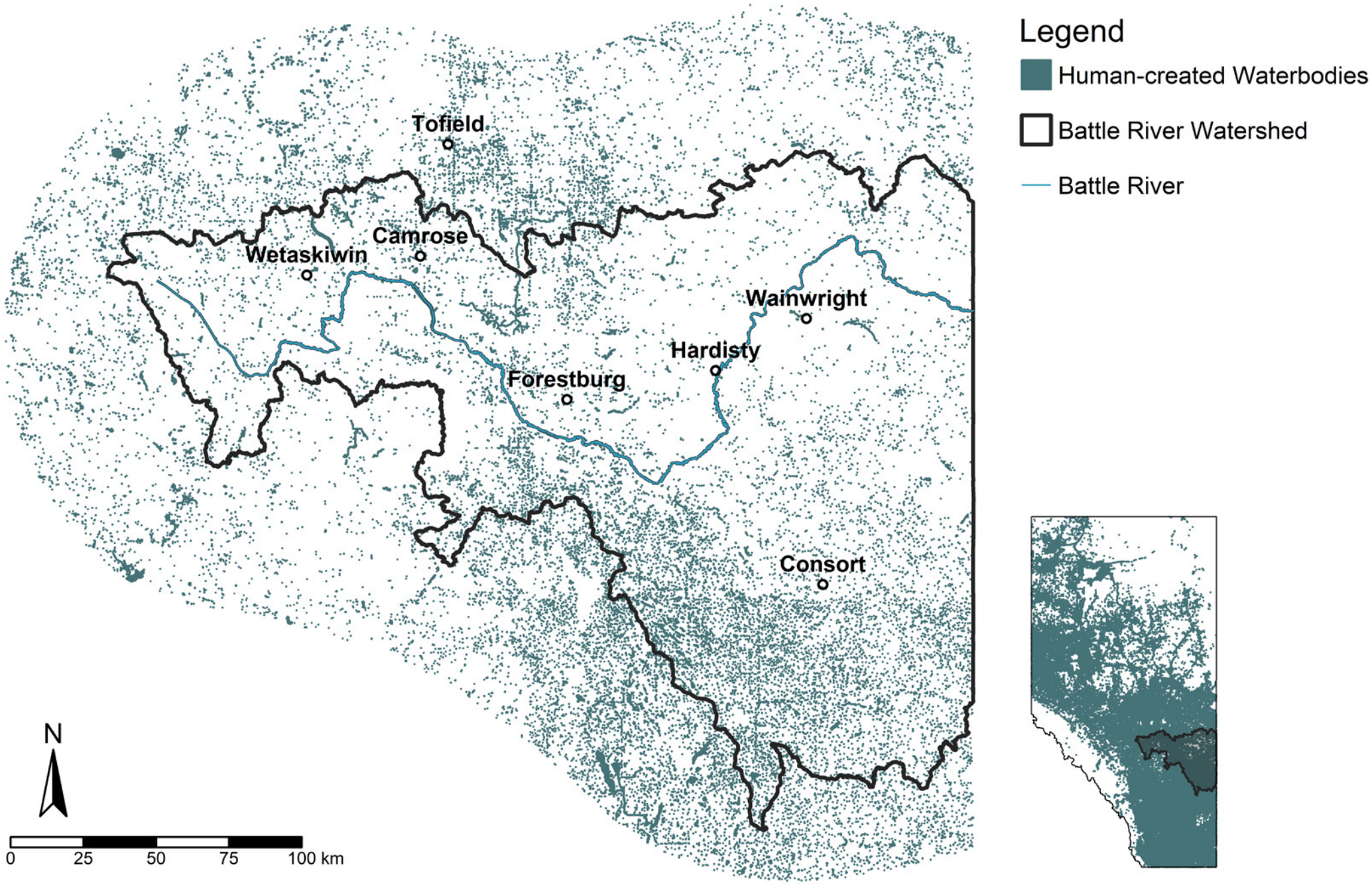
What could be done?

Linear Development

Linear development is clearly an essential component of Alberta's economic and social infrastructure. At the same time, however, linear developments need to be regulated for health and safety, and environmental protection. Meeting health and safety requirements entails making sure linear infrastructure is maintained in good working order, or properly decommissioned if it is no longer in use. Maintenance encompasses activities from monitoring pipelines, water lines, and wastewater lines for leaks to repaving roads. Earlier, we discussed road reclamation and the need to properly decommission linear developments that are no longer in use. Reclamation of roads potentially protects and restores wildlife habitat, and can help to reduce the risk of forest fires, mudslides, and other environmental damage through reducing vehicle access to the backcountry. Proper reclamation of other types of linear infrastructure can be important for similar reasons: protecting and restoring wildlife habitat, safeguarding human health, protecting water sources, and allowing the site either to be returned to a natural condition or making it available for other types of land-use.

Human-created Waterbodies (2018)

Land cover by development type



Map 4.23: (Source: Wall-to-Wall Human Footprint Inventory. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020).

When we consider the reclamation of linear infrastructure in Alberta, oil and gas wells are an area of increasing public concern, industry focus, and government action. When a well reaches the end of its productive life, steps must be taken to remove it from service and seal it. This process is called abandonment (Alberta Energy Regulator n.d. a).

The AER states that there are approximately 170,000 abandoned wells in Alberta, representing 37% of all wells in the province (Alberta Energy Regulator n.d. a). Abandoned wells remain the responsibility of the company that owns them, which means even if wells are located on a piece of private land (a farm, for example), the company that built and/or operated them remains liable for ensuring the abandoned well has been properly shut down, does not leak, and does not cause any other environmental problems. Abandoned wells must also be surrounded by a buffer zone of land, called a setback, to ensure that homes or other buildings are located a safe distance from the well (Alberta Energy Regulator n.d. a).

Wells that are no longer in use but have no owner to shut them down and be responsible for them are called orphaned wells (Alberta Energy Regulator n.d. b). As of September 1, 2021, the Orphan Well Association has identified 3,231 orphan sites for decommissioning, 3,585 orphan pipelines for decommissioning, and 5,204 orphan sites which have been decommissioned but still require environmental reclamation work to restore disturbed land and vegetation (Orphan Well Association n.d.).

Part of the reason orphan wells exist is because companies have more incentive to open new wells than to properly maintain or decommission wells. Including a full accounting of the cost of decommissioning a well into the cost of opening a well may place more of the financial burden of oil and gas development on companies, and reduce the burden for the government and for landowners (Riley 2018).

Land Development

The clearest obstacle for land development in Alberta that both meets human needs for housing and other infrastructure and meets the needs of industry, agricultural production, and environmental conservation is the lack of action on the Regional Plans. As of 2017 only two out of seven regional plans are complete, more than a decade after the LUF came into effect. The two approved and ongoing plans are for the Lower Athabasca Region and the South Saskatchewan Region (Alberta Land Use Secretariat n.d. b; Alberta Land Use Secretariat 2017).

Regional Plans go through several stages before they are approved. These stages include planning, consultation, the establishment of a regional advisory council, and the submission of progress reports (Government of Alberta n.d. o). Once approved, they are subject to amendments and must demonstrate progress towards the ongoing implementation of provincial strategies (Government of Alberta n.d. t).

The North Saskatchewan Regional Plan is in development and set to be the third regional plan implemented in Alberta (Land Use Planning Hub n.d.). The history of regional planning in Alberta tends to follow the economic fortunes of the province. In prosperous years, there is support for long-range thinking and expansive government programs. In times of recession, government priorities shrink (Land Use Planning Hub 2018). The two completed land-use plans were completed in 2012 and 2014, just before the province began a financial downturn (Gibson 2016; Land Use Planning Hub n.d.) Waiting for the Alberta economy to boom again may result in lost opportunities for land conservation, installing efficient, safe, and up-to-date infrastructure in new developments, and achieving a long-term vision for land-use in Alberta.

Agricultural Land-Use

Among the recommendations in the ELC report is the finding that the ALSA and other regional planning systems could mandate the establishment of agricultural green belts, or reserved agricultural land (Powell 2019). An example of a zoning system that provides for a green belt is British Columbia's Agricultural Land Reserve (ALR) (Government of British Columbia n.d. a). Land in the ALR is classified as land where agriculture is recognized as the priority use. On these lands, farming is encouraged and other land-uses are restricted.

The report notes, however, that the two completed RLUP do not include provision for green belts. Land stewardship and land-use planning policy in Alberta do not currently include robust mandates for agricultural land conservation, so the report recommends the implementation of financial tools designed to help farmers keep their land and for that land to remain designated for agricultural use when sold or passed on. More information is needed to facilitate the development of such tools, but one possible source of data would be enhanced tracking of land transfer transactions which would allow us a better understanding of what happens to agricultural land when it is sold. From here, it might be possible to develop taxation plans that would favour buyers who commit to agricultural land-use (Powell 2019).

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Table A-1: Census subdivisions (CSDs), and their respective populations, considered part of the Battle River Watershed for the purposes of calculations.

CSD ID	Name	Population (2019)
4808029	Blackfalds	11493
4808038	Ponoka County	10096
4804016	Cereal	111
4804019	Youngstown	154
4804021	Veteran	207
4804022	Consort	678
4807006	Hughenden	244
4807001	Provost No. 52	2149
4807002	Provost	1999
4807008	Amisk	204
4807012	Coronation	968
4807016	Halkirk	111
4807019	Stettler County No. 6	5594
4807022	Gadsby	41
4807024	Botha	207
4807026	Stettler	5950
4807029	Donalda	217
4807031	Flagstaff County	3779

CSD ID	Name	Population (2019)
4807032	Alliance	156
4810001	Camrose County	8618
4810003	Rosalind	191
4810004	Ferintosh	207
4810006	Edberg	154
4810009	Bawlf	414
4810011	Camrose	19306
4810012	Bittern Lake	224
4810014	Hay Lakes	557
4808031	Lacombe	13910
4808039	Ponoka	7437
4811011	Millet	2111
4810022	Viking	1097
4811001	Wetaskiwin County No. 10	11298
4808811	Samson 137	3573
4807004	Czar	202
4811002	Wetaskiwin	12989
4807036	Forestburg	871

Appendix A

CSD ID	Name	Population (2019)
4807038	Heisler	159
4807039	Daysland	838
4807042	Killam	988
4807044	Sedgewick	808
4807046	Lougheed	256
4807048	Hardisty	551
4807049	Wainwright No. 61	4467
4807051	Chauvin	334
4807052	Edgerton	366

Appendix A

CHAPTER FIVE

ECOSYSTEMS AND BIODIVERSITY

TABLE OF CONTENTS

INTRODUCTION

Alberta is home to many different ecosystems and natural regions, including Grassland, Parkland, Foothills, Boreal Forest, Rocky Mountains, and Canadian Shield (Alberta Parks 2014, 4). Each ecosystem/natural region is classified based on landforms, climate, geology, soils, animals, vegetation, and more (Alberta Parks 2014, 3). The BRW and surrounding regions are comprised primarily of the Parkland and Grassland ecosystems. Parkland is known as a transition between grasslands and forests and is diverse in both landscapes and vegetation. However, this region is also the most populated and has extensive agricultural development (Alberta Parks 2014, 30). In fact, only 5% of the native vegetation in the Central Parkland area remains intact (Alberta Parks 2014, 30).

Biodiversity is defined as the "species, genetic, and ecosystem diversity in an area, sometimes including associated abiotic components such as landscape features, drainage systems, and climate" (Swingland 2001, 399). Biodiversity is crucial in all ecosystems, as many species often depend on another to survive (National Geographic 2022). Biodiversity is also important for culture and identity. For example, threatened species such as the bison are symbolic in Indigenous cultures. Unfortunately, much of world's biodiversity is threatened due to anthropogenic changes, pollution, climate change, population growth, and more (National Geographic 2022).

Ecosystems and Biodiversity

1. Species Intactness

The Alberta Biodiversity Monitoring Institute (ABMI) (2014b) defines species intactness as a measurement of biodiversity in a given area, providing an estimate of how much a species abundance has diverged from baseline due to human disturbance. For example, low scores for a species reflect highly modified habitats due to human intervention (Alberta Biodiversity Monitoring Institute 2014b). It is also important to note that an abundance of a certain species does not always reflect a healthy ecosystem. Some species are invasive in nature and may appear abundant when the native species are threatened.

2. Fish Health

Fish health is measured by the Index of Biological Integrity (IBI). The IBI evaluates aquatic habitats through assessment of river conditions (Stevens and Council 2008, 1). The IBI is sensitive to changes in cumulative anthropogenic effects (Stevens and Council 2008, ii). This includes the effects of human impact on the aquatic ecosystem, and for the ability to observe any long-term changes. For example, excessive nitrogen and phosphorus nutrient runoff into these bodies of water can cause eutrophication and uninhabitable living conditions for the native fish (Chislock et al. 2013). As with species intactness, the abundance of one species of fish does not necessarily mean the ecosystem is 'healthy'.

3. Riparian Health

Riparian zones are strips of land that separate a body of water from land. Riparian zones provide habitats for many species of plants and animals (Alberta Riparian Habitat Management Society n.d. b; Battle River Watershed Alliance n.d. c). For example, the health of a riparian zone influences the health of fish by providing food from insects and other organic matter (Bruneau 2015, 43). Riparian zones are also subject to human activities, such as farming, grazing, land and road development (Bruneau 2015, 49-54).

4. Land Cover

Land cover refers to the features of the terrain in a land mass. The ABMI uses 11 unique land cover classes, based on a variety of features, to classify land coverage as a part of their Wall-to-wall Land Cover Map initiative. These maps identify classes such as water, which is described by features like lakes and lagoons, and grassland, which has features such as native grasses and herbaceous vegetation (Alberta Biodiversity Monitoring Institute 2010). Land cover is important because the type of land cover, and any changes to it, can have direct impacts on the quality and well-being of an ecosystem (Rimal et al. 2019, 1). Humans can have a direct influence on land cover through land-use.

Understanding the Political Context of Ecosystems and Biodiversity

Ecosystems and biodiversity policy can be tracked along two different lines: (1) policy tools intended to regulate activities that could have a potentially negative impact on ecosystems and biodiversity, and (2) legislation and programs that authorize environmental planning of selected areas and/or biological indicators (Government of Alberta n.d. i; Government of Alberta n.d. a). One interesting policy direction for ecosystems and biodiversity management in Alberta is the objective to build functional coalitions between different kinds of stakeholders (Government of Alberta n.d. i; Government of Alberta n.d. e). This means that different levels of government, First Nations peoples, industry, scientists, farmers, landowners, and citizens' groups may all find themselves working together to either create management plans or to fulfill planning requirements.

Overall Policy Design

Alberta has a fairly sophisticated network of legislation and policy relating to ecosystems, biodiversity, and land-use, perhaps in part because the province is the site of such intensive land-use and resource development.

In 1948, the province introduced the concepts of the 'White Zone' and the 'Green Zone' to public land management. The White Zone extends over much of southern Alberta, while the Green Zone covers the northern half of the province and the Rockies (Alberta

Wilderness Association n.d.). Agriculture and oil and gas wells are prevalent in the southern half of the province, while parts of the north see extensive oil sands production, much of which is extracted via strip or open pit mining.

A consistent criticism of environmental policy in Alberta from a wide cross-section of stakeholders - including industry professionals, professionals from non-governmental organizations (NGO), academics, and public service staff - is jurisdictional fragmentation (Clare and Sass 2012, 41).

Jurisdictional fragmentation means some responsibility for environmental governance rests with each of the municipal, provincial, and federal governments, but these governments have differing levels of authority and ability to enact policy (Clare and Sass 2012, 41-42). One jurisdiction may create policy that conflicts with or overrides the rules set by another jurisdiction, which leads to confusion for land managers and people using the land about what can or cannot be done on a given piece of land. This is also seen within the provincial government, as different ministries sometimes have overlapping or conflicting responsibilities (Clare and Sass 2012, 6).

Such fragmentation creates the perception of a lack of coordination for environmental policy within the provincial government and between levels of government (Clare and Sass 2012, 41). There may also be conflicting guidelines for environmental management, which creates the perception that there are too many hands involved (Clare and Sass 2012, 42). The result is both over-legislation and under-legislation, making it difficult for everyone involved to act in ways that both comply with legislation and effectively protect ecosystems and biodiversity.

Under these circumstances, monitoring can tell us if and where biodiversity and ecosystem quality are declining, but monitoring by itself cannot remediate damage or conserve sensitive ecosystems. Monitoring may also be hampered by conflicting government priorities, overlapping areas of authority, or authority without clear guidelines for activities, as appears to be the case with municipal governments' authority, through the Municipal Government Act (MGA), to manage riparian areas (Clare and Sass 2012, 42).

The primary piece of legislation in Alberta regarding ecosystem and biodiversity protection is the Environmental Protection and Enhancement Act (EPEA), which was released in 1993, updated in 2000, and revised as of June 2021 (Government of Alberta 2021b). This act governs environmental management generally through the designation of requirements for approval of certain land-use activities (Government of Alberta 2021b).

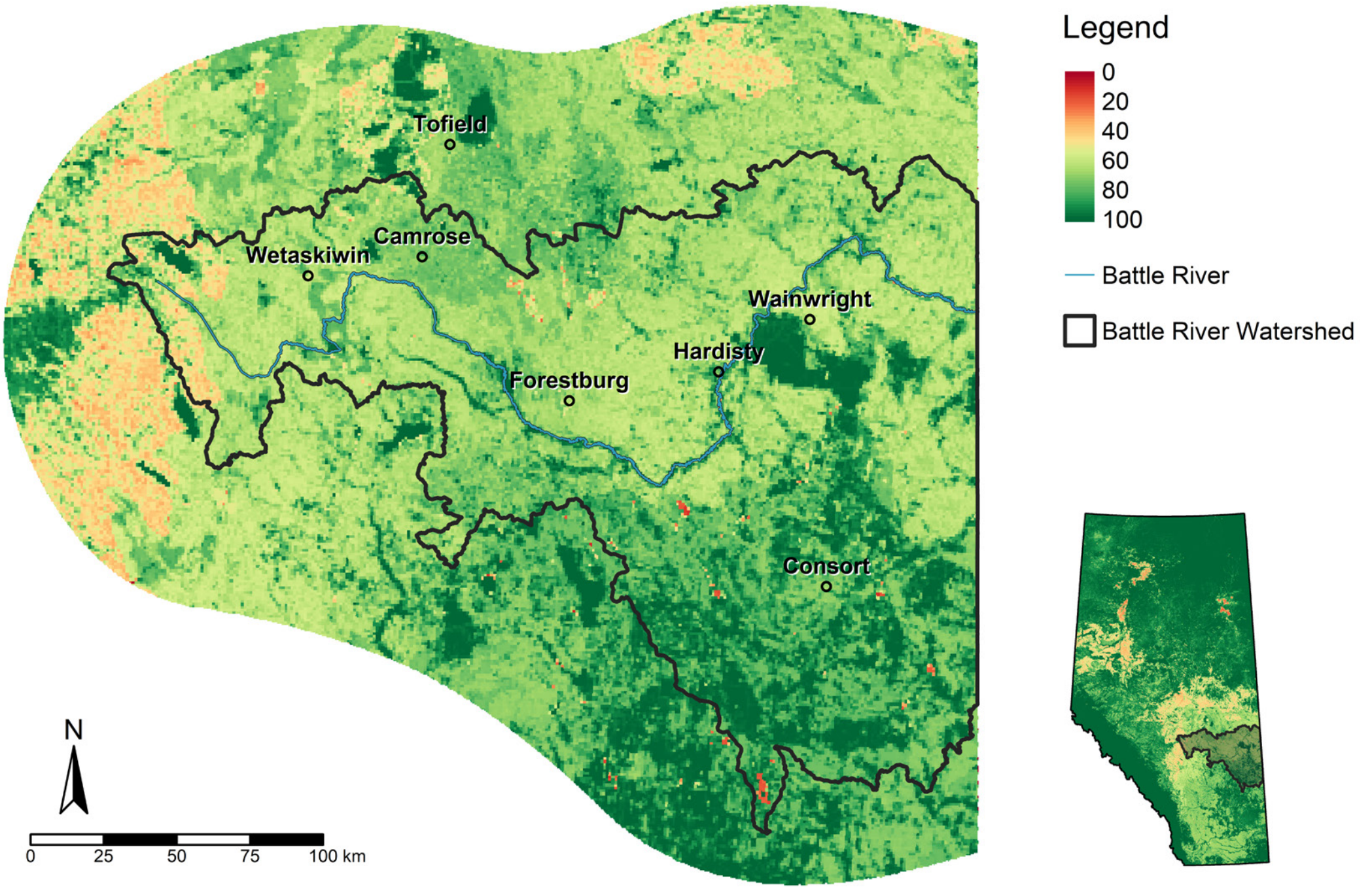
These requirements include activities such as registering a project, conducting environmental assessments, and adhering to relevant codes of practice (Alberta Environment and Parks 2015). The Act also specifies penalties for breaches of the legislation, including releases of potentially harmful substances into the environment (Government of Alberta 2021b).

There is also federal legislation that governs some activities pertaining to ecosystems and biodiversity, such as the Fisheries Act, as well as secondary provincial legislation that refers to more specific activities; for example, the Public Lands Act. A short list of legislation relating to environmental policy in Alberta, beyond the EPEA and the Public Lands Act, includes Alberta's Wildlife Act; the Forests Act; the Water Act; the Wilderness Areas, Ecological Reserves, and Natural Areas Act; the Provincial Parks Act; and the Alberta Land Stewardship Act (ALSA).

The ALSA (last updated in 2021) provides the legislative basis for the Alberta Land-Use Framework (LUF) (2008) (Government of Alberta 2021a, 46-50). The LUF supports regional-level land-use planning by dividing the province into seven land-use regions and requiring the development of a regional plan (Regional Land-use Plan (RLUP)) for each one. The Government of Alberta's LUF requires that "[t]he regional plans will integrate provincial policies at the regional level; set out regional land-use objectives and provide the context for land-use decision-making within the region; and reflect the uniqueness and priorities of each region. Municipalities, other local authorities and provincial government departments will be required to comply with each regional plan" (Alberta Land Use Secretariat 2008, 3).

Mammal Species Intactness (2018)

Relative intactness of mammal species, with values closer to 100 representing complete intactness (*i.e.*, no disturbance)



Map 5.1: (Source: Alberta Biodiversity Monitoring Institute. 2014. Manual for Species Modeling and Intactness, Version 2014-09-25. Alberta Biodiversity Monitoring Institute, Alberta, Canada. Report available at: abmi.ca).

The RLUPs are not meant to be top-down plans, but instead seek to define and reflect regional needs and priorities. The regions specified in the LUF are based on Alberta's watersheds, similar to the division of the province into regional Watershed Planning and Advisory Councils (WPACs). However, there are 11 WPACs and only 7 land-use regions, meaning some areas in the province will fall under a different land-use plan and watershed plan, and will be defined as belonging to a different watershed for each plan (Government of Alberta n.d. s; Alberta Land Use Secretariat n.d. c). As an example, the lands of the BRW fall into two different RLUPs: (1) the County of Stettler, Lacombe County, and the County of Paintearth fall within the Red Deer Regional Plan; while (2) Camrose County, Flagstaff County, and the Municipal District of Wainwright are within the North Saskatchewan Regional Plan (Battle River Watershed Alliance n.d. a; Alberta Land Use Secretariat n.d. b; Alberta Land Use Secretariat n.d. a).

Mammal Species Intactness by Subwatershed (2010-2018)

Subwatershed	2010 Intactness (%)	2018 Intactness (%)	Percent Change
Bigstone	50.9	51.9	1.0%
Blackfoot	47.8	47.5	-0.6%
Iron Creek	51.4	50.6	-1.5%
Paintearth	55.3	55.5	0.4%
Ribstone	64.9	64.0	-1.5%
Sounding Creek	59.0	58.4	-1.0%

Table 5.1: Mammal species intactness (an index ranging from 0-100 where higher values indicate greater species abundance) by subwatershed in 2010, 2018, and percent change from 2010 to 2018 (Source: Alberta Biodiversity Monitoring Institute 2018).

Species Intactness

Mammal Species Intactness

Mammal Species Intactness is one indicator of

the biological integrity of an ecosystem. An ecosystem can have biological (or ecological) integrity when we find the living components of the ecosystem intact in their natural region (Government of Canada 2022a, 1). Mammal Species Intactness compares the predicted relative current abundance of a chosen indicator species within a given area to that species' expected relative abundance if there were no human footprint in that area (Alberta Biodiversity Monitoring Institute 2014a, 5-6). The result is a measure of human impact on animal populations. A score can be given that summarizes humans' effect on the ecosystem. A score indicating low species intactness suggests a number of things, potentially including poor ecological stewardship or a polluted, ecologically degraded ecosystem.

While taking measurements for a single animal species will provide insufficient data to make a determination about ecological health, the size and effect of the human footprint in a given area becomes much clearer when we collect data for a cross-section of species, including herbivores, carnivores, and both large and small mammals. If there is a notable decline across several species, it might be because of human activities which are reducing the size or quality of animal habitat in the area. If there is an upward trend in only a few species and a downward trend in others, this can also point towards negative human influence.

However, sometimes the effects of human footprint are not so clear-cut. Some sites with large human footprints also have high species intactness, and some sites with small human footprints have low species intactness (Belote et al. 2020, 376). Low animal species intactness is not always directly related to the presence of human activity, and there are some situations where certain kinds of human activity correlate with high levels of species intactness. These findings suggest two things: (1) human activity is not the only factor negatively affecting animal species intactness, and (2) certain kinds of human activities either have no effect on or even enhance animal species intactness (Belote et al. 2020).

Mammal species show relatively low intactness in the BRW. With a mean intactness percentage of 67.6%, over 30% of the mammals we would expect to find in the BRW are absent. Some of the reasons for these absences may include extensive agricultural land-use and competition from domestic animals, oil and gas development, and urban development (Alberta Biodiversity Monitoring Institute 2014b).

Understanding Mammal Species Intactness

Threatened species are defined as a species that is "likely to become endangered if limiting factors are not reversed" (Alberta Environment and Sustainable Resource Development 2014a). Limiting factors include food, mates, physical space, and temperatures. Endangered species are those that are at immediate risk of extinction, meaning the species could no longer exist anywhere in the world (Alberta Environment and Sustainable Resource Development 2015).

Mammal Species

Mammals are vertebrate (comprised of an internal skeleton) animals that possess hair/fur, and the females give birth to live young that are nourished with milk from the mammary glands of the mother (Wilson 2022). There are more than 6,000 species of mammals of varying body size and functionality (Lacher Jr. et al. 2019, 942). Some mammals are important pollinators, dispersers of seeds, and consume insects which help with mitigating disease transmission (Jones and Safi 2011, 2452). Other mammals can be classified as 'ecosystem engineers', where they create, modify, or destroy habitats thus increasing ecosystem biodiversity (Lacher Jr. et al. 2019, 942).

Intactness

- Threatened or endangered mammal species in Alberta include grizzly bears and swift foxes (Alberta Environment and Sustainable Resource Development 2015),
- The badger is classified as 'S-Rank 4', defined as "uncommon but not rare; some cause for long-term concern due to declines or other factors" (Alberta Biodiversity Monitoring Institute and Boreal Avian Modelling Project 2019a; Alberta Parks 2018),
- The conservation status of the pronghorn is classified as 'Sensitive', defined as "any species that is not at risk of extinction or extirpation but may require special attention or protection to prevent it from being at risk" (Alberta Biodiversity Monitoring Institute and Boreal Avian Modelling Project 2019c; Alberta Sustainable Resource Development 2011).

Risk Factors for Mammal Species Intactness

Anthropogenic actions, meaning actions of human origin, can degrade ecosystems in both indirect and direct ways, such as by contributing to global climate change, as well as disruption and conversion of land leading to habitat loss (Government of Canada 2019; Alberta Biodiversity Monitoring Institute 2015, 12).

Human impact is a major factor in species intactness decline. This can be termed as the 'human footprint', defined by the ABMI as "the visible alteration or conversion of native ecosystems to temporary or permanent residential, recreational, agricultural, or industrial landscapes" (Alberta Biodiversity Monitoring Institute 2017, 10). As of 2015, the human footprint took up 29.2% of Alberta (Alberta Biodiversity Monitoring Institute 2017, 6).

Climate Change

Climate change vulnerability includes "exposure to expected climate change, inherent sensitivity of a species to altered climate, [and] the capacity of a species to adapt to possible change" (Shank and Nixon 2014, iii). For example, mammals may require climatic temperatures to be within a specific and narrow range for hibernation, as well as travel distributions that are dependent on climate (McKelvey, Perry, and Mills 2013). As a result, mammals may need to migrate to new areas to stay within the climate zone suitable for their survival; however, many mammal species may not be able to adapt quickly enough (McKelvey, Perry, and Mills 2013). Alberta grassland species are 'warm-adapted', meaning that they can benefit from warming temperatures; however, boreal species are 'cold-adapted' and would react poorly to warming temperatures (Shank and Nixon 2014, 23). Extreme weather events or climatic variations can cause a decline in prey species, which threatens the survival of many predator species such as the swift fox (Alberta Environment and Sustainable Resource Development 2014a, 60).

The relationship between climate change and intactness is also seen in bird populations. The increased rainfall and temperature in the Alberta prairies have led to greater abundance of some species of birds, such as migratory birds from the South which are arriving earlier in the year to North America (Mantyka-Pringle et al. 2019, 1935).

In contrast, there is an antagonistic relationship between temperature change on terrestrial insectivores, including ground, shrub, tree, and cavity-nesting birds, presumably due to the decline in the insects that serve as a food source (Mantyka-Pringle et al. 2019, 1935). Bird species are likely to be able to shift their habitat range; however, this may have implications to the overall health of the original native ecosystem that relied on the presence of these birds (Shank and Nixon 2014, 27).

Climate change also affects plants, with "rising carbon dioxide concentrations and temperatures directly affecting plant growth, reproduction, and resilience" (Eisenach 2019, 2537). The increase in temperature throughout many years has resulted in the shift in distribution of plant species, and the decrease in crop yield (Eisenach 2019, 2537).

Agriculture and Land Development Change

Agriculture footprint is defined as "areas of annual or perennial cultivation, including crops and tame pasture, as well as confined feeding operations and other high-density livestock areas" (Alberta Biodiversity Monitoring Institute 2017, 10). Agriculture is the largest human footprint category, covering 20.2% of Alberta (Alberta Biodiversity Monitoring Institute 2017, 6). Drivers of species decline mediated by agriculture include "habitat loss and fragmentation through land conversion, mowing and harvesting operations, livestock grazing disturbance, and pesticide toxicity" (Stanton, Morrissey, and Clark 2018, 245).

Land development causes a significant disturbance in the habitat of many species. For example, the agricultural sector is responsible for a 28.9% negative change in the species relative abundance of the hare and rabbit population in the Alberta prairies (Alberta Biodiversity Monitoring Institute 2018, 5). As of 2016, the population of birds that depend on native grasslands for breeding and wintering have declined by 87% (North American Bird Conservation Initiative Canada 2019). Agriculture is listed as the greatest threat to the decline in bird species, with increased agriculture intensification related to a decline in bird population (Stanton, Morrissey, and Clark 2018, 244-245). Agricultural effects are predicted to result in a 46.29% drop in the relative abundance for the blue grama grass (Bouteloua gracilis) in the Prairie region (Alberta Biodiversity Monitoring Institute and Boreal Avian Modelling Project 2019b). This is significant as blue grama is an important food source for many species of small rodents and also provide an important source of nutritional food for grazing livestock (Alberta Biodiversity Monitoring Institute 2015, 28).

Many species are sensitive to edge effects, which are "ecological alterations linked with development of sudden, artificial edges of forest fragments" (Rogan and Lacher Jr. 2018, 8). The conversion of grassland habitat often leads to the fragmentation of much smaller remnant grasslands which are unsustainable for species sensitive to these edge effects (Stanton, Morrissey, and Clark 2018, 248). The fragmentation of habitat is known as one of the main drivers of species extinctions (Rogan and Lacher Jr. 2018, 5). Each individual species has their own patch size requirements, which often is not considered in the conversion of native land to cropland (Rogan and Lacher Jr. 2018, 4).

Non-native plant species, defined as "species that have been introduced, intentionally or otherwise, into new areas beyond their natural habitat," can become both an economic and ecological concern (Alberta Biodiversity Monitoring Institute 2015, 30). Weeds, a category of invasive non-native plant species, cost Canadians approximately $2.2 billion annually in reduced crop and pasture productivity (Alberta Biodiversity Monitoring Institute 2015, 30). Non-native plant species also compete with and displace native plant species which will lead to a reduction in biodiversity in the given ecosystem (Alberta Biodiversity Monitoring Institute 2015, 30).

Development

The urban, rural, and industrial footprint is defined as "residences, buildings, and disturbed vegetation and substrate associated with urban and rural settlements, such as housing, shopping centres, industrial areas, golf courses, and recreation areas, as well as bare ground cleared for industrial and commercial development" (Alberta Biodiversity Monitoring Institute 2017, 11). Roads and linear infrastructure have been related to habitat loss, isolation of populations, road mortality, and increased human access (Benítez-López, Alkemade, and Verweij 2010, 1307). The growing human population has influenced land-use through development of infrastructure such as roads, pipelines, and well-sites (Farr et al. 2017, 24, 32). This increase in human access near natural habitats is a known threat to many populations of species. For example, habitat loss from increased road density for public motorized access is a major contributor towards human-grizzly bear interaction and conflict (Farr et al. 2017, 49-50).

Bird Species Intactness by Subwatershed (2010-2018)

Subwatershed	2010 Intactness (%)	2018 Intactness (%)	Percent Change
Bigstone	55.4	55.0	-0.8%
Blackfoot	54.8	54.4	-0.8%
Iron Creek	55.2	54.7	-1.0%
Paintearth	60.5	60.0	-0.9%
Ribstone	69.1	67.6	-2.1%
Sounding Creek	65.7	64.8	-1.4%

Table 5.2: Bird species intactness (an index ranging from 0-100 where higher values indicate greater species abundance) by subwatershed in 2010, 2018, and percent change from 2010 to 2018 (Source: Alberta Biodiversity Monitoring Institute 2018).

Bird Species

Birds are often used as an environmental indicator due to their sensitivity to habitat change and tracking ease, meaning that the abundance and behaviours of birds in a given

area can be an indicator for environmental conditions (Hill n.d.). Birds are critical for maintaining the health of an ecosystem in many ways: they control pests, pollinate plants, and spread seeds which allows for the reintroduction of plants in destroyed ecosystems (Law 2019).

Intactness

- Grassland specialist bird species have seen the most pronounced population decline in comparison to other bird groups in Canada. The primary causes for this decline are habitat loss and fragmentation of native prairie land (Alberta Biodiversity Monitoring Institute 2015, 20). The following grassland specialist bird species are provincially and federally listed as species at risk: Baird's sparrow, Sprague's pipit, chestnut-collard longspur, and grasshopper sparrow (Alberta Biodiversity Monitoring Institute 2015, 20),
- The following grassland specialist bird species are found in greater abundance than expected: the horned lark, and the long-billed curlew. This demonstrates how the impact on species intactness can be both positive or negative depending on the species and their physiological and environmental requirements (Alberta Biodiversity Monitoring Institute 2015, 20),
- Waterfowl and birds of prey are recovering, while aerial insectivores, grassland birds, and shorebirds are rapidly declining (North American Bird Conservation Initiative Canada 2019).

Mammal and Bird Species Intactness by Subwatershed (2018)

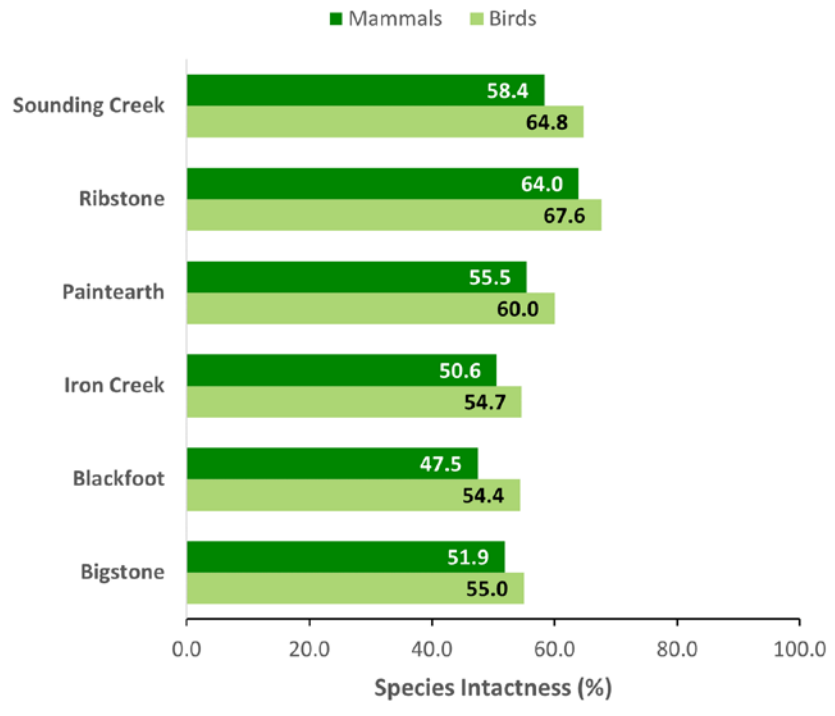


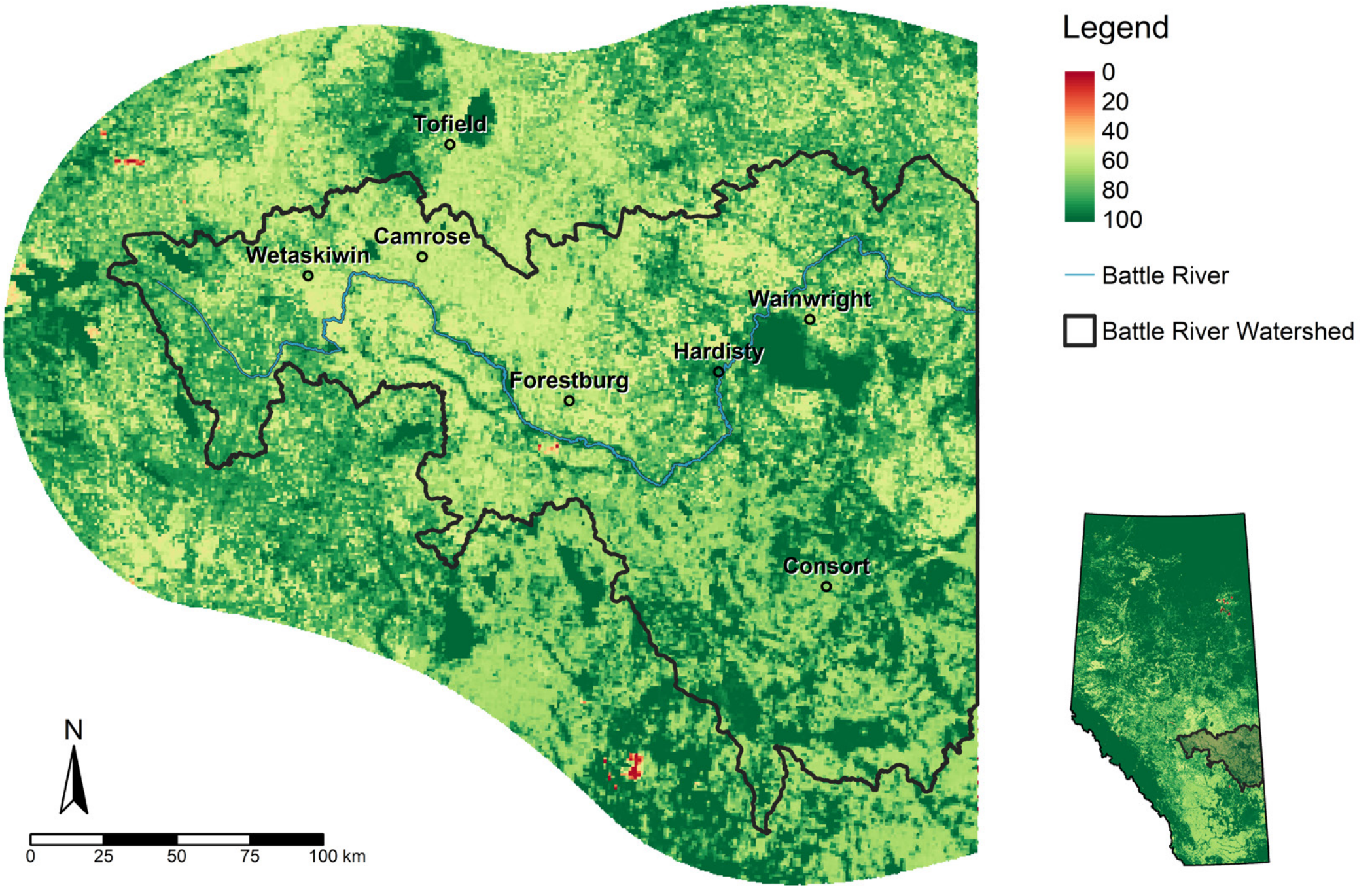
Figure 5.1: Species intactness, which reflects how species abundance has been impacted by human activities, for mammal and bird species within each subwatershed of the BRW in 2018 (Source: Alberta Biodiversity Monitoring Institute, 2018).

Measuring biological integrity through biodiversity monitoring became an important part of conservation efforts around 1992, after the Rio de Janeiro Earth Summit (Gregory et al. 2003, 11). Alongside mammal, fish, and plant biodiversity monitoring, bird biodiversity studies are a key part of contemporary conservation efforts. Birds are an excellent indicator of biodiversity within an ecosystem for many reasons. Our knowledge of bird biodiversity has been helped by the fact that birds have been systematically observed for many decades and methods for bird observation are standardized, meaning that we have long term data on bird populations, and the data we have is essentially being collected in the same ways (Gregory et al. 2003, 13-14). This makes it much easier to compare data over time and between different study sites.

Although there are clear benefits to using bird species as indicators of biological integrity, care must be taken to choose the right species, or group of species, in order to gain relevant data on ecosystem health. Not all birds depend on specific habitats, and many thrive in a wide range of ecosystems. Many birds migrate over long distances and between very

Bird Species Intactness (2018)

Relative intactness of bird species, with values closer to 100 representing complete intactness (*i.e.*, no disturbance)



Map 5.2: (Source: Alberta Biodiversity Monitoring Institute. 2014. Manual for Species Modeling and Intactness, Version 2014-09-25. Alberta Biodiversity Monitoring Institute, Alberta, Canada. Report available at: abmi.ca).

different habitats, making it difficult to pinpoint exactly what environmental changes may be affecting bird biodiversity.

However, birds are an extremely useful biological indicator for one more reason other than the ones already discussed: many people are very interested in birds, and bird studies can make use of the general public's interest in birds. Many communities, including several in Alberta, hold annual or seasonal bird counts (Attia 2021). These bird counts are sponsored by organizations like the Audubon Society, and data from the counts is used by a variety of people including biologists and NGO to assess population trends and develop public awareness campaigns (Birds Canada n.d.).

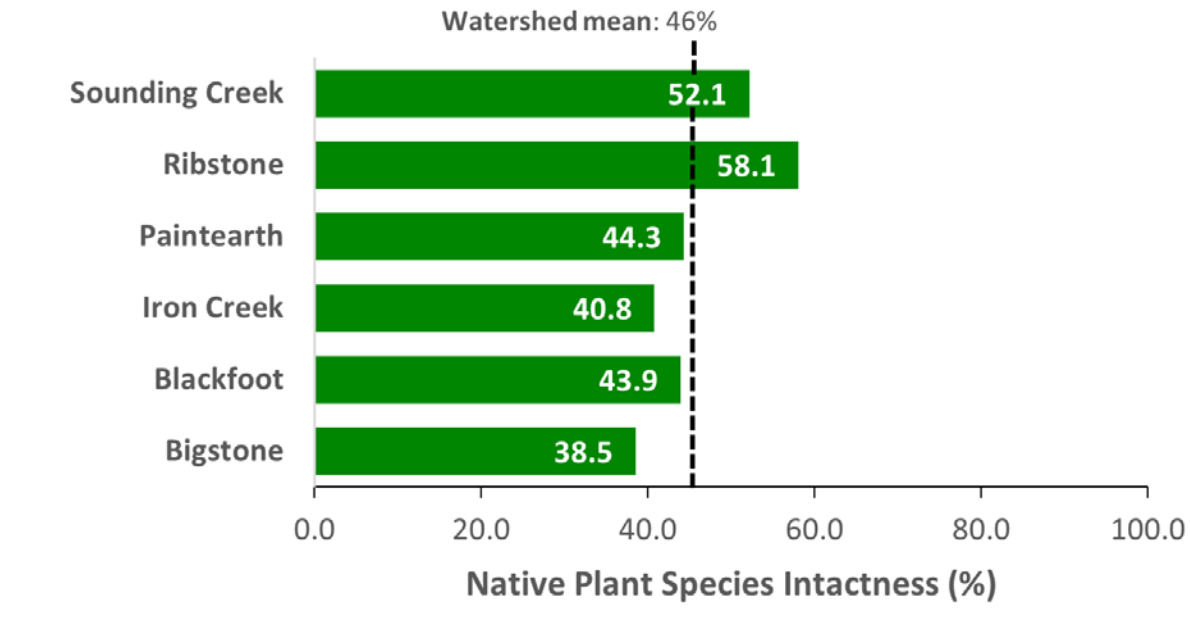


Figure 5.2: Species intactness, which reflects how species abundance has been impacted by human activities, for native plant species within each subwatershed of the BRW in 2018 (Source: Alberta Biodiversity Monitoring Institute, 2018).

Plant Species

The Prairies consist of grass species, but also include species of trees, shrubs, herbs, as well as wildflowers (Alberta Biodiversity Monitoring Institute 2015, 28). Native grassland plant communities are incredibly important in the success of an ecosystem due to their support in ecological processes and functions, such as nutrient cycling, as well as support for wildlife habitat and forage for grazing livestock (Alberta Biodiversity Monitoring Institute 2015, 28).

Intactness:

- "All 36 grassland-associated vascular (native) plants were less abundant than would be expected in landscapes with no human footprint." Intactness ranged from 22-71% in the Prairie region (Alberta Biodiversity Monitoring Institute 2015, 28),
- Non-native invasive plant species have been increasing in the Prairies. The Common Dandelion is the most abundant non-native plant (Alberta Biodiversity Monitoring Institute 2015, 30).

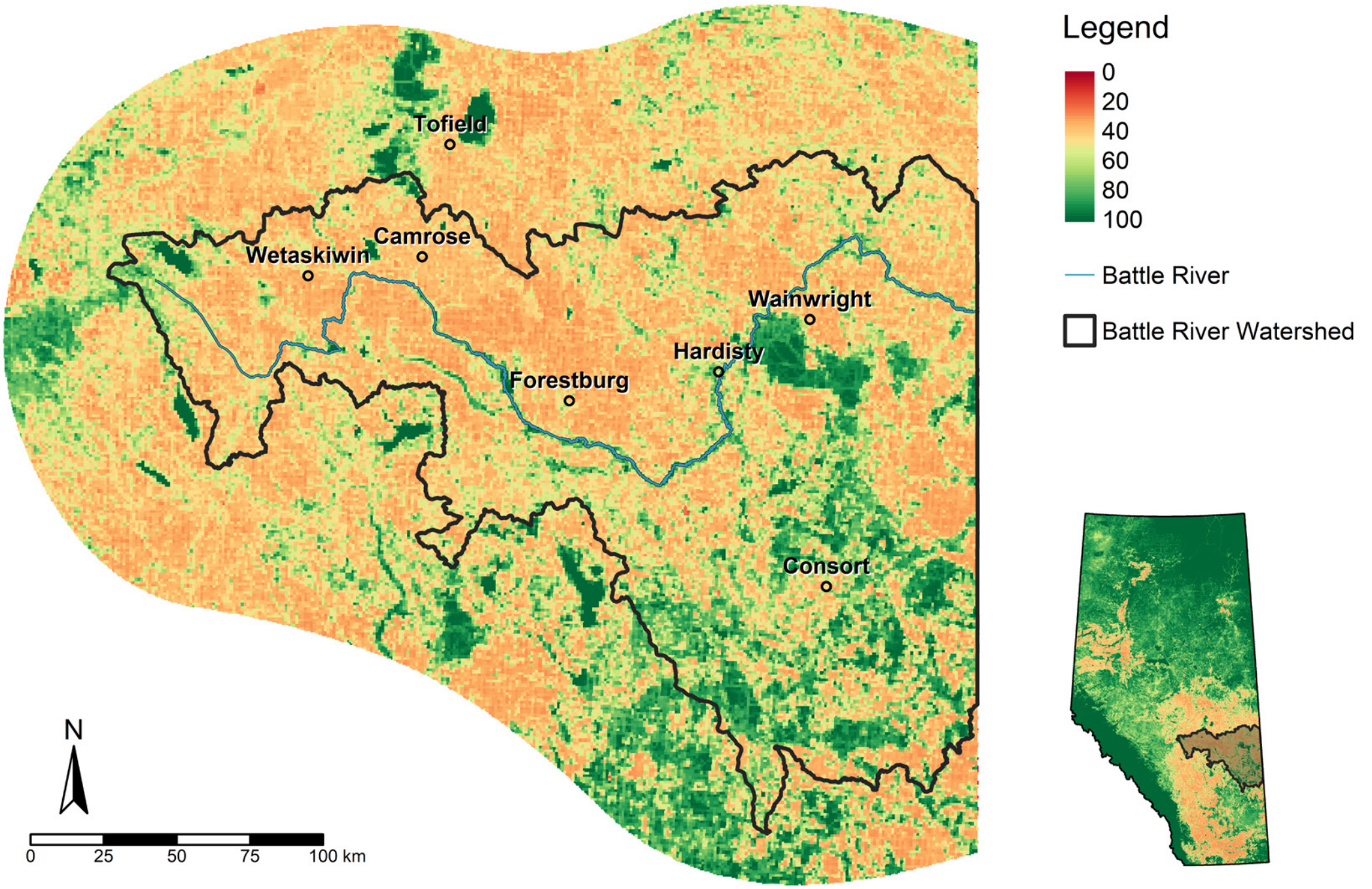
Policy Responses for Species Intactness

Why do we measure it?

We measure biodiversity because biodiversity is a useful indicator of the health of an ecosystem. Intact and functioning ecosystems will, generally speaking, be diverse in animal and plant species, and will have high levels of species intactness. In the context of a developed province like Alberta, adverse changes to biodiversity linked to human activity are of particular concern. Some types of human activity, or intensity of activity, can lead to a loss of species or replacement of native species

Native Plant Species Intactness (2018)

Relative intactness of native plant species, with values closer to 100 representing complete intactness (*i.e.*, no disturbance)



Map 5.3: (Source: Alberta Biodiversity Monitoring Institute. 2014. Manual for Species Modeling and Intactness, Version 2014-09-25. Alberta Biodiversity Monitoring Institute, Alberta, Canada. Report available at: abmi.ca).

with non-native or invasive species. When ecosystems are degraded in this way, not only will native species and natural environments be damaged, but some human activities, such as hunting and fishing, and even human needs such as clean water, will no longer be supported.

How have governments responded?

In order to know what is out there – including plant and animal species, water quantity and quality, air quality, and soil health – and how it might be changing, we need to monitor biodiversity and land-use. The province of Alberta has been conducting environmental monitoring activities under the requirements of the EPEA (Government of Alberta n.d. a). As Brown and Ross (2018) outline, environmental monitoring includes:

- Baseline environmental monitoring,
- Cumulative effects monitoring,
- Data evaluation and management,
- On-going condition of environment reporting in all regions of Alberta, and
- Credible data, evaluation, knowledge and reporting to inform policy and regulatory decision-making (Brown and Ross 2018, 4).

Provincial environmental monitoring also includes air quality, land, and water monitoring (Government of Alberta n.d. h), which we will return to in later sections of the chapter.

Monitoring is an activity "which needs to be performed in the context of fulfilling legislated mandates" – that is, in order for these acts to fulfill their respective purposes, there must be ecological monitoring to gather data about the state of the natural environment (Alberta Research Council 1998, 18).

A 2019 report from Alberta's Environmental Law Centre (ELC) identifies the Wildlife Act (2020), ALSA (2021), the Water Act (2021), the MGA (2022), and the EPEA (2021) as the key pieces of current provincial legislation that mandate biodiversity monitoring and planning for biodiversity management (Kauffman and Staff Counsel 2019, 16-17).

The Wildlife Act speaks especially to endangered species and species at risk, and outlines the tool of recovery plans for species found to be at-risk (Government of Alberta 2020b, 13). Recovery plans are not mandatory, but they do acknowledge biodiversity concerns and allow for the identification of critical habitat (Kauffman and Staff Counsel 2019, 19). Under the Wildlife Regulation, some authority over planning and monitoring species is delegated to the Alberta Conservation Association (ACA), an organization that is also governed by a MOU with the Alberta Ministry of Environment and Parks (AEP) (Government of Alberta 2022c, 130; Alberta Conservation Association n.d. a).

Under the ALSA, regional plans "enable the government to zone areas for habitat protection, set limits on impacts on habitat, and direct how discretionary decisions are made concerning habitat" (Kauffman and Staff Counsel 2019, 20). The regional plans legally require the province to "establish monitoring programs for conservation areas, indicators, and strategies in relation to the plan objectives along with monitoring and evaluation programs for evaluating the status of these indicators and the effectiveness of the strategy" (Kauffman and Staff Counsel 2019, 21). This provision also includes a requirement to develop indicators for monitoring biodiversity and strategies for "maintaining landscapes for ecosystem function and biodiversity" (Kauffman and Staff Counsel 2019, 21).

The Water Act ensures the quality and quantity of Alberta's water supply through planning, use, and enforcement (Government of Alberta 2010). Under the Act, there is a provision for the creation of Water Management Plans and Approved Water Management Plans (Government of Alberta 2021c, 21). These plans are regional and focus around major rivers in the province, including the Battle River (Government of Alberta 2021c; Government of Alberta n.d. d). Water management plans may contain Water Conservation Objectives, which outline plans for the protection and conservation of a given natural water body and the fish and wildlife that live there (Alberta Environment 2001, 15).

Municipalities in Alberta also have some responsibility for habitat management and environmental planning. Under the MGA, two or more municipalities that share a common boundary must collaborate on the creation of an intermunicipal development plan that addresses environmental matters within the shared area (Government of Alberta 2022a, 398).

One of the main components of the EPEA is governing the Environmental Impact Assessment (EIA) process (Government of Alberta 2021b, 41; Government of Alberta n.d. g). Environmental assessments are "generally triggered by large-scale projects and the assessment requirements differ based on the degree of anticipated environmental effect" (Kauffman and Staff Counsel 2019, 25-26). In other words, environmental assessments are required as part of the approval process for some proposed developments, but not for all of them. To successfully complete an environmental assessment, the project proponent must account for sensitive species and habitat (including aquatic and terrestrial habitat) that will be disrupted because of the project and indicate how they will mitigate damages (Kauffman and Staff Counsel 2019, 26).

The federal government also participates in international conventions on biodiversity and has set out a national biodiversity strategy (Biodivcanada n.d.). In 1992, the Government of Canada signed the United Nations Convention on Biological Diversity. The Canadian Biodiversity Strategy seeks to uphold and fulfill the three key objectives of the UN Convention on Biological Diversity: conservation of biological diversity, sustainable use of biological resources, and fair and equitable sharing of the benefits that result from use of genetic resources (Biodivcanada n.d.). The Canadian strategy outlines plans for cooperation between different levels of government and regions within Canada, and a key piece of the strategy involves reporting on biological diversity in Canada (Biodivcanada n.d.).

What is being done?

Alberta's Environmental Monitoring and Science Division (EMSD) connects the scientific community with stakeholders. The province has also begun reporting and providing relevant environmental monitoring data and information under Alberta's Environmental Science Program (AESP) (Government of Alberta n.d. a).

Province-wide, the ABMI monitors species intactness using a grid-based network of permanent monitoring sites (Alberta Biodiversity Monitoring Institute n.d. c). The provincial government's monitoring activities conducted under the EMSD share this grid-based network (Government of Alberta 2015a). Significant species are selected for each site, and species run the gamut from mosses and lichens and aquatic invertebrates to birds and mammals (Government of Alberta 2015a).

A more detailed description of this monitoring grid can be found on the Alberta Government's EMSD's Biodiversity and Land website: "a grid-based network of permanent sites...[measured]…on a 5-year re-measurement cycle, with over 300 sites potentially being measured per year. Every node on the network consists of a pair of sites – one terrestrial and one nearby wetland. At each site, standard upland or wetland monitoring protocols are applied for ecological characterization and measurement of up to 2200 species including vascular plants, mosses and lichens, birds, soil mites, winter-active mammals and aquatic invertebrates" (Government of Alberta 2015a).

There are 1,656 sites in total on 20 km spacing (Alberta Biodiversity Monitoring Institute n.d. d). These sites are confidential in order to maintain their integrity as monitoring sites. A separate survey protocol exists for the terrestrial sites and for the aquatic/wetland sites, but each site survey involves species identification, classification of site characteristics, mapping, photography and audio recording, and physical and chemical analysis (Alberta Biodiversity Monitoring Institute n.d. d). These sites also permit long-term or short-term enhancement of monitoring (more frequent monitoring) regionally or province-wide when there are specific needs for data (Government of Alberta n.d. h).

There are two main criteria that inform the selection of species to monitor and the methods of monitoring. One of the key criteria is allocation for harvest. If a species that is harvested for economic purposes – like fir, pine, or spruce – it is monitored "in relation to a number of factors, including resource pressures, public observations and response, and time since last survey" (Government of Alberta 2015a). The other primary criteria is status, or abundance: "Species detected as sufficiently abundant in the grid-based network of permanent sites receive an "intactness index" report; otherwise, their frequency of occurrence is reported" (Government of Alberta 2015a).

The Wild Species reports are part of the commitment made by wildlife ministers in Canada in 1996 when they signed the

Accord for the Protection of Species at Risk (Canadian Endangered Species Conservation Council n.d. a). The Accord committed governments in Canada to monitoring, assessing, and reporting regularly on the status of all wild species (Canadian Endangered Species Conservation Council n.d. a). Starting in 2000, the reports are produced every five years, and represent a collaboration between the federal, provincial, and territorial governments (Canadian Endangered Species Conservation Council n.d. b). The 2015 Report contained information on over 29,000 species in Canada, and every report includes status assessments for each recorded species (Canadian Endangered Species Conservation Council n.d. a). Status refers to the conservation status of each species, its abundance, reproductive potential, and the security or insecurity of its habitat (Canadian Endangered Species Conservation Council 2016, 11-12). If a species is determined to be 'at risk' or assessed as a priority concern, this triggers further assessment by Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Canadian Endangered Species Conservation Council 2016, 2).

What could be done?

Ecosystems and biodiversity protection in Alberta occurs in a context of significant agricultural, oil and gas, construction, and other kinds of development. Provincial policy reflects these realities, with numerous documents including the LUF, noting the need to balance environmental protection with the land and resource needs of Alberta's economy (Government of Alberta n.d. j). The policy climate should be understood as one that sees economic growth as compatible with environmental protection, and in which Alberta's economy, which remains heavily dependent on agriculture and natural resource extraction, is considered to be the backbone of the province's wellbeing. This context is one in which (temporary) negative effects on the natural environment are often considered both acceptable and necessary.

In this context, whether or not a policy is working is a complicated question because effective environmental policy in the context of resource extraction might be aimed more at limiting or mitigating obvious detrimental effects rather than halting or vetoing certain practices or industries. We can perhaps answer the question of effectiveness by making a different inquiry: whether or not the various organizations and frameworks created to support ecological integrity in the province are succeeding at fulfilling their mandates. Much of the environmental monitoring, planning, and advising in Alberta happens through partnerships and/or councils which are mandated to achieve cooperation between stakeholders, such as the WPACs (Government of Alberta n.d. s).

As an example, Alberta's oil sands are subject to a unique monitoring program which is jointly delivered by the provincial and federal governments. Before 2012, "most regional monitoring was undertaken by a patchwork of regional, multi-stakeholder organizations… essentially driven by a need to address local, Indigenous, and environmental concerns regarding cumulative environmental effects in the absence of a more comprehensive government monitoring or management framework" (Dubé et al. 2022, 321).

The Joint Oil Sands Monitoring Program (JOSM), now called the Oil Sands Monitoring Program (OSM), took over from this patchwork regional monitoring and has been in place since 2012 (Alberta Environment and Parks and Environment and Climate Change Canada 2018, 7). Monitoring activities within the OSM collect data on water quality, biodiversity and wildlife health, and air quality (Alberta Environment and Parks and Environment and Climate Change Canada 2018, 4-5). The program also includes community-based monitoring through projects which are led by Indigenous communities from the oil sands regions (Alberta Environment and Parks and Environment and Climate Change Canada 2018, 6).

One challenge for the OSM was the dissolution of Alberta Environmental Monitoring Evaluation and Reporting Agency (AEMERA) in 2016 and the creation of a new monitoring division within the provincial government's EMSD (Alberta Environment and Parks and Environment and Climate Change Canada 2018, 7). The transition resulted in reduced monitoring and publication for 2017/2018 as data, procedures, and staff were re-housed within the provincial civil service (Alberta Environment and Parks and Environment and Climate Change Canada 2018, 27-28). In 2017, the provincial government and the federal government signed a revised

memorandum of understanding (MOU) that re-established their intention to design and implement an integrated monitoring, evaluation, and reporting system for the Oil Sands Region (OSR) through the OSM program (Oil Sands Monitoring Program 2019, 10).

This MOU also "identified some significant shifts by formally recognizing and affirming the Treaty and Aboriginal Rights of Indigenous peoples under Section 35 of the Constitution Act (1982)…[and]…marked a commitment [by the provincial and federal governments] to establish effective mechanisms for Indigenous participation in the design, implementation, and governance of the program" (Dubé et al. 2022, 325).

Producing information about species intactness, biodiversity, and ecosystem health is best regarded as only one piece of the puzzle in creating a policy environment that is responsive to changes in ecosystem function, and effective in creating a climate where stakeholders are equally invested in supporting and maintaining healthy ecosystems. The provincial and federal governments, the ABMI, regional land-use plans, and watershed management plans all contribute to producing critical information and creating buy-in from stakeholders.

The ABMI has been a primarily science-focused organization. Recommendations from the organization's 10 year review indicated a need to broaden the scope of the ABMI's activities. These recommendations reflect the need to actively reach out and engage implicated parties and stakeholders as to the state of biodiversity in Alberta (North Raven Consulting 2018). Broadening the scope of the ABMI's activities and reaching out to municipalities and Indigenous groups, for example, would connect the ABMI's work to the social components of health, including civic engagement and community stewardship.

The effectiveness of this program, and the provincial government's monitoring programs is dependent upon the choices made in the sampling protocol: for example, which species are sampled and why, how a significant time-interval for sampling is determined, and the selection of sampling sites (Nielsen et al. 2009, 2967).

Building in the capacity to know if one is monitoring the right things, and monitoring them in a way that reveals information about those selected things, is perhaps the most important element of project design. Nielsen et al. (2009) found that the ABMI has not been completely successful in conducting effective monitoring, but the ABMI's 10 year review, a more current assessment, found the ABMI's sampling design to be adequate overall (Nichols Applied Management Inc. 2018, 2).

It is important to remember that the policy climate in Alberta is sensitive, as noted above, to the demands of a provincial economy dependent on resource use and production. Provincial legislation is the ultimate source of policy, but legislation has binding force while policy is often non-regulatory or functions as guidance. Changes in government priorities or inconsistency of support with the election of new provincial governments may result in new policy directions or the abandonment of existing policy (Dubé et al. 2022, 323). Under these conditions, there are legitimate concerns about the power of the environmental policy framework in Alberta to meaningfully set an agenda that protects ecosystems and biodiversity in the province.

The interconnectedness of government, business, and science is reflected in the structure of some of the organizations which contribute to the protection of biodiversity in the province. The ABMI, for example, has members that include Alberta-Pacific Forest Industries Inc. and Suncor Energy Inc., and their funders include the provincial government as well as the energy and forestry sectors (Alberta Biodiversity Monitoring Institute n.d. b).

Healthy functioning ecosystems are the foundation of the province's economy, and yet there is significant risk that regulating resource consumption by large companies, and especially subjecting proposed resource development projects to meaningful public deliberation will be seen by the government as unattractive to corporate investment and detrimental to the economy (Bowness and Hudson 2014, 63). This said, many of the organizations that contribute to the policy climate in Alberta are mandated to involve all of the stakeholders in an area of ecological concern, and to find ways of promoting education, cooperation, and best practices (Government of Alberta n.d. s; Battle River Watershed Alliance n.d. d). This may be

easier to achieve among some stakeholder groups than others, but a framework does exist in which, theoretically at least, a wide diversity of stakeholders - from Indigenous groups to municipal governments, ranchers to oil and gas companies to citizens' groups - have a voice in shaping policy that supports biodiversity and species intactness.

Measuring the success of Alberta's environmental policy might also look in part like monitoring organizations like the WPACs, the ABMI, the OSM, and others for functionality in their governance structure and processes, checking to see whether or not they are meeting timelines for producing plans and reports, or assessing programming on the basis of interest and buy-in on the part of stakeholders.

Another element of success or effectiveness involves making choices that allow for effective and relevant monitoring. A number of decisions go into designing a monitoring program, including selecting monitoring sites, choosing who does the monitoring (government-employed scientists and technicians, NGOs - or privately-employed scientists and technicians, or non-professional community based researchers), determining what methods should be used in order to gather the most relevant data, and deciding which species will be the best indicators for the state of biodiversity and changes to biodiversity in the selected research area (Seak, Schmidt-Vogt, and Thapa 2012, 707-708; Chiarucci, Bacaro, and Scheiner 2011, 2426-2427).

Fish Health

Index of Biological Integrity

IBI is a framework for evaluating the quality of the fish assemblage in a given aquatic ecosystem (Barbour et al. 1999, 8-7). This measure includes data for twelve (or thirteen, in some indexes) fish-based metrics that relate to biological integrity. These metrics are grouped under three or four broader headings: species richness and composition (the number of species and the kinds of species present), trophic composition (the proportion of species present which are omnivores, insectivores, and top carnivores), fish abundance and condition (number of fish, age, presence of disease or damage), and, optionally, total fish biomass (Barbour et al. 1999, 8-15). The IBI was developed as a tool to assist biologists in assessing the quality of small, Midwestern warm water streams, but has been adapted for many different ecosystems and jurisdictions (Barbour et al. 1999, 8-7).

The Fish-based IBI has been adapted by the ACA specifically for use in the BRW (Stevens and Council 2008, ii). The Fish-based IBI can help us understand how human activities are affecting the composition and quality of aquatic ecosystems, and may help us to understand what kinds of human activities or practices have the most detrimental effects. By assessing the presence or lack of key fish species, and their population numbers, a general assessment of the health of the water body can be drawn. A healthy BRW would have a high number of older fish, low proportions of fathead minnow, the presence of mature white sucker fish, and a low number of fish with deformities or disease (Stevens and Council 2008, 9).

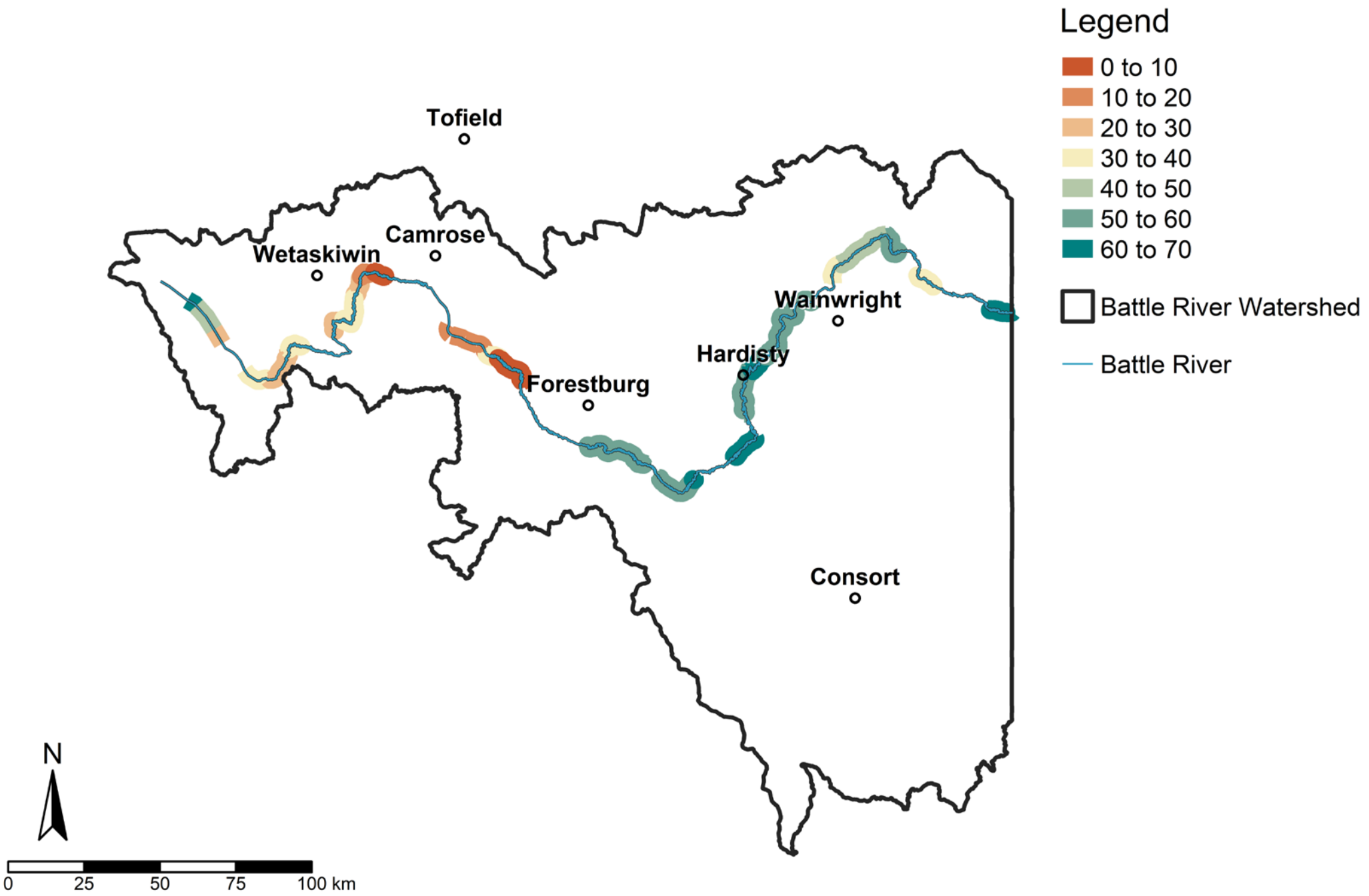
In 2007 the Battle River received a mean score of 42% on the Fish-Based IBI (Stevens and Council 2008, 17). Scores for each individual species on the IBI ranged from 4%-69% (Stevens and Council 2008, 16-17). Fourteen of the 19 known species of fish in the Battle River were captured (Stevens and Council 2008, 13). The results of the Index indicate that fish integrity in the Battle River is currently poor. The poor state of health is likely due to high nutrient levels in the water and disturbed riparian zones.

Understanding the Index of Biological Integrity

The Battle River in Alberta flows out of Battle Lake eastward toward the Prairie-Parkland ecoregion, reaching the North Saskatchewan River near North Battleford in Saskatchewan (Stevens and Council 2008, 2). Studies in the Battle River found that the IBI was connected to human land-use patterns, specifically with road networks through mechanisms of "contamination, pollution, hydrologic alteration, fragmentation from improperly used culverts, and elimination of nursery habitat" (Stevens and Council 2008, 23).

Fish-based Index of Biological Integrity (2018)

Measure of the relative abundance of fish species; higher values indicate greater fish health



Map 5.4: (Source: Stevens, C., and T. Council. 2008. A fish-based index of biological integrity for assessing river condition in central Alberta. Technical Report, T-2008-001, produced by the Alberta Conservation Association, Sherwood Park and Lethbridge, Alberta, Canada. 29 pp. + App).

Risk Factors for Biological Integrity

Urban Development

Anthropogenic effects, such as creation of new roads and urbanization, alter the physical habitat and chemical environment of a stream and its fish inhabitants (Stevens and Council 2008, 23). Other watersheds within Canada have found proximity to urban development results in negative effects for fish species diversity over an extended period (Seilheimer et al. 2007, 300). For example, aquatic environments are affected by highway runoff that includes elevated levels of heavy metals, as well as large volumes of de-icing salt (Seilheimer et al. 2007, 310). De-icing road salt has been found to elevate salinity in freshwater resources, producing negative impacts on the freshwater animals residing in these habitats such as stunting the development of trout over a period of time (Hintz and Relyea 2017, 409).

Watersheds throughout North America have found that urbanization has impacted fish communities as well. One study in Wisconsin watersheds found urbanization from the 1970s to the 1990s resulted in a decrease of the mean number of fish species by 15%, as well as a decrease in fish density by 41% and IBI score by 32% (Wang et al. 2000, 1173).

Agriculture

Human impacts on land also include the surrounding water ecosystems. Of particular importance to Alberta is the formation of blue-green algal blooms and its effects on the fish health. These algal blooms are linked to agricultural practices as they are formed through runoff from land that contain traces of phosphorus from fertilizers and animal manure (DeBruyn et al. n.d., 1). Algal blooms reduce oxygen levels in the water through the decomposition of algae by bacterial species, forming hypoxic 'dead zones' which kill fish (DeBruyn et al. n.d., 2).

As the BRW is home to a large agricultural sector, farming practices risk the introduction of phosphorus into nearby fish ecosystems. In fact, "from 1981 to 2011, the level of risk increased on 50% of agricultural land, primarily due to an increase in the area treated with fertilizers, an intensification of livestock production in some regions and unusually wet weather and high snowmelt runoff rates in the Prairies in 2011" (Agriculture Canada 2021). Central Alberta is classified as being in a 'very high risk' category of risk of phosphorus water contamination (Agriculture and Agri-Food Canada 2021).

Oil & Gas Industry

Although the oil sands substantially influence Alberta's economy, it has negative effects on ecosystems. In examining the effects of oil

Relative Abundance of Fish in the Battle River (2006/07)

Species	Proportion of Total Catch
White sucker	49%
Longnose dace	15.8%
Lake chub	11.5%
Northern pike	9.8%
Shorthead redhorse	6.6%
Trout-perch	3.3%
Walleye	2.4%
Fathead minnow	0.9%
Other	0.89%

Table 5.3: Proportion of fish caught in the Battle River using electrofishing in 2006 and 2007 (total catch = 3, 473 fish) (Source: Stevens and Council, 2008).

sand sediment exposures on larval embryos of fathead minnows, two sediment sites were linked to the decreased survival of these fish species (Environment and Climate Change Canada 2016). Fish were exposed to melted snow from sites located near oil sands and mining facilities and it was found that these fish underwent biological effects. Exposure to oil sand sediment has a direct impact on fish, which reflects the negative effect that the oil and gas industry can have on ecosystems (Environment and Climate Change Canada 2016).

Riparian Zones

Riparian zones are essential areas for the biodiversity and healthy maintenance of fish habitats. Many endangered, threatened, and vulnerable fish species rely on these riparian areas for part of their lifecycle in the BRW (Bruneau 2015, 41). Riparian areas provide habitat and food sources for the insects that are the dietary foundation for many fish species. Healthy and diverse populations of fish species require healthy and diverse insect populations (Bruneau 2015, 43).

The vegetation in riparian areas influence the stability and maintenance of fish populations as well as providing shelter to reduce fish stress and loss from predation (Bruneau 2015, 43). Development on these areas can drastically alter the fish environment and cause a decrease in the IBI. This, again, provides an explanation of the poor IBI score in the BRW, as land development in riparian zones has caused significant impact.

Conservation

Stewardship programs are in place to protect the health of fish species in our watersheds. For example, the BRW has a riparian restoration program in place to work with landowners and other stakeholders to help mitigate the devastating impacts of riparian destruction on fish and other animal species habitats (Stanley and Specht 2014). Alberta also has water monitoring and soil phosphorus testing in place to prevent the occurrence of algal blooms and other means of toxicity to fish species (Government of Alberta n.d. q; Government of Alberta n.d. h).

Policy Responses for Fish Health

Why do we measure it?

We can think about fish health in Alberta along two different pathways. The first refers to the activity of fishing, and the fishing regulations and fish management plans that pertain to commercial, sport, and traditional fishing within the province. The second refers to aquatic ecological health more generally, and includes the management of fish species that are not considered to have recreational or commercial value in Alberta but that are valuable both as components of intact ecosystems and as indicators of ecological health.

In Alberta, the Fish Conservation and Management Strategy for Alberta (2014) describes the policy framework for fish management in the province (Alberta Environment and Sustainable Resource Development 2014b). From the Strategy: "ESRD [Alberta Environment and Sustainable Resource Development] has the mandate and responsibility within the provincial government to oversee the management of fish populations, and advocate for the conservation of fish and fisheries. The Ministry is also solely responsible for regulating and managing the use of Alberta's fisheries. ESRD is responsible for fish population and use assessments, allocation of fish resources and setting regulations in consultation with the public and First Nations. These responsibilities are delivered through ESRD's Fisheries Management branch" (Alberta Environment and Sustainable Resource Development 2014b, 5).

ESRD is also responsible for a number of activities that relate to biological monitoring and ecological integrity under different pieces of provincial legislation, including:

- Wildlife Act (2020), which requires biodiversity management, including the identification of species at risk and the creation of recovery plans (Alberta Environment and Sustainable Resource Development 2014b, 6),
- Public Lands Act (2022), which regulates public land management, including planning which balances land access for recreation, commercial activities, and industrial use with protection of riparian and fisheries values (Alberta Environment and Sustainable Resource Development 2014b, 6),
- Forests Act (2021) and the Forest and Prairie Protection Act (2016), which include mechanisms designed to preserve and conserve riparian locations,

aquatic environments, and fish habitats (Alberta Environment and Sustainable Resource Development 2014b, 7),
- The Water for Life Strategy (2003), one of the major objectives of which is preserving healthy aquatic ecosystems (Alberta Environment and Sustainable Resource Development 2014b, 7),
- Water Act (2021) and the EPEA (2021), which gives the ESRD management responsibilities for the use of water resources in Alberta, which includes collecting data on water quality (Alberta Environment and Sustainable Resource Development 2014b, 7).

Alberta Justice and Solicitor General are responsible for the enforcement of fishing regulations and other Wildlife Act regulations. Some ESRD staff also hold the position of Fishery Guardian, with the authority to enforce fishing regulations (Alberta Environment and Sustainable Resource Development 2014b, 7).

Between 2014 and 2016, environmental monitoring was conducted by the AEMERA, an arm's length agency (Alberta Environment and Sustainable Resource Development 2014b, 7; Dubé et al. 2022, 324-325). This agency no longer exists, and monitoring has been folded back into AEP under AESP (Government of Alberta n.d. a).

Today, AEP is responsible for the ALSA (2021), the Forest Reserves Act (2021), the Public Lands Act (2022), the Water Act (2021), the Wildlife Act (2020), and the Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act (2014) (Government of Alberta n.d. n). The Alberta Energy Regulator (AER) was also created in 2013 to take control of some (former) ESRD responsibilities and now administers the Public Lands Act, the EPEA, and the Water Act for matters pertaining to energy development (Alberta Energy 2013).

An Alberta Fish-based IBI was developed in the 2000s and released in 2008 by the ACA (Stevens and Council 2008). This fish-based IBI was designed to assess the health of the aquatic ecosystem along the Battle River through multiple sampling points and the development of metrics designed to capture a picture of the river's "fish assemblage" (Stevens and Council 2008, ii). Other fish-based IBIs have been conducted in other jurisdictions, and the construction of the Battle River IBI takes these other study designs into account (Stevens and Council 2008, 7-8). While the Fish-based IBI for the Battle River is a regional indicator, monitoring fish health aligns with some issues that fall under provincial jurisdiction discussed above, including promoting outdoor recreation and requirements to conduct biological monitoring, and also, as in the OSM Plan, collaborations between the province and the federal government to gather data on the ecological effects of industrial development on Alberta's aquatic environments (McMaster et al. 2018).

The ACA is a Delegated Administrative Organization (DAO) in operation since 1997 under Alberta's Wildlife Act (Alberta Conservation Association n.d. a). In Alberta, DAOs are organizations that operate at arms-length from the provincial government to deliver services. Under Alberta's Alternative Service Delivery arrangements, DAOs and other delegated service organizations deliver some government services, have some of their leadership appointed by the relevant Minister, and report annually to that Minister. At the same time, DAOs are responsible for day-to-day operations and for raising their own funds to cover their operating costs (Government of Alberta n.d. f).

The ACA's activities are also governed by an MOU with AEP. The ACA encourages Albertans to participate in outdoor activities like fishing, hunting, and birdwatching, and they have a mandate to communicate with and educate the general public about fish, wildlife, and habitat (Alberta Conservation Association n.d. b).

Their environmental activities include multi-year studies and monitoring programs, and advocating for conservation areas. Data from ACA studies, surveys, and assessments incorporated into AEP management plans and forms "the basis for fishing and hunting regulation changes and evaluations of...management strategies" (Alberta Conservation Association n.d. b)

How have governments responded?

Across Canada, many fish species are considered to be important natural resources, and both recreational and commercial fisheries associated with selected fish species are important contributors to Canada's economy (Castaneda et al. 2020). Fisheries and Oceans Canada (DFO) is a federal department that works to manage fish populations and safeguard aquatic environments at the national level (Government of Canada 2022b). Although Alberta does not have an ocean-based fishery, the provincial AEP/ESRD and the federal DFO share information and advise each other on the state of fish health within the province, and also share monitoring data and other relevant scientific information (Alberta Environment and Sustainable Resource Development 2014b).

The Fish Conservation and Management Strategy for Alberta outlines a nested framework for fish management and conservation in the province. The first layer is species management plans, the next layer is water body management plans, and the next layer is the LUF and Regional Plans (Alberta Environment and Sustainable Resource Development 2014b). Two of the assessment tools used by the AEP/ESRD and described in the Fish Conservation and Management Strategy for Alberta are: the Fish Sustainability Index (FSI) and the Index of Native Fish Integrity (INFI). The FSI is used to assess the health of individual fish species, and information from the Index contributes to fish management plans, species management plans, and species recovery plans. The INFI is a tool for assessing the health of fish communities, similar to the Battle River Fish-based IBI. Information from INFI studies support water body management plans, watershed management plans, and LUF regional plans (Alberta Environment and Sustainable Resource Development 2014b).

The Alberta government describes the FSI as "Alberta Fish and Wildlife's method of assessing fish stocks on a provincial scale… developed to bring consistency to individual fish stock assessments and provide a province-wide evaluation of the status and sustainability of Alberta fish species" (Government of Alberta n.d. k).

The FSI allows for the creation of a score for a given fish species, which indicates the health of the population. The score is also related to the Species Management Plan for a given fish species, and may trigger the creation of a Species at Risk Plan if the species is found to be in decline (Government of Alberta n.d. b). Species Management Plans include plans for stocking and natural reproduction and allowable catch levels for species with fisheries. Alberta's fish management planning also emphasizes a preference for sustaining native fish species over introduced species, and for managing fish communities and habitats rather than focusing on single species (Alberta Environment and Sustainable Resource Development 2014b).

In the BRW, the Fish-based IBI was designed to assess aquatic health by looking at the intactness of the fish community in the Battle River. Also included were habitat requirements, life history, and functional and structural guilds (communities) of species that indicate an intact and functioning ecosystem. The IBI developed positive scoring metrics (attributes that should increase with increasing biological integrity), such as the population's proportion of older, longer-lived fish; and negative scoring metrics (attributes that should decrease with increasing biological integrity), such as the population's proportion of omnivores (Stevens and Council 2008).

The IBI was intended to provide a picture of the entire Battle River, but the 80 separate sampling points mean health of the river can also be pinpointed at specific locations, and an assessment of the surrounding land and land-use patterns may suggest positive correlation between local human activity and localized river condition. The IBI thus also developed a set of hypotheses considering human-caused disturbance patterns, taking into account water quality affected by pathogens, nutrient runoff, disturbance from cattle, urbanization, and human access and road density (Stevens and Council 2008).

The results of the IBI suggest the three most significant fish-based metrics for gauging health on the Battle River are species richness, percent omnivores, and percent carnivores. The primary hypotheses for predicting these metrics were the urban model, the urban-access model, and the urban-agriculture model. Road density and nutrient runoff (nitrogen and phosphorus) are especially correlated with degradation of aquatic ecosystems and poor fish health (Stevens and Council 2008).

What is being done?

Managing for fisheries involves managing fish populations to meet the needs of recreational anglers, commercial fisheries, and Indigenous fisheries while also ensuring the sustainability of these fish populations and the health of aquatic ecosystems. Alberta's primary management tool in this regard is regulating the number of fish available for harvest. AEP/the ESRD issue fishing licenses and set limits on the sizes and numbers of fish available for harvest in a given period of time. Alberta also maintains a provincial stocking program, raising trout and other species for release into selected ponds where they will be available for recreational fishing. In addition, each fishery species is managed and monitored individually, according to its own sustainability requirements. For example, walleye are only available for harvest through a lottery system, ensuring only people who have gained permission to fish for walleye are allowed to do so and that only a limited number of fish are harvested each year (Alberta Environment and Sustainable Resource Development 2014b).

In order to determine catch limits for all harvested species, the provincial government monitors fish populations. A number of protocols exist in Alberta for gathering data on fish populations, including:

- Index-netting, which uses standardized nets at specific times of year to assess stock density and the size, age, and sex distribution of the fish population,
- Electrofishing, which uses electricity to temporarily immobilize fish and allows for tagging and other sampling procedures,
- Trapping, which is used in areas with high concentrations of fish such as spawning grounds,
- Angler surveys, which ask anglers about their fishing experiences such as time spent fishing and catch rate,
- Sample angling, which is often used in remote areas,
- Population estimates, which are based on data from physical sampling such as index-netting or electrofishing,
- Movement studies, which give information about where fish travel, how far they go, and how long it takes them to move between locations, and
- Genetic studies, which give information about boundaries between different fish populations of the same species, genetic diversity, and can be used in creating management and restocking programs (Alberta Environment and Sustainable Resource Development 2014b).

These monitoring protocols also apply to fish species that are not commercially or recreationally fished in Alberta, and fish conservation goes beyond managing specific species for harvest.

At the federal level, the DFO researches fish health and pathogens affecting fish populations; conducts environmental monitoring; and researches marine mammals, invertebrates, water systems, and the interactions between oceans and climate. The DFO also produces scientific reports and advice related to fish and ocean health, and partners with other governmental and non-governmental scientific organizations on research projects (Government of Canada 2022c). As previously mentioned, the DFO and the provincial AEP/ESRD share data to help develop management plans and to ensure the province and federal government are both aware of and up to date on relevant information.

In Alberta, Water Management Plans sit above the Species Management Plans. There are individual Water Management Plans for selected watersheds in the province, including the BRW (Government of Alberta n.d. r). Water Management Plans provide direction for the use of water resources in a given area, with the goal of sustainable managing the quantity and quality of water. Water Management Plans are written "in accordance with the Framework for Water Management Planning, which is enabled by section 11 of the Water Act" (Government of Alberta 2014). Each Water Management Plan also takes into account the social and administrative context of the watershed as a part of sustaining healthy aquatic ecosystems (Government of Alberta 2014).

Using the watersheds as ecological guideposts for planning represents a fundamental shift in the way the province approaches land management and planning because the plans assume that the natural unit for management is the watershed and divide up the province

according to major watershed boundaries (Roth and Howie 2011). The Integrated Resource Management Plans (IRPs) that have been in use in Alberta since the late 1970s also identify watershed integrity as a priority for land-use management but this was a goal that sat alongside other management goals and although IRPs included watershed plans, any given IRP was not necessarily based around a watershed (Alberta Land Use Secretariat 2008).

The LUF now in place identifies carrying capacity as the significant metric for determining watershed health. Carrying capacity refers to the "ability of a watershed, airshed and/or landscape to sustain activities and development before it shows unacceptable signs of stress or degradation"(Alberta Land Use Secretariat 2008). Determining carrying capacity for the watershed and the effectiveness of management actions naturally involves monitoring.

Watershed monitoring under the land-use plans involves both implementation monitoring and effectiveness monitoring. Implementation monitoring refers to the monitoring progress made in carrying out watershed management plans. This is done through various methods of tracking, which is completed regularly as part of the overall process. Effectiveness monitoring refers to ongoing processes that are used over the long term to track the outcomes of the management plan. This is done by collecting scientific data throughout the watershed plan's life, and evaluating whether the goals of the plan are being met (Government of Alberta 2015c).

The Watershed Plans also include reporting requirements, known as State of the Watershed reports. These reports must include information about three types of indicators which together give a picture of the health of the watershed: condition indicators, pressure indicators (also know as stress indicators), and response indicators.

Condition indicators signal the health of the environment and its natural resources as well as the overall status of ecological and human health. They do this by examining a wide variety of variables, such as chemical, biological, physical, ecological, and more (Government of Alberta 2015c).

Pressure indicators refer to "natural processes and human activities that impact, stress, or pose a threat to environmental quality" (Government of Alberta 2015c, 22). Examples of pressure indicators include soil erosion, industrial activities, and human populations (Government of Alberta 2015c, 22).

Response indicators are defined as "individual and collective actions or management programs implemented to halt, mitigate, adapt to, or prevent damage to the environment" (Government of Alberta 2015c, 22). Watershed management planning initiatives, stewardship activities, and education programs are examples of response indicators.

The BRWA, like other watershed stewardship groups in the province, works with landowners and other regional stakeholders on a collection of projects designed to protect, improve, and restore riparian health in the region. Their riparian restoration projects and programs focus on riparian health inventories, protecting streambanks and shorelines through fencing and tree planting, and user education and engagement (Battle River Watershed Alliance n.d. c). Working with stakeholders at the local level to correct disturbances from shoreline development, cattle, and agricultural runoff may go some way to correcting some of the most significant sources of degradation on the Battle River.

What could be done?

The Fish Conservation and Management Strategy for Alberta outlines the fisheries management structure in the province, the first layer of which are species management plans, the next layer of which are waterbody management plans, and the last layer of which are the LUF and Regional Plans (Alberta Environment and Sustainable Resource Development 2014b).

Not all fish species in Alberta are subject to pressure from fishing. Thus, the state of commercially and recreationally harvested fish does not necessarily correlate to the health and abundance of all fish species in Alberta. Fisheries often concentrate around the large, long-lived carnivorous fish whose presence the ACA's Fish-based IBI finds to be a significant indicator of aquatic health. In Alberta, two of these carnivorous fish are

trout and walleye, whose populations are also supported with enhancement measures including hatcheries, stocking, and species management plans (Government of Alberta 2022b).

As previously noted, the ACA's Fish-based IBI was conducted in 2006-2007 and the results were published in 2008. A regular schedule of studies, perhaps on the 5-year timeline the ABMI follows, could help to keep information about fish species intactness in the BRW current, and could also serve as a measure of the effectiveness of remediation programs and progress or decline in land-use management. Studies require financial support, and a long-term study requires a long-term commitment of financial resources. However, the Fish-based IBI developed by the ACA exists as a tool that can be replicated and applied in the BRW and in other Alberta watersheds, and is similar to other tools used by the province in fish monitoring.

Without longitudinal studies, it is difficult to know if the Fish-based IBI is working to restore fish populations in the Battle River. By itself, the Index can only tell us what is happening with fish populations and how fish health is likely to be linked to land-use at specific monitoring sites. Particularly as the study is, so far, only a one time event, it can only tell us what was happening at the time it occurred.

It seems likely that an effective approach to fish species intactness and aquatic health in Alberta could take into account the information provided by the ACA's Fish-based IBI, looking at both commercially viable and non-commercial fish, and connecting species intactness with habitat quality, intactness of associated species, and human land-use. A management plan developed from this information could look at allowable harvests and species management but would also take into account, to the extent that it is feasible, watershed and land-use management. These factors do inform the Fish Conservation and Management Strategy for Alberta. As with all the other measures of health in the Atlas, the first layer is accurate and relevant data. Translating this data into effective management, and keeping both data and management practices current, requires a political climate where such practices and expenditures are understood to be valuable.

Riparian Health

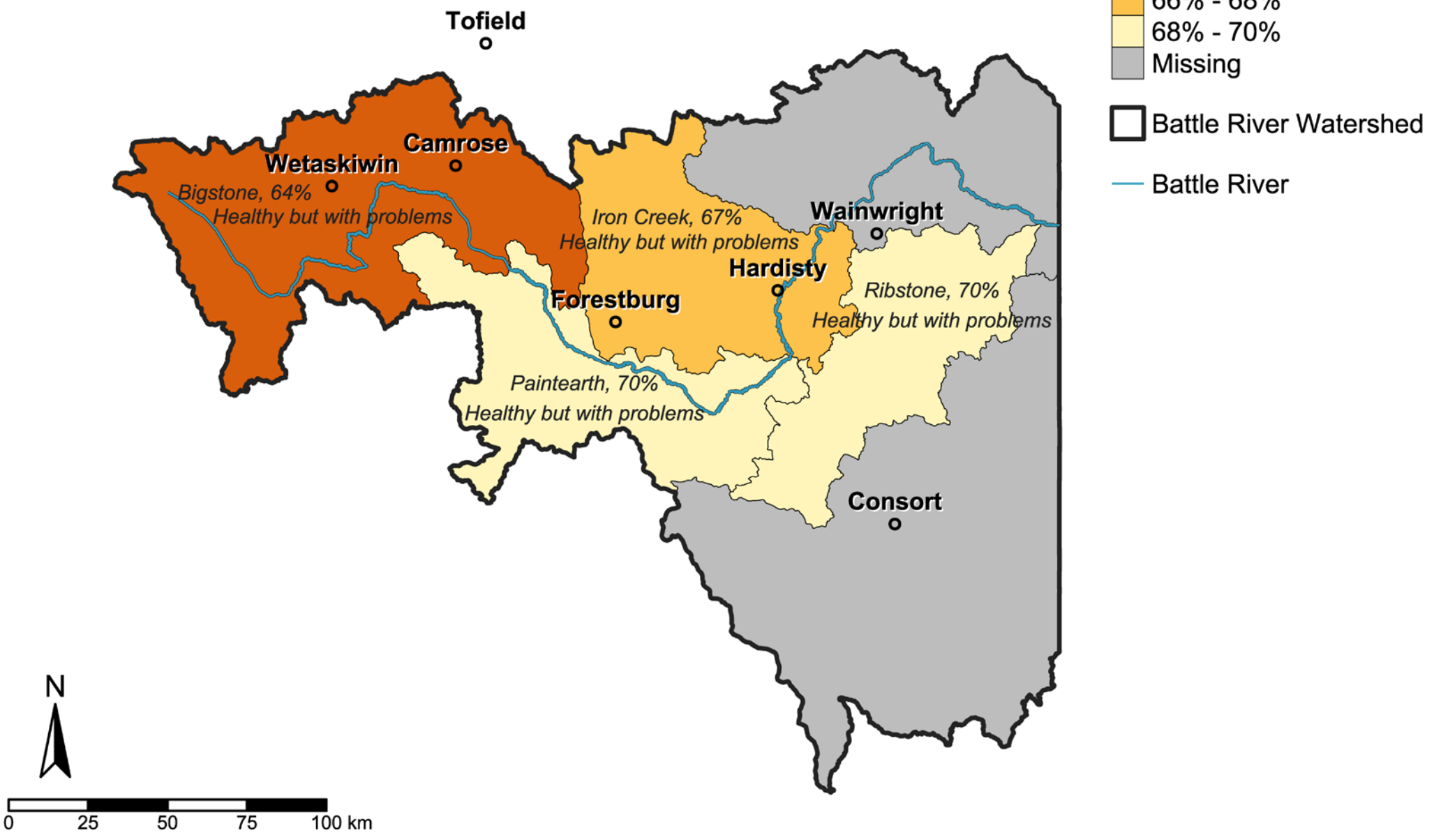
Riparian Health Assessments

Riparian Health Assessments are a tool for evaluating and monitoring the health and functionality of riparian zones. The riparian zone is the strip of land that separates a body of water from the upland zone. This area provides a bridge between the two biomes of the water and the land. A healthy riparian zone serves many crucial functions on the landscape: it is home to many species of plants and animals, helps to prevent erosion, filters and stores water, and traps sediment (Government of Alberta n.d. m). Direct and indirect human impact, through activities including removal of shrubs and trees, road building, and livestock grazing can damage the riparian zone. This can have negative effects on the body of water it surrounds and the species that live in and around it. In Alberta, one of the uses of riparian assessments is in managing livestock grazing (Government of Alberta 2019c).

Improperly managed livestock can have a number of negative effects on riparian areas, including removal of vegetation because of overgrazing, erosion and soil compaction, and reduced water quality because of nutrient loading and the introduction of disease organisms (Government of Alberta 2019c). The Alberta Riparian Habitat Management

Riparian Health Assessment (2010)

Performance on the Cows and Fish riparian health assessment; a maximum score of 60/60 (100%) indicates perfectly healthy vegetation and soil/hydrology



Map 5.5: (Source: Cows and Fish – Alberta Riparian Habitat Management Society. 2010. Battle River Watershed Riparian Areas and Health Summary).

Society (Cows and Fish) assists landowners, communities, and volunteer groups to understand riparian areas in their local areas, conduct assessments and monitoring to determine riparian health, and come up with appropriate and effective management strategies (Alberta Riparian Habitat Management Society n.d. a).

Understanding Riparian Health Assessments

Riparian health assessments function as part of a Watershed Management Plan, providing the empirical data required to inform policy recommendations and management practices (Battle River Watershed Alliance n.d. b). Using techniques including aerial photography/videography and remote sensing (satellite) imagery, WPACs in Alberta can develop a picture of the "intactness" of riparian areas, helping stakeholders to identify "priority areas for riparian conservation and restoration projects" (Battle River Watershed Alliance n.d. c). The results of the 2007 study indicated the riparian zone of the Battle River is in poor condition. This is likely a contributing factor to the poor biological integrity of the Battle River as indicated by the Fish-based IBI.

Vegetation in a riparian area is an appropriate proxy measure for the health of other systems and ecosystem components, most importantly the state of water (hydrology) and soil. Hydrology and soil are also known as physical features of an ecosystem, while vegetation is a biotic feature. Riparian Areas: A User's Guide to Health (2003) refers to vegetation as the glue that holds the physical features of a riparian area together. Vegetation is relatively easy to identify by eye and without specialized training or expertise, meaning that a visual assessment is a useful and accessible tool for gaining significant information about the health of a riparian area. Riparian health assessments can be conducted by a broad cross-section of stakeholders: property owners, farmers and ranchers, hunters and fishers, hikers, bird watchers, volunteers with environmental organizations, and environmental scientists (Fitch and Ambrose 2003).

A riparian health assessment involves a visual survey combined with assessment questions designed to elicit key information about the state of a watershed. A key concept is 'tuning the eye' in order to be able to identify significant features that indicate health or damage (Fitch and Ambrose 2003).

The first question is: how much of the riparian area is covered by vegetation? Subsequent questions ask the observer to identify what percentage of the vegetation is weedy/noxious species, and what percentage is species that grow in disturbed soil. Among other important effects, vegetation reduces erosion and traps sediment. This slowing down effect protects aquatic environments from large and fast inundations of water (rainfall, for example) and from becoming choked with soil particles and potentially harmful substances carried with the soil (Fitch and Ambrose 2003).

However, not all vegetation is similarly helpful. Species that grow in disturbed soil tend to be short-lived, meaning that they do not provide the continuous protection of larger, deep rooted species such as shrubs and trees. A high proportion of weedy/noxious species indicates the ecosystem is under stress and ecosystem's function is compromised. Further questions ask the observer to identify the proportion of woody species (trees and shrubs) that are present, if woody species are maintaining themselves (*i.e.,* there is a mix of age-classes present), and whether or not there is a significant presence of dead wood (Fitch and Ambrose 2003).

There are twelve questions in the Riparian Health: A User's Guide (2003), although more comprehensive assessments and inventories may employ more measures, which also cover soil compaction/disturbance and the appearance of shoreline alteration (down cutting, channelization) and water manipulation (withdrawal, diversion, control of flows and levels) (Fitch and Ambrose 2003).

This assessment framework also recognizes different riparian areas behave differently and will have different characteristics. The assessment classifies riparian areas as streams and small rivers, large rivers, or lakes and wetlands. Different questions will be more or less significant to different classifications; for example, a stream or small river may not require or support the same proportion of tree species or mature trees as a large river will in order to function. So tuning one's eye is also a matter of tuning in to the particular

ecosystem one is observing. Riparian Health Assessments translate observations into a score or checklist of riparian health. "The characteristics we measure help us understand the potential of the site to perform these functions and the degree to which the functions may be impaired" (Fitch and Ambrose 2003).

The eight functions are: (1) trap sediment, (2) bind banks, (3) store water, (4) recharge aquifer, (5) filter/buffer, (6) dissipate energy, (7) biodiversity, and (8) primary productivity. Taken all together, the twelve measurements identified by the assessment indicate healthy ecological functioning. Each measurement plays a role in supporting each function, or indicates major impairment of a function. For example, soil compaction indicates major impairment of bank binding, recharging the aquifer, and primary productivity (Fitch and Ambrose 2003).

Using riparian area assessments and similar tools, observers have been able to classify Alberta's riparian areas into 'healthy' (scores above 80%), 'healthy, with problems' (scores from 60-79%), and 'unhealthy' (scores below 60%). According to current information, only 11% of Alberta's riparian areas can be classified as 'healthy', while 49% are 'healthy, with problems' and 40% are 'unhealthy' (Fitch and Ambrose 2003). This decline in quality has come about largely because of human use since the settlement of the province by non-Indigenous people: clearing vegetation, municipal development, drainage, grazing, road-building, channelizing, and other practices have significantly affected the health of Alberta's riparian areas, and with it the future of water quality and quantity in the province (Fitch and Ambrose 2003).

Decentralized governance of watershed health through WPACs and Watershed Stewardship Groups in Alberta means local bodies are empowered to monitor watershed health but are also responsible for coordinating stakeholders and achieving buy-in on watershed conservation and restoration initiatives. Riparian health assessments can help to involve a community of different users in becoming more aware of, and responsive to, signs of riparian decline.

While no single user can address riparian health completely - because users have limited control over upstream or downstream management issues and ecological disturbances - many significant land-use and management prescriptions are within a user/property owner's control. These include controlling livestock grazing patterns to minimize disturbances to and overgrazing of riparian areas, encouraging the growth of woody and deep-rooted plant species and discouraging weedy species (also by minimizing ecosystem disturbance), and planning for and allowing natural water fluctuation rather than channelizing, straightening, or draining streams and wetlands (Fitch and Ambrose 2003).

By cultivating buy-in and a sense of community responsibility for riparian areas, riparian health assessments can support a local level of riparian management. Healthy riparian areas are in the best interests of all land users (and particularly long-term land users) because they support healthy ecosystems. These are ecosystems in which fish and game animals are abundant, crops and livestock flourish, and recreational values are high. Programs supported by WPACs, and documents like the Cows and Fish Riparian Health Assessment Guides, help to create informed and empowered users who are capable of intervening positively in riparian health where it is possible and appropriate for them to do so, and who are connected to organizations to which larger management concerns can be directed.

Policy Responses for Riparian Health

Why do we measure it?

Riparian health is a key component of ecosystem health. Riparian areas take up relatively little land area, but play a large role in processes such as water filtration, nutrient and energy cycling, erosion and flood control, and primary productivity (Government of Alberta 1997). They are also ecologically sensitive areas whose physical and biotic components are vulnerable to human-caused disturbance. Road building, urban expansion, and uncontrolled grazing can all potentially put riparian areas at risk, with significant knock-on effects for water quality and for broader ecosystem integrity and function.

Both public and private lands in Alberta contain riparian areas. In Alberta's settled areas (White Zone), private land "generally borders rivers, streams, lakes and wetlands"

and public land can also border water bodies, and private interests can lease this land for grazing (Government of Alberta n.d. p). Alberta's Green Zone (also known as the forested region) includes water bodies and their beds and shores, which the Crown generally owns. Most approved land-uses will require some sort of riparian buffer between use areas and the shores and banks of water bodies (Government of Alberta n.d. p).

Riparian Health Assessments are consistent with Alberta's overall approach to environmental policy. With this program, as with many of the other monitoring and stewardship programs in the province, there is an underlying ethos of partnership, stakeholder engagement, and buy-in. For example, the province emphasizes private land owners and other riparian-area users and stewards should develop an experiential sense for riparian health, and should strive to be active managers of the land they use (Government of Alberta n.d. o).

It may be easier to manage problems in riparian areas if they are first observed in local areas by people who are in constant contact with the environment as part of their work or other daily activities. There is an obvious cost-saving for government in this policy model, but for the model to effectively protect riparian areas, stakeholders must come to recognize and care about their responsibilities to protect sensitive ecosystems, and must also develop their capacities for stewardship (Watt and the Kettle River Watershed Management Plan Stakeholder Advisory Group 2014). There must also be coordination between stakeholders and different jurisdictions within the province to ensure there is a consistent set of standards for assessment and to ensure as much of Alberta's riparian area as possible is assessed (Alberta Water Council 2013).

There are also provincial guidelines for forest management and land development that discuss riparian management. These include the Forest Management Planning Standard (2006), which discusses riparian buffer zones and the protection of watershed and riparian values as a part of timber harvesting plans (Government of Alberta 2006).

Stepping Back from the Water is a 2017 provincial document that outlines beneficial management practices for new developments in Alberta's settled zone, highlighting the importance of effective buffers between developments and riparian areas for Alberta's water quality (Government of Alberta 2012). In 2013, the Alberta Water Council (AWC) issued the Riparian Land Conservation and Management Report and Recommendations. According to the Report, the AWC is a partnership made up from multiple stakeholders invested in Alberta's water health. This partnership is in a position to provide expertise and leadership to multiple areas such as industry, NGOs, and the government in order to achieve the Water for Life strategy. The AWC is involved in reviewing the implementation of the Water for Life strategy, and pushes for its goals. Additionally, the AWC has a role in advising the public, stakeholders, and the Government of Alberta on proper water management, solutions for current water issues, and research on water issues (Alberta Water Council 2013).

Municipal governments also have an interest in riparian health within municipal boundaries. In 2014, the Alberta Urban Municipalities Association (AUMA) was concerned the MGA did not grant municipalities enough power to protect riparian areas, particularly urban areas that suffer from runoff problems. In response, the AUMA issued their own policy paper to address protection of urban riparian areas: the 2014 AUMA Stormwater Policy Paper (Alberta Urban Municipalities Association 2014).

How have governments responded?

The AWC Report (2013) states that "only a very small percentage of Alberta's riparian areas have been assessed. In general, assessments were concentrated in settled areas, often on a specific water body type (*e.g.*, lakes), and assessment methods used were not always consistent or linked."

To put this in slightly different terms, riparian assessments in Alberta are incomplete, and there is no systematic, government-led approach in place that has the explicit goal of assessing all of Alberta's riparian area. In addition to an incomplete inventory of assessments, there are two different rationales driving assessment: (1) a sector-based rationale and (2) an opportunity-based rationale. This means that there is a question of

whether or not the current state of riparian areas are represented accurately (Alberta Water Council 2013, 20). The AWC Report raises the concern that having two different rationales may leave out some provincial riparian lands, and argues better coordination between jurisdictions within the province would result in a more accurate and comprehensive assessment of riparian health for Alberta (Alberta Water Council 2013).

Riparian health assessment checklists offer a template for action for the riparian user or stakeholder. According to Riparian Areas: A User's Guide to Health (2003), if an assessment yields a grade of 'Healthy,' the user is encouraged to consider how to maintain this state of health, to identify current management practices that support the health of the riparian area, and to make future management decisions with the riparian area's health in mind.

An assessment of 'Healthy, with problems' indicates a need to identify specific management problems that are causing stress and to begin shifting the management strategy, while an 'unhealthy' assessment indicates the need for the riparian user to take immediate action to stabilize the area and then to reassess and adopt new management strategies (Fitch and Ambrose 2003).

While much of the responsibility for riparian health is placed on the user/stakeholder in this strategy, assessing, altering, and implementing management strategies are all moments where input from a broader network of supports and policy actors can come into play. For example, a rancher might seek input into shifting their management strategies from Cows and Fish and/or other monitoring and stewardship partners, including Agricultural Service Boards/Rural Extension Agencies and Ducks Unlimited (Fitch, Adams, and O'Shaughnessy 2003).

What is being done?

Riparian assessments serve the provincial goal of making progress toward the restoration of the 25% of assessed watersheds in the province currently considered 'Unhealthy' and the almost 50% of assessed watersheds currently considered 'Healthy, with problems' (Clare and Sass 2012). It is also important for Alberta's communities and other ecosystems in the province that the approximately 25% of assessed watersheds currently considered healthy remain healthy. We also need to learn about the condition of the many watersheds and riparian areas that have not yet been assessed.

The Forest Management Planning Standard (2006) and Stepping Back from the Water (2017) are two more provincial guidelines that discuss riparian management in different ecological contexts, forestry, and land development in the settled zone. The 2014 AUMA Stormwater Policy Paper is another example of guidance that addresses protection of riparian areas in relation to a specific activity or land-use, in this case, protection within municipal boundaries and urban areas.

The provincial Agricultural Watershed Enhancement Program (AWEP) was a program that focused on watershed enhancements for agricultural land and was delivered in tandem with the Watershed Resiliency and Restoration Program (WRRP), overseen by Alberta Agriculture and Forestry and Alberta Environment and Parks (Government of Alberta 2017b). AWEP aimed "to increase the uptake of wetland restoration and riparian health beneficial management practices (BMPs) by producers within agricultural sectors. AWEP [facilitated] the realization of measurable changes within high risk watershed areas and [facilitated] the delivery of targeted, comprehensive extension programs, focus on addressing water quality issues"(Government of Alberta 2017a).

AWEP was financially supported by Growing Forward 2, a joint federal-provincial-territorial initiative which has now finished (Government of Alberta 2017a). The current Canadian Agricultural Partnership (CAP) program, a federal program which is delivered in partnership with the provinces, offers funding to agricultural producers to address water management on farms but does not directly address watershed or riparian management (Canadian Agricultural Partnership n.d.).

At the federal level, Natural Resources Canada (NRCan) conducts research and releases management guidelines for riparian areas under the umbrella of sustainable forest management. NRCan's current research on riparian areas involves learning about

natural disturbance patterns in riparian areas in order to inform forest management and timber harvesting practices (Government of Canada 2020b). Agriculture and Agri-Food Canada also "provides information about the role of riparian areas in maintaining good water quality and how the careful management of riparian areas can provide sustainable forage for producers and improved water quality for all" (Government of Canada 2020a).

What could be done?

Finding out whether or not the riparian health assessments are working as a tool for watershed protection involves finding the answers to several questions. These questions include: Is there uptake of the riparian health assessment within the management practices of ranchers and other watershed stakeholders? Does conducting a riparian health assessment lead to management changes? Are management changes as a result of riparian health assessments proving beneficial to watershed health?

These questions themselves require a funded and supported process of data gathering, both on the social side of the equation (are the tools being used?) and on the environmental side (are the tools ecologically effective?). Some kind of program review is necessary for this evaluation and, until such a review occurs, it is difficult to say for sure what effect riparian health assessments are having on watershed health in Alberta.

A program review of riparian health assessments would yield information about both the social and ecological effectiveness of riparian health assessments. This could be conducted at the watershed level, but would require adequate funding both to examine the program, review findings, and to implement any suggested changes from the findings. The goal of such a review would likely be to find ways to facilitate as much uptake as possible of riparian health assessments as a management tool used by watershed stakeholders, and to connect the health assessments as effectively as possible to beneficial changes in riparian management practices.

Riparian management is often politically complex. In Alberta and across Canada more broadly, there is some criticism that protection laws are not really laws, but rather recommendation, and thus not able to be rigorously enforced and protect the environment, while others still allow exceptions for industrial activity such as logging (Kamstra 2021). Some jurisdictions in Canada also have legislation that distinguishes between land that must be protected from industrial activity and land that need not be protected. In British Columbia, for example, forested buffer zones around small streams are not required for logging or other industrial activity, although even small streams have mandatory operation-free zones (Kuglerova et al. 2020).

Land Cover

Natural Vegetation Cover

Vegetation cover plays several important roles in many ecosystems. The Canadian National Vegetation Classification (CNVC), an ecological classification of natural and semi-natural vegetation in Canada, lists some of these roles:

- An important part of any ecosystem, vegetation regulates various environmental chemicals like carbon, nitrogen, and water,
- As the base of the food chain, vegetation converts solar energy into biomass to be introduced to the environment, primarily through wildlife food and habitat,
- The capture of carbon and release of oxygen,
- Typically, soil with vegetation is more productive and improves over time,
- Provides socioeconomic benefits such as plant products as well as soil protection,
- Some cultures have special cultural or spiritual ties to plants (Canadian National Vegetation Classification n.d.).

Vegetation cover also includes the ecological indicator plant species intactness. The ABMI monitors three classes of plants for species intactness: (1) native vascular plants (trees, shrubs, and herbs), (2) bryophytes (mosses),

and (3) lichens. Plant communities in Alberta have been significantly altered by land-use patterns including oil and gas extraction and agriculture. Some areas of the province have seen greater disruptions to species intactness than others: while the northeastern corner of the province shows close to 100% intactness, much of southern and central Alberta and the area around Grande Prairie show rates below 50% (Alberta Biodiversity Monitoring Institute 2014b). Low plant species intactness does not necessarily mean an absence of plants. Often, what it does mean is native plant communities have been displaced, often as a result of human activity.

In the BRW, out of all the species intactness indicators, native plant species show the highest sensitivity to human impacts. With an average intactness for native plant species of less than 51%, we can clearly see the footprint of large-scale farming on biological integrity (Map 5.3).

Understanding Natural Vegetation Cover

Vegetation cover is a significant indicator of the health of an ecosystem (Thompson and Hansen 2002). Vegetation supplies a number of ecosystem services, from preventing erosion and soil loss to providing habitat for animals and maintaining plant and animal species diversity to sequestering carbon (Robinson and Lundholm 2012).

Vegetation cover can be further subdivided between natural vegetation cover and vegetation cover, the latter of which does not specify whether the plant community consists of native or introduced species.

The history of the Prairies, including the province of Alberta, is closely connected with the history of colonization and the displacement of Indigenous peoples by non-Indigenous settlers. After 1872, the Dominion Lands Act authorized settlement of the Prairies with economic and property incentives for homesteaders. Settlement proceeded according to a surveyed, grid-based township and range system. An extensive effort to survey the natural vegetation of the province went hand-in-hand with these policies (Archibold and Wilson 1980). This survey both documented existing native vegetation and served as the basis upon which the vegetation of the Prairies would be transformed by large-scale agriculture, including ranching, grain production (wheat and barley), and oilseed production (canola) (Revel 1985).

Role of Vegetation Cover in the Ecosystem

Whether native or introduced, vegetation cover plays a significant role in supporting and regulating ecological processes. Speaking broadly, these functions include: biological productivity, site stability (prevention of erosion), capture and beneficial release of water, nutrient cycling, and (plant) species diversity (Adams et al. 2009).

Temperature regulation is another significant ecological service supported by vegetation cover. Low-growing plants including mosses, grasses, and low-lying shrubs create a thermal buffer zone that helps to keep the ground cool. While the effects of temperature regulation are typically not as critical for humans, ground-dwelling species benefit greatly from such a buffer. In the hot months of the summer, temperatures at ground level, beneath the plant cover, will be more consistent, while during the winter months low-lying plants provide a layer of insulation to help maintain warmer temperatures and provide shelter from the wind. In riparian areas, vegetation cover contributes to keeping water cool as well, which is essential for the health and survival of aquatic organisms (Kalny et al. 2017).

One of vegetation cover's other essential roles is site stability and the prevention of erosion caused by wind and water. Riparian zones play a critical role in the maintenance of shorelines: when the vegetation cover within those areas is removed, the result will likely be greatly increased levels of erosion (Government of Alberta n.d. m).

The same can be seen in agricultural areas: if a field is left bare of vegetation, the soil (and any fertilizers and pesticides on or within it) will be blown or washed away with the rain far more readily. This can lead to sedimentation and down cutting (downward erosion of a river or stream through its bed), as well

as more turbulent water flows and increased nitrogen and phosphorus (nutrient) levels in waterways.

High nutrient levels in water can result in blue-green algal blooms and lowered water quality. Vegetation cover helps to maintain soil placement, traps runoff soil, and catches and stores water. This reduces sedimentation, slows the speed at which rainwater and runoff enters a body of water, and filters out potentially harmful substances.

Natural vegetation cover also plays an essential role in nutrient cycling. Plants take up nutrients from the soil as they grow and build biomass, release nutrients when they die back or shed leaves, or when they are browsed by animals. This slowing down prevents the loss of nutrients from soil into the water table in two ways: (1) by moderating the infiltration of water into the soil, and (2) by making nutrients available to other organisms within the ecosystem (Hobbs 1993).

Large fluctuations in regional temperatures can affect crop yields, algal blooms can affect both recreational and productive values, and decreased biodiversity and biological productivity at basic levels can lead to decreased biodiversity and productivity at more complex scales, lowered ecosystem resilience, and degraded ecosystem services. As such, the state of natural vegetation cover can be used as one of the indicators for ecological and community health. If a region has below-average vegetation cover, the surrounding communities may well experience negative outcomes in their economies, community health, and quality of life.

Risk Factors for Natural Vegetation Cover

While some vegetation change over time is natural, some change can degrade the environment and reduce its ecological resilience. This can include total removal of vegetation because of expansion of the built environment (parking lots, roads, etc.) or because of certain industrial techniques like strip-mining. It may also include vegetation replacement with species that are not as well suited to provide comprehensive ecosystem services, as is the case with annual agriculture (Hobbs 1993).

One of the significant ecological changes agricultural vegetation introduces into a landscape is the seasonal removal of vegetation cover when crops are harvested, resulting in seasonal fluctuations in soil temperature, humidity, nutrient cycling and availability, and local water cycling (Hobbs 1993). These are serious disruptions to ecosystem processes.

Loss of natural vegetation cover occurs in the form of removal or replacement, but also in the form of fragmentation, where infrastructure including roads, pipelines, and human settlements breaks up natural vegetation into smaller, disconnected parcels. Fragmentation is a serious concern for several reasons, but has been studied particularly for its effects on animal habitat and animal behaviour. Habitat fragmentation can impede migration, access to food sources, and reproduction (Hinam and St. Clair 2008). Habitat fragmentation can also render animals more vulnerable to negative interactions with humans such as vehicle collisions. It should also be noted the loss of biodiversity that accompanies the loss of natural vegetation cover applies to plant species as well as animals.

Differences Between Natural Vegetation Cover and Vegetation Cover

The detrimental ecological effects of degraded vegetation cover include loss of temperature modulation capacity, increased erosion, and loss of habitat and biodiversity. Loss of soil moisture and reductions in the productive capacity of the land are also associated with degraded vegetation cover and especially with vegetation litter removal (*i.e.,* removal of fallen leaves, dried grass, etc.) (Deutsch, Bork, and Willms 2010).

According to Riparian Areas: A User's Guide to Health (2003), not all vegetation is created equal when it comes to supporting healthy ecosystem functioning. Weedy species, such as invasive dandelions, are plant species that have been introduced from elsewhere that may cause ecological and economic damage. They can indicate there has been ecosystem disturbance, such as soil compaction from human activity or overgrazing, since many weedy species also thrive where bare soil has been created. Weedy species and disturbance-caused species (which may be endemic/native species rather than introduced species) tend to be shallow-rooted and

have shorter life-cycles. They may not have the biomass or site-stabilizing capacity to prevent erosion, and they may not be present on the landscape at critical times of the year for preventing erosion, for example, in early spring (Fitch and Ambrose 2003).

While natural vegetation cover includes some disturbance-caused species as well as other annual species, vegetation that remains present through the year will tend to be deep-rooted and productive, providing consistent support for other ecosystem functions, like the capture and beneficial release of water, nutrient cycling, and species diversity. This consistency has knock-on effects for other aspects of the ecosystem. Runoff rates are usually lower in areas with intact natural vegetation, and water table levels are also lower because of year-round evapotranspiration. A rising water table will bring up salt stored at depth in the soil, and can result in salinization and ultimately the loss of productive cropland (Hobbs 1993).

Relationship Between Vegetation Cover, Human Values and Community Health

Natural vegetation cover is subject to pressures beyond immediate human impacts on land-use. One of the two most significant pressures on prairie ecosystems is prairie fire suppression, which is likely contributing to the disappearance of native grasslands and their replacement by conifers. Climate change is the second significant pressure, affecting vegetation communities by shifting temperatures and patterns of precipitation (Widenmaier and Strong 2010).

Changes in vegetation will not necessarily have negative consequences for overall ecosystem services or for human health, but change may also be unwelcome on other grounds. For example, the encroachment of conifers into prairie grasslands is not necessarily a problem in terms of ecosystem function. Such a change, however, represents a possible issue for the agricultural economy, as well as at the level of cultural values, way-of-life, and aesthetic preference.

Policy Responses for Land Cover

What do we measure?

Whether native or introduced, vegetation cover plays a significant role in supporting and regulating ecological processes. These functions include: biological productivity, site stability (prevention of erosion), capture and beneficial release of water, nutrient cycling, temperature regulation, and species diversity (Adams et al. 2009).

Natural vegetation tends to support critical ecological processes more effectively than introduced vegetation. Natural vegetation tends to be perennial and deep rooted, providing crucial protection for soil year-round. Introduced vegetation often thrives in disturbed areas, and is generally shorter-lived and less effective at supporting integrated ecosystem functions (Fitch and Ambrose 2003).

In the mid-20th century, the province conducted two sets of vegetation inventories to support land development in Alberta. Phase 1 of the inventory, also called the Phase 1 Forest Inventory or the Broad Scale Forest Inventory, began in 1949 and was completed in 1956. Lands surveyed in Phase 1 included all publicly owned forested lands in the province except First Nations and Métis lands, national parks, and the Rocky Mountains Forest Reserve (Government of Alberta 2019a).

According to the Government of Alberta, the Phase 1 Forest Inventory examined land and placed it in one of three categories: productive, potentially productive, and non-productive. This inventory examined forests to determine potential timber development and harvest, forest protection, and industrial development. It also examined the land to determine if it was suitable for agriculture. Forest land was one type of land that could potentially be labeled productive, and if it was, trees were identified by their species, height, and crown density. Land that was already harvested, cultivated, or burned could be identified as potentially productive. Non-productive lands were usually barren, rocky, had organic soils, or included lakes. The inventory was conducted using aerial photography, with a site size of 65 hectares (Government of Alberta 2019a).

The Phase 2 Forest Inventory, also called the Detailed Forest Inventory, took place between 1956 and 1966, again using aerial photography. The Phase 2 Forest Inventory took a closer look at already productive timber lands

which were not examined as part of the Phase 1 Forest Inventory. This included detailed information about trees, including stand density and heights, stand maturity ,and species composition. This inventory also looked at some other areas missed in Phase 1, primarily in the eastern slopes of the province (Government of Alberta 2019b).

Alberta also has several other vegetation inventories, which correspond to different ecosystems in the province or further the goal of land-use planning in the province:

- "Alberta Vegetation Inventory (crown land and post inventory cutbacks),
- Central Parkland Vegetation Inventory,
- Grassland Vegetation Inventory,
- Native Prairie Vegetation Inventory,
- Forestry Inventory (phase 1, 2 & 3), and
- Reconnaissance Vegetation Inventory" (Land Use Planning Hub n.d.).

Vegetation inventories also play a role in Environment Impact Assessments (EIAs) which are mandatory for proposed development projects where there is uncertainty about the potential environmental or ecological impact of the project, or where the project may have negative environmental or ecological effects (Government of Alberta n.d. g).

Both historical and current (to 2014) vegetation cover inventories conducted under Alberta Environment and Parks are available to the public as geospatial inventories through the GeoDiscover Alberta website (Government of Alberta n.d. l). The ABMI also collects data on vascular plants, lichens, and bryophytes. Geospatial data collected by the ABMI can be accessed through their Data and Analytics portal (Alberta Biodiversity Monitoring Institute n.d. a).

How have governments responded?

Alberta's Natural Heritage Information Centre Guidelines for Natural Heritage Inventories in Parks and Protected Areas (2002) describes two broad types of inventory: (1) systems-wide inventory, and (2) site-specific inventory. Systems-wide inventories are used for "identifying conservation opportunities and issues in a land unit of large areal extent such as a subregion" and site-specific inventories are "employed for identifying conservation opportunities within and providing management information for existing or proposed protected areas." The Guideline also identifies three types of site-specific inventory: (1) reconnaissance survey, (2) protected areas ecological land classification, and (3) single-sector inventory (Alberta Natural Heritage Information Centre 2002).

The Alberta Vegetation Inventory (AVI), the Grassland Vegetation Inventory (GVI), and the Primary Land Vegetation Inventory (PLVI) provides the basis for vegetation inventorying and monitoring in Alberta (Government of Alberta n.d. h).

Private companies and non-profits also conduct or supervise vegetation inventories and vegetation monitoring in Alberta. Different organizations may be measuring slightly different things, measuring according to differing objectives, or using different research methods.

What is being done?

As with other indicators, provincial policy and government priorities influence vegetation cover and vegetation monitoring. Farmers and ranchers are directly implicated in the management of vegetation cover, as are large mining and both oil and gas operations. Community-based restoration organizations offer citizens and stakeholders an opportunity for civic engagement, stewardship and cooperative management, education, and spending time in nature.

Vegetation cover in Alberta is also described in the province's EPEA. This Act was proclaimed in 1993, revised in 2000, and is currently in effect (Government of Alberta 2021b). The purpose of the EPEA is to regulate the use of Alberta's environment, with a focus on enhancement, wise use, and protection (Government of Alberta 2015b).

The Act aims to achieve its goals through several methods. This includes empowering AEP to create regulations and standards that protect the environment:

- Allowing Albertans to be involved in decision making about the environment,
- Creating a review process that emphasizes environmental protection as a consideration early in planning process of developments,

- Creating a hotline to report any kind of environmental harm from substance releases, so it can be addressed, and
- Enforcing compliance with the regulations of the act through education, monitoring, prevention, and orders or prosecution (Government of Alberta 2015b).

The Alberta Water Act, came into effect in 1999. As the name suggests, the Act regulates usage of Alberta's waters, whether from groundwater, rivers/streams, lakes, or wetlands, with a focus on ecologically responsible use of that water. To regulate usage, the Act differentiates between homes using water sources nearby and large scale use that may alter the water, land, or vegetation. This includes projects that can be small, like ditches, or large, like dams. All of these require approval and oversight by the government (Government of Alberta n.d. c).

One other piece of provincial legislation that applies to vegetation cover is the Public Lands Act. Regulations in the Public Lands Act are applied both by the AER and by Alberta ESRD. As of 2013, the AER became responsible for regulating energy related development under the Public Lands Act. This includes thing such as oil sands, oil, gas, and coal activities that occur on public lands. Meanwhile, the responsibilities for regulating non-energy related development, such as sand/gravel operations and rangeland/grazing management, remained with the ESRD (Alberta Energy Regulator 2014).

Wildfire and wildfire management practices are two other interrelated areas of environmental and political change that are increasingly recognized as affecting vegetation cover composition, with the wildfire suppression policies of much of the twentieth century resulting in the expansion of coniferous forests into grassland habitat (Stockdale, Macdonald, and Higgs 2019).

Alberta Wildfire, under Alberta Agriculture and Forestry, is responsible for fire response and fire management within the province. The major piece of legislation governing wildfire response in the province is the Forest and Prairie Protection Act. Much of the legislative approach to managing wildfire in Alberta centres around the protection of property and punishment for actions found to lead to fires (Government of Alberta 2020a).

Local governments may be better positioned than higher levels of government to recognize and adapt to the reality of a changing and intensifying wildfire season. Although local governments have less legislative power and smaller budgets than the provincial government, a 2011 study found a number of local governments are completing emergency preparedness plans, education, hazard assessments on public and private land, and infrastructure reinforcement measures (Harris, McGee, and McFarlane 2011). The efficacy of these plans in managing wildfires, and by extension managing local vegetation, is dependent upon a number of factors, including the presence of issue advocates and stakeholder buy-in, human and financial resources, and support from higher levels of government.

Responding proactively to wildfire, and the threat wildfire poses to vegetation cover, is a significant challenge for all levels of government. Local governments tend to not have extensive authority over land management beyond municipal limits, meaning they have limited power to conduct fireproofing activities except within town boundaries. Changing the fire management regime at higher levels of government (for example, to allow more prescribed burning) may be supported by scientific research, but is not yet popular with voters nor, presumably, with business and industrial interests (McGee 2007; Sachro 2003).

What could be done?

Protection of natural vegetation can come into direct conflict with provincial priorities around resource development and economic growth. Public perception of natural vegetation can also vary, with some people actively supporting efforts to conserve or enhance native vegetation, and others actively opposing such efforts (Anderson, Messer, and Langellotto 2021; Bauer, Wallner, and Hunziker 2009; Zoderer and Tasser 2021). The protection of natural vegetation cover requires the provincial government and NGOs like Cows and Fish to build support with land-users and stakeholders. When land users, including both recreational users and people who use the land in support of their livelihoods, are included in discussions about the value of natural vegetation and are more connected to conservation and management organizations, protection and

restoration projects have a better chance of success (Keenelyside 2012; Zoderer and Tasser 2021).

One concrete action that would support natural vegetation, and several other biodiversity indicators as well, would be decommissioning and reclaiming unused roads and trails. Roads and trails (linear development), including logging roads, ATV trails, and abandoned roads, have significant negative impacts on watershed health and ecosystem integrity through vegetation removal, soil disturbance and erosion, fish and wildlife disturbance, barrier effects and habitat fragmentation, and increased human access to sensitive ecological areas (Johancsik 2016).

Decommissioning and restoring roads is a process with a significant financial cost, but abandoned roads and trails do a disproportionate amount of damage to ecosystem integrity. Road restoration could be written into EIAs and restoration plans, and could also become a focus for local conservation and management organizations.

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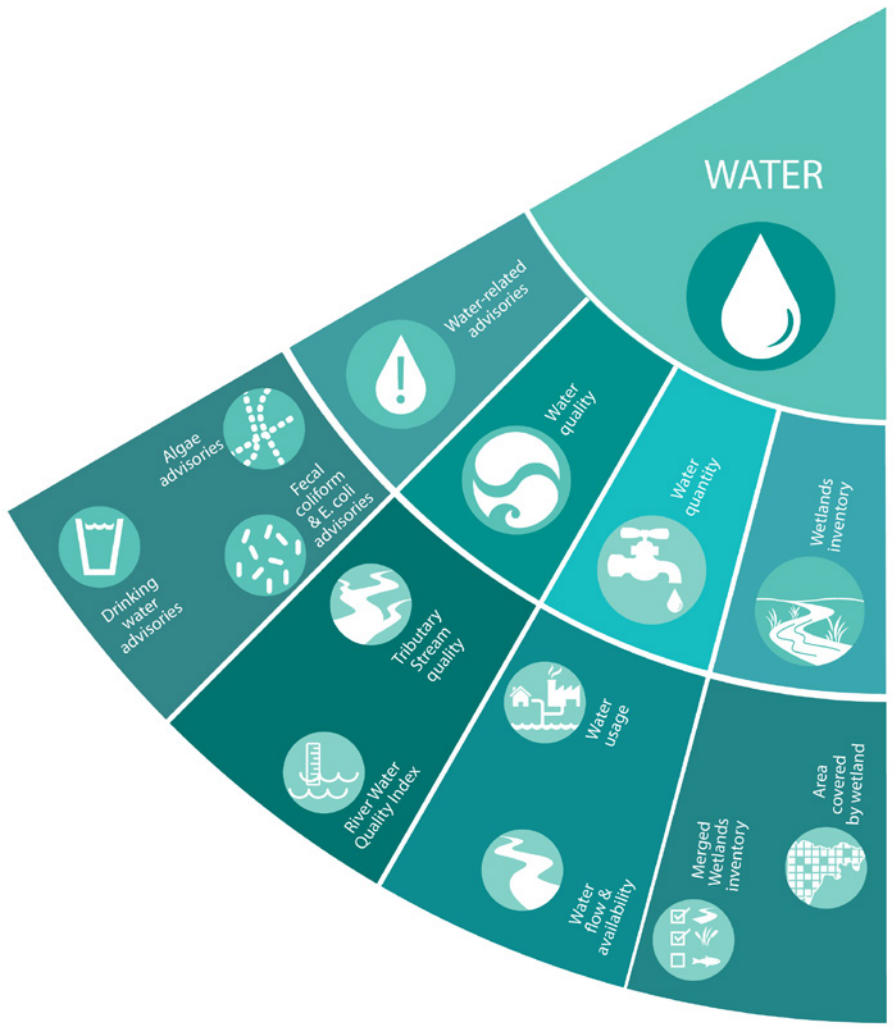
CHAPTER SIX

WATER



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INTRODUCTION

The Battle River scored significantly lower on both upstream and downstream measures using the Alberta River Water Quality Index (RWQI) than surrounding rivers. Most of the watershed's groundwater usage is allocated to agricultural and municipal usage while the majority of the surface water is allocated to commercial usage. The Battle River may be seeing a declining flow rate, which could cause future problems for water quality and quantity. There are no boil water advisories in the BRW but there were eight cyanobacteria advisories in the Central Zone in 2018.

Measuring Water

1. Water Quality

Water quality refers to the physical, chemical, and biological characteristics of water, usually within the context of a specific purpose (*i.e.,* drinking, swimming, and fisheries management). In Canada, water quality is measured at every level of government: federal, provincial, and municipal. Many Alberta water bodies provide water resources to industry, communities of all sizes, and to individual farms. In Alberta, approximately half of allocated water is used for the agriculture industry alone. Water refers to both surface water, which includes oceans, lakes, rivers, streams, wetlands, and ground water, which is water below the surface of the ground and includes water in the soil and underground aquifers. Water quality is of central importance to maintaining healthy ecosystems, vibrant and diverse industry, and high quality of life.

2. Water-related Advisories

Water-related advisories refer to situations that cause impairment to water quality, whether for recreation, consumption, or ecosystem health. Examples include the presence of contaminants in the water, such as *E. coli*, or other bacteria, that are dangerous for human and animal consumption. They may also refer to algal blooms caused by agricultural runoff, making water unsafe for swimming. Or they could refer to industrial spills that cause fish kills. A significant problem facing the sustainability of our Indigenous communities is boil water advisories. Ensuring clean, potable water for all Albertans is an attainable goal.

3. Water Quantity

Water quantity refers to the volume of water in the area being measured. This is important because the various industries, developments, and human habitations in the province consume vast quantities of water without most of us realizing it. Measured by all levels of government, managing water quantity is important, as weather extremes from flooding to drought can negatively impact ecosystems, industry, and human habitations. Tracking and managing water quantity is a policy response more recent than that of tracking and managing water quality. Doing both together is the most effective way to manage water resources.

4. Wetlands Inventory

Wetlands are one of the most ecologically diverse and environmentally important parts of the province. Conducting an inventory, or examining the province's wetlands and better understanding them and the threats they face, is important to the future of the province. Peatlands, covering vast parts of Northern Alberta, are a type of wetland that is particularly fragile and needs to be conserved. Unfortunately, peatland is also constantly at risk as it is often covering areas with valuable natural resources such as oil and gas. Exploration of the peatlands can cause harm, and extraction can completely wipe them out. However, that does not always have to be the case, as proper oversight and regulation can allow for less impact, reclamation, or replacement of natural wetlands. An integral part of preserving our environment is to inventory them, understand how they work and how best to work with them, and preserve the ecology and environment for future use.

Understanding the Political Context of Water

A number of policy documents shape water and watershed governance in Alberta, including four major acts and several pieces of legislation, regulations, directives, and codes of practice. There is also an overarching government-wide framework called the Water for Life strategy, which, while it does not have legal standing, "guides policy measures across Government of Alberta ministries" (Government of Alberta 2011).

This chapter's policy sections will look at the Water for Life strategy and relevant sections of legislation to provide a picture of the overall policy design for water governance in Alberta. These sections will also examine the policy framework through which each of the indicators within the Water Chapter is measured and regulated.

Understanding the geography and scale of water governance in Alberta is important for making sense of water policy. Water issues are both local and provincial matters of concern.

While some aspects of water policy apply to the province as a whole, water policy has also developed in recognition of the perspectives and needs of smaller regions within the province. As can be seen from such organizations as the Watershed Planning and Advisory Councils (WPACs) and watershed stewardship groups, the watershed, as an ecological and cultural feature, is an important unit in Alberta's water policy framework.

Around the world, there is an increasing incidence of watersheds as governance units (Cohen 2012, 2207). In part, the move to watershed-level governance is in alignment with movements away from centralized, top-down governance toward more local and inclusive decision-making (Cohen 2012, 2207). A watershed may also suggest a 'natural' boundary for governance, with communities in a particular watershed being linked ecologically, socially, and politically through their usage of a shared water system (Cohen and Bakker 2014, 139). Critics of the concept of watershed-level governance argue this 'rescaling' of governance can disguise imbalances in political power and accountability, permitting provincial or national governments to offload responsibility for the complex requirements of ecological regulation and monitoring onto smaller communities that lack the political power to carry out these tasks (Cohen 2012, 2213; Cohen and Bakker 2014, 139). Proponents of the watershed governance concept, however, argue that "watersheds are appropriate units for managing ecosystems" because they are "place-based units" within which it is possible to "understand and manage interactions" between social systems and ecosystems (Parkes et al. 2010, 695-696).

Overview of the Policy Design

Broadly speaking, water policy in Alberta can be divided into policies related to the conservation of water supply, and policies related to the protection of water quality and quantity.

Conservation-related policy is designed to protect ecosystems, water quality, and water quantity by prohibiting certain kinds of activities in certain areas. Protective legislation is designed to describe allowable development and water usage; and limit, respond to, and remediate damage. Policy that aims to specify and incentivize certain kinds of behaviour has been called 'distributive' policy by the American political scientist T.J. Lowi, while policy that aims to limit or punish certain kinds of uses and behaviours was given the name 'regulatory' policy (Roberts and Dean 1994, 71-73).

The primary legislation for water policy in Alberta includes the Alberta Land Stewardship Act (ALSA) (2021), the Environmental Protection and Enhancement Act (EPEA) (2021), the Public Lands Act (2022), and the Water Act (2021). The Alberta Water Act, overseen by Alberta Environment and Parks (AEP), is a good place from which to begin to understand Alberta water policy because the Act is solely and specifically dedicated to Alberta's water. In summary, "Alberta's current water management legislation, the Water Act (Act), came into force on January 1, 1999. It focuses on the planning, use and enforcement needed to manage and protect Alberta's water. The Act emphasizes the wise use and allocation of our water - including the protection of Alberta's rivers, streams, lakes and wetlands" (Government of Alberta 2010).

The Act specifies and regulates three types of water use: household use, licensable use, and traditional agriculture use (Government of Alberta 2010). While household users are given the highest priority of water rights under the Act, licensable use is the broadest category of use since it includes municipal use and all uses other than household use, traditional agriculture use, and those uses exempt from licensing requirements under Water Regulation (Government of Alberta 2010).

Alberta's Water for Life strategy functions as the province's guiding document for water policy (Government of Alberta 2011). The Water for Life strategy was developed in response to the multi-year drought that affected the province around 2000. It came into effect in 2003 and was renewed in 2008 (Government of Alberta 2011).

Water for Life is a comprehensive water strategy for a large geographic area (the province as a whole), and addresses water conservation, safe drinking water, irrigation, and the protection of aquatic ecosystems (Government of Alberta 2011). It has three main goals: (1) safe, secure drinking water, (2) healthy aquatic ecosystems, and

(3) reliable, quality water supplies for a sustainable economy (Government of Alberta 2011). The strategy focuses on three key directions: (1) knowledge and research that supports effective policy and management, (2) partnerships with stakeholders including the Alberta Water Council, WPACs, and watershed stewardship groups, and (3) water conservation through best management practices (Government of Alberta 2011).

For over a century, water policy in Alberta has been shaped by policies that link development (primarily through settlement and agriculture) with political authority (Schmidt 2007, 61). Watersheds, and particularly the watersheds of southern and central Alberta such as the South Saskatchewan River Basin (SSRB), have been important sites for the development of these water policies. Newer policy initiatives, such as the Water for Life strategy, attempt to shift political, social, and ecological attitudes toward water away from simply increasing the supply of available water (which is increasingly understood to be unsustainable) toward the collaborative management of existing water supplies among all water users (Schmidt 2007, 50-51).

The WPACs are an important forum for regional governance. WPACs are "independent, non-profit organizations that are designated by AEP to report on the health of [Alberta's] watersheds, lead collaborative planning, and facilitate education and stewardship activities" (Government of Alberta n.d. n). WPACs act as charitable organizations that obtain funding from grants and supplements from both industry and the general public (Berzins, Harrison, and Watson 2006, 257).

There are eleven WPACs in Alberta, and the Battle River Watershed Alliance (BRWA) is the WPAC for the Battle River region (Government of Alberta n.d. n). Although WPACs have no formal regulatory or statutory standing, they generally enjoy a high level of recognition and support for their activities among the municipalities within a watershed (Nicol and Nicol 2021, 18-19). Many of the activities WPACs undertake, from Watershed Management Plans (WMPs) to technical studies, can inform local municipal planning (Nicol and Nicol 2021, 11). However, the extent to which municipalities take WPAC activities into account in their planning varies from watershed to watershed, indicating both the need for WPACs to devote energy to making connections with local municipalities and the difficulty of making such connections in geographical regions which are defined by long distances between small communities (Nicol and Nicol 2021, 18).

To summarize, water policy in Alberta seeks to regulate water use within the province to safeguard the quality and quantity of the water supply. This is done for several reasons: (1) to safeguard human health, (2) to protect ecosystems now and in the future, and (3) to develop and regulate industrial, agricultural, and commercial water usage. These goals are articulated within a policy framework that has moved from a province-level command and control model of regulation to one that emphasizes community (municipal) responsibility, stakeholder participation, and technocratic expertise (Schmidt 2007, 49-52).

The shift to a collaborative approach to policy has also been described as a shift from 'needs-based' policy to 'risk-based' policy (Schmidt 2007, 48). This shift has a number of implications for how we measure the health of water in the watershed, and how we act on these measurements of health. One such shift is the recognition in policy of a much larger number of actors in water governance, including individual water users, agricultural operations, municipalities, organizations, like WPACs, and aboriginal communities (Government of Alberta n.d. m; Government of Alberta n.d. n).

In a 'needs-based' policy framework, each of these actors might be assessed by the provincial government on the basis of their water needs (Schmidt 2007, 52). Under the current policy framework, each of these actors is asked to participate in the creation of policy that not only attempts to meet their own needs for water, but also requires each actor to account for the ways that they effect the water needs (both in terms of quantity and quality) of other actors (Schmidt 2007, 52). Strategies like increased reliance on public consultation to develop policies as well as the creation of the WPACs support this shift toward public accountability for water sustainability.

Water Quality

River Water Quality Index

The RWQI is a measurement of surface water quality in Alberta. The RWQI has been reported annually by AEP since 1996 (Alberta Environment and Parks 2015). Alberta RWQI scores are provided on a scale of 1-100 with a score of 96-100 being considered excellent, a score of 81-95 being considered good, a score of 66-80 being considered fair, a score of 46-65 being considered marginal, and a score of 0-45 being considered poor (Mighty Peace Watershed Alliance 2015).

By testing for levels of four selected contaminants (bacteria, metals, nutrients, and pesticides) and publishing this information on an annual basis, the RWQI is developing a long-term picture of changes to water quality in the province, and also has specific data on what is driving those changes (Land Use Planning Hub n.d.; Alberta Environment and Parks 2017a). Measurements are taken at 28 Long Term River Network (LTRN) sites on major rivers in the province, with testing sites selected to capture water samples both upstream and downstream of locations of notable human activity (Alberta Environment and Parks 2015). This approach captures a measurement of the quality of water coming into a community and also captures the potential effects on downstream water quality within the community, such as wastewater treatment and release or nutrient runoff.

This indicator contributes to our understanding of community health in two ways. First, if the quality of water coming into a community is consistently low over time, we can expect the community will have to spend more on water treatment, and community members may be at greater risk from some illnesses related to poor water quality.

Second, low water quality is related to environmental impact. If community activities are releasing pollutants into the water, this will likely result in a poor index score at downstream monitoring sites, which is an indicator that the community is creating environmental damage. While the repercussions may not be felt by the polluting party, downstream communities will likely feel the effects leading to a reduction of total health across the watershed.

Understanding River Water Quality Index

The Alberta RWQI takes into account four indicators of water health: (1) bacteria, (2) metals, (3) nutrients, and (4) pesticides (Land Use Planning Hub n.d.). Across all four measures, the northern rivers average from a low of 73 to a high of 100 (Alberta Environment and Parks 2017b).

Risk Factors for River Water Quality Index

Bacteria

Across the northern rivers of Alberta, quality scores for bacteria remain at 'excellent' levels, excluding the Wapiti River above Smoky River and the North Saskatchewan River at Pakan (Alberta Environment and Parks 2017b). The presence of bacteria in these bodies of water is often the result of nearby land-use/disruption, or industrial practices such as agriculture. In fact, there is a greater diversity of bacteria found in water sources near agricultural-dominated areas (Chen et al. 2018, 7). Runoff near these sources can contain chemicals that influence the bacterial composition in water bodies (Chen et al. 2018, 17).

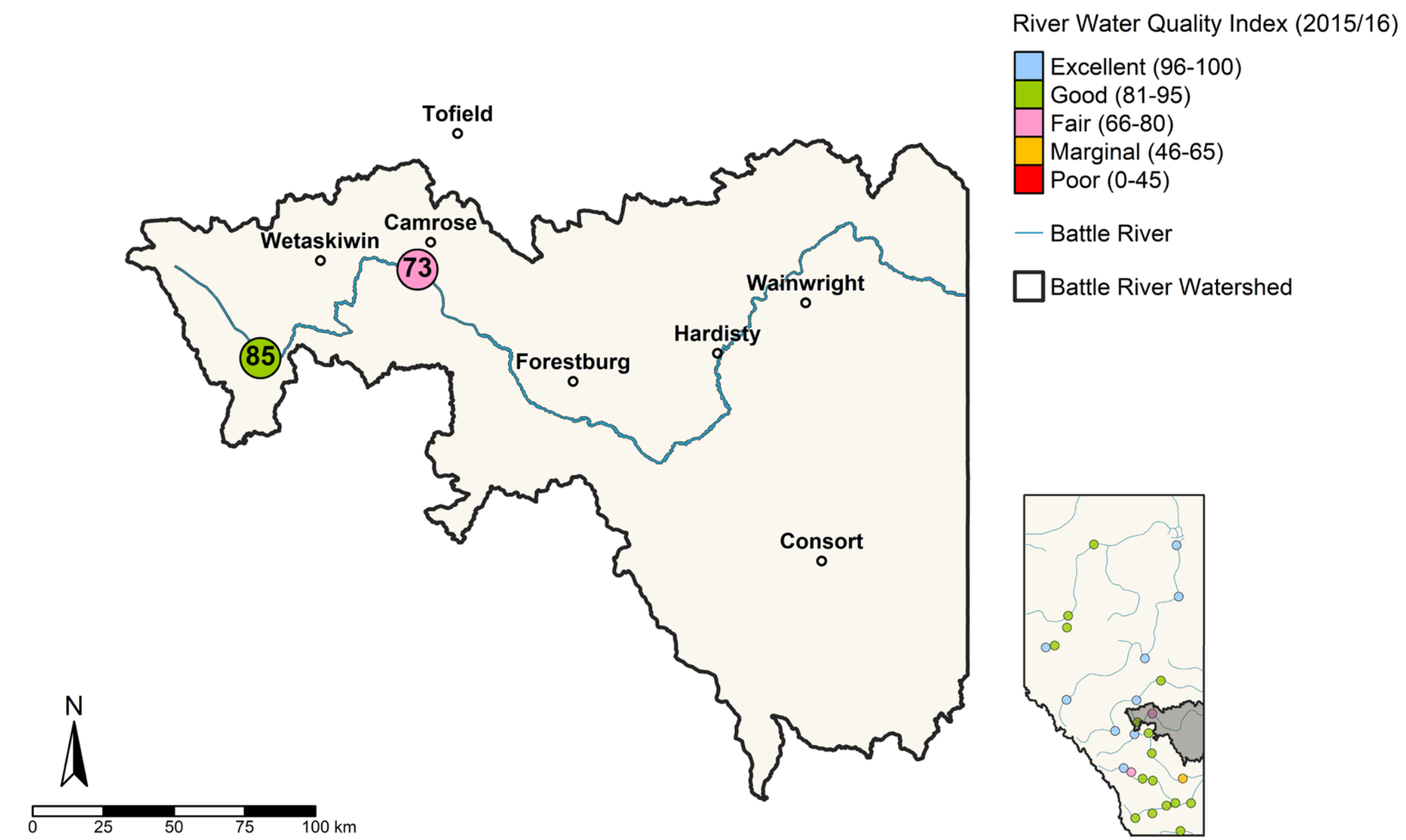
Another concern is an overgrowth of cyanobacteria, also known as blue-green algae. When there is an overgrowth or algal bloom, the cyanotoxins produced by these organisms are present in sufficient quantity to be dangerous to humans and animals. It is important to note that not all bacterial presence is negative. There are many beneficial bacteria whose presence aid in maintaining clean water.

Metals

The quality index for metals in the northern rivers ranges from 'good' to 'excellent' categories. Some of the metals that have been found in water bodies include manganese, zinc, and copper (Regional Aquatics Monitoring Program n.d. b). At high concentrations, these metals are toxic to aquatic organisms, and to humans if ingested through drinking water (Regional Aquatics Monitoring Program n.d. b). Copper and zinc are utilized as additives for animal feed and often build up in the soils (Government of Canada 2020). Metals may also end up in the water bodies through

River Water Quality Index (2015/16)

A general measure of river water quality which includes various metals, pesticides, bacteria, and nutrients



Map 6.1: (Source: Government of Alberta. 2016. Alberta River Water Quality Index Results (2015-2016)).

agricultural contaminants from chemical spills that are not adequately cleaned (Government of Canada 2020).

Mercury and arsenic are two metals that occur naturally in the Athabasca River. Concentrations of these metals in the muscle tissue of the northern pike fish have exceeded Health Canada criteria for fish consumption (Regional Aquatics Monitoring Program n.d. b). Mercury is especially susceptible to bioaccumulation in fat tissues. Mercury poisoning may cause neurological damage if ingested at high enough concentrations (World Health Organization 2017).

Nutrients

The quality index for the nutrients category is the lowest amongst the other three indicators (bacteria, metals, pesticides) of water health in the northern lakes of Alberta. The Battle River at Driedmeat Lake has a drastically low score for nutrients at 25/100 (Alberta Environment and Parks 2017b). Given the concentration of agriculture in the area, this section of the river likely accumulates fertilizer-laden runoff from the surrounding cropland.

Nitrogen and phosphorus are the two nutrients of greatest concern in Canada, and are often sourced from fertilizers, decomposed crop residues, and agricultural waste products (Government of Canada 2020). Nitrogen and phosphorus are often added in agricultural processes to maximize crop yields; however, the runoff of these nutrients into water systems can disrupt the biological equilibrium of that water body (Government of Canada 2020). These two nutrients speed up eutrophication, a process in which a water body becomes over-enriched with nutrients, leading to an overgrowth of simple plant life, such as algae (Government of Canada 2020). Eutrophication is harmful to both the river ecosystem and to the communities that rely on these water sources for recreational purposes or drinking water. A eutrophic lake becomes depleted of oxygen as microbes decompose the mass of dead algae from the algal bloom. This results in the death of fish and the depletion of life in aquatic animals overall (Government of Canada 2020). It also leaves an unpleasant smell on the lake (Priskin 2008, 59).

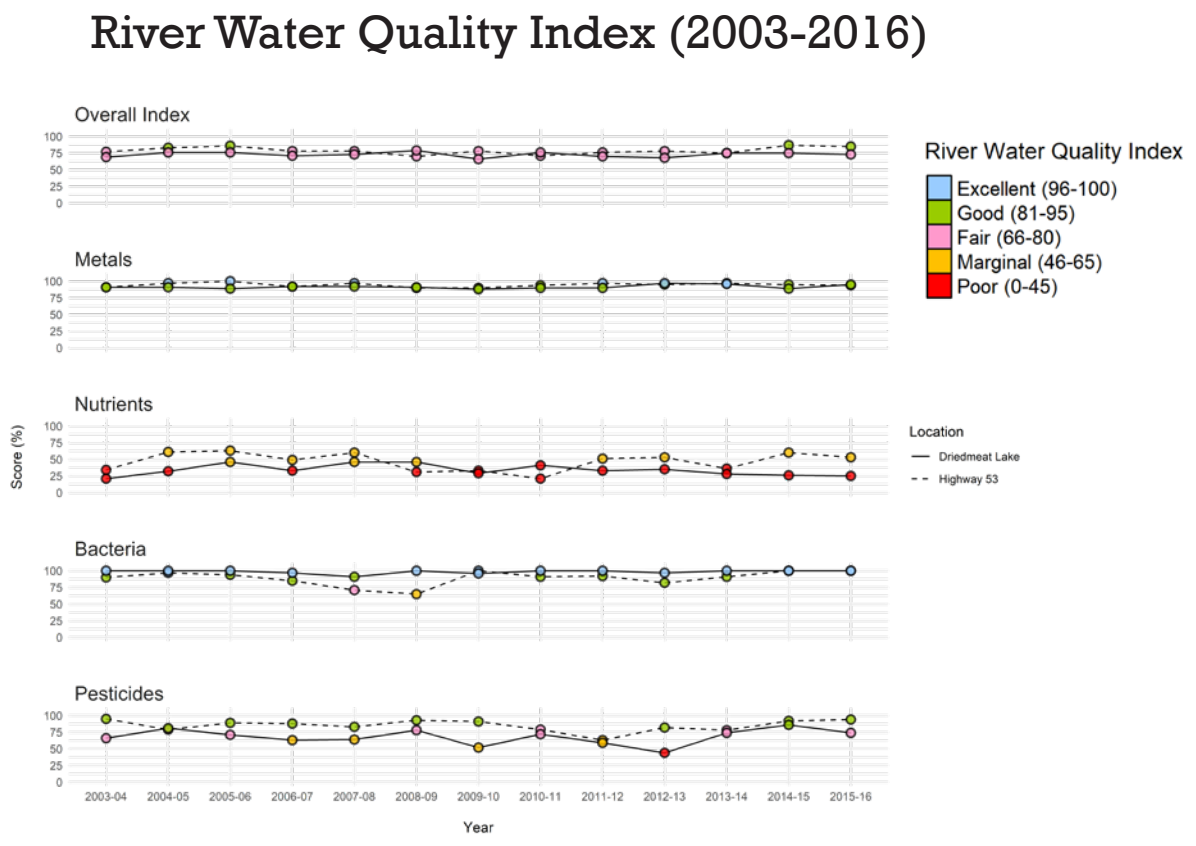


Figure 6.1: River Water Quality Index (RWQI) and sub-index scores for the two water monitoring sites in the BRW from 2003/04 to 2015/16. (Source: Battle River Watershed Alliance, 2021. Battle River Watershed Alliance. 2021. Battle River Water Quality Data: Water Quality Index Scores & Surface Water Quality Compliance. https://www.battleriverwatershed.ca/wp-content/uploads/2021/05/Battle-River-Water-Quality-Data_Branded-2021.pdf).

Pesticides

The prevalence of pesticides in the northern rivers of Alberta are not of major concern, with the index ranging in the 'good' to 'excellent' categories, with the exception of the Battle River at Driedmeat Lake in the 'fair' category. Pesticides create toxic effects through the process of biomagnification, which is the process in which organisms that are lower in the food chain ingest chemicals from water

Subwatersheds of the Battle River Watershed

Map 6.2: (Source: Agriculture and Agri-food Canada. 2013. Sub-sub-basins of the AAFC Watersheds Project - 2013).

and food, leading to a higher concentration of chemicals than its food concentration (Drouillard 2008, 353). These smaller aquatic organisms are then consumed by animals higher in the food chain, such as fish. These pesticides become increasingly concentrated as it moves up the food chain, reaching humans as well in their consumption of fish and other mammals (Energy Education n.d.).

Pesticide use has been a huge advantage to the agricultural economy, as it is estimated that pre-harvest crop loss would inflate to an average of about 40% if there was no pest management in agricultural practices (Government of Canada 2020). With pesticide use, however, comes adverse effects on the surrounding aquatic ecosystems. Pesticides are harmful to aquatic organisms through its level of toxicity, exposure time, and persistence in the environment (Lakhani 2015, 2).

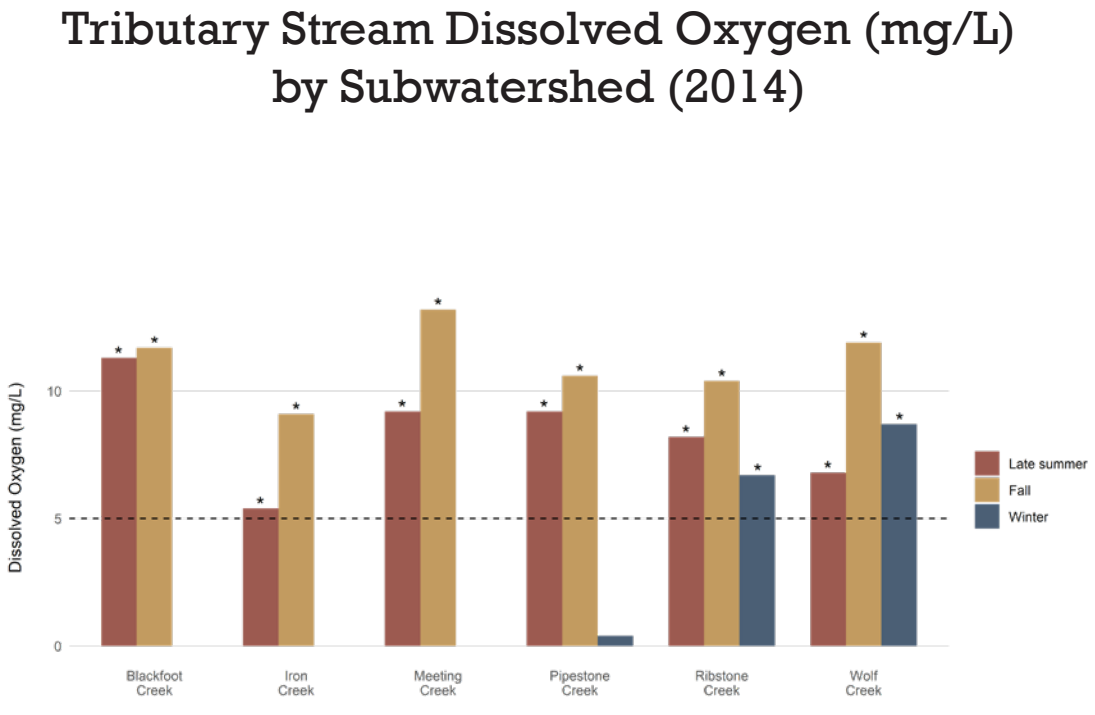


Figure 6.2: Dissolved oxygen levels (mg/L) by season in tributary streams within each subwatershed of the BRW in 2014. *Denotes exceedance of Canada water quality guidelines, shown with a dashed line (Source: Hutchinson Environmental Services Ltd., 2014).

Tributary Stream Quality

Tributary stream monitoring in Alberta is part of the province's Monitoring Water Quality in Alberta's Rivers and Streams initiative (Alberta Environment and Parks 2019b). The initiative is a five-year plan overseen by AEP, and released in 2019. The Monitoring Water Quality initiative has two distinct data-gathering components: LTRN, and the Tributary Monitoring Network (TMN) (Alberta Environment and Parks 2019b).

Since 2016, the TMN initiative has gathered data on small streams and rivers in Alberta. The monitoring initiative uses the major watersheds as ecological boundaries within which to identify these small streams and rivers (Alberta Environment and Parks 2019b). A river or stream is described as small if it is 'wadeable,' that is, if it is shallow and/or narrow enough to be walked across (Alberta Environment and Parks 2019b). A fact sheet for the Monitoring Water Quality initiative notes that a "major driver for the TMN program is the need to better understand environmental change associated with activities such as forestry, agriculture, resource extraction and climate change" (Alberta Environment and Parks 2019b).

Small streams are extremely important habitat sites for fish and other aquatic life. An adequate buffer around small streams helps protect habitat, prevent erosion, and limit the amount of harmful substances entering the water (Sweeney and Newbold 2014, 561). Small streams also feed into larger streams, meaning that impairment of water quality at the level of small streams will feed into water quality for larger streams and rivers.

While there are two LTRN monitoring sites on the Battle River, there are no TMN monitoring sites in the BRW. The Battle River has a number of tributaries, including Driedmeat Creek, Castor Creek, Iron Creek, and Ribstone Creek (Anderson 1999, 3-4). For the communities of the BRW, these tributaries and associated small streams provide essential ecological services and contribute to economic and social wellbeing.

Ecologists argue that "tributaries and confluence zones [where tributaries and major rivers meet] are sites of intrinsic ecological value where particular biophysical processes and ecosystem services may be concentrated" (Rice et al. 2008, 209). Although the TMN is not in operation in the BRW, data from the two LTRN sites shows that the degraded surface water in the BRW most often stems from phosphorus and nitrogen contamination likely through runoff from agriculture and other human activities (Alberta Environment and Sustainable Resource Development 2014, 32).

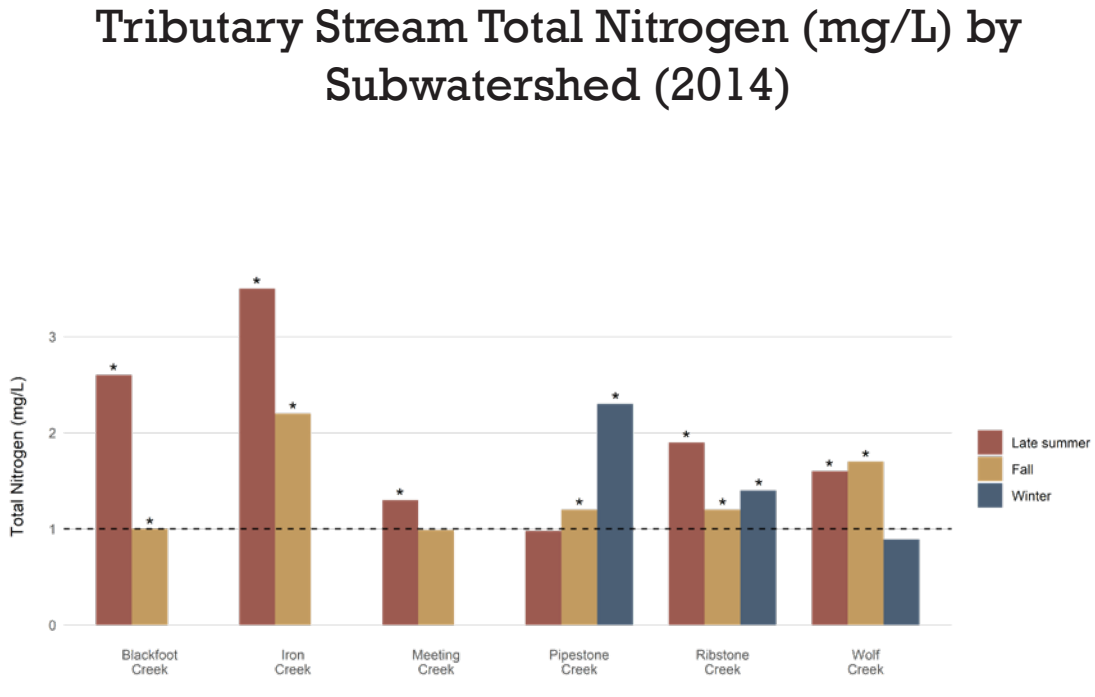


Figure 6.3: Total nitrogen levels (mg/L) by season in tributary streams within each subwatershed of the BRW in 2014. *Denotes exceedance of Canada water quality guidelines, shown with a dashed line (Source: Hutchinson Environmental Services Ltd., 2014).

Understanding Tributary Stream Quality

Ecological Importance

A tributary stream is defined as a freshwater stream that flows into a mainstem, which is usually a bigger stream, river, or other body of water (National Geographic 2022). Tributaries hold biological value, as they can provide their mainstem with nutrients, organic matter, and sediment which can increase productivity in the larger body of water, and also aid in structuring the mainstem habitat (Rice et al. 2008, 210-214). In this sense, tributary streams increase the biodiversity of the larger water body into which they flow (Milner, Yarnell, and Peek 2019, 291).

Human Activity in Tributaries

Human activity in these tributaries can influence the health of the larger mainstem. Pollutants associated with the runoff will flow through the tributary into the mainstem (National Geographic 2022). Development near tributaries is a major contributor towards the pollution of water bodies (National Geographic 2022). The biological activity and turbidity levels of streams can be altered with the removal of riparian vegetation for urban or agricultural development (North, Winter, and Dillon 2013, 221).

Policy Responses for Water Quality

We measure water quality for a variety of reasons. Water quality is about more than drinking water. In the broadest terms, we need to understand, monitor, and control water quality because clean water is essential

for human health, the health of the environment, and for economic security. An adequate supply of water that is free from contaminants, within appropriate temperature boundaries, and contains adequate levels of dissolved oxygen is essential not only to human health but also to livestock, crops, wildlife, and native vegetation. Riparian areas, which we discussed in Chapter 5, encompass not just the water but the soil and vegetation in proximity to that water, each of which plays a role in maintaining water quality.

The BRWA has produced a number of reports explaining the policy context of environmental management in the Battle River Watershed (Battle River Watershed Alliance n.d. b). Their reports help us to understand water policy in Alberta and also draw from the broader environmental literature on protecting water quality. In discussing the policy context of measuring water quality in Alberta, we will also draw from the plan for the provincial river and stream monitoring network, titled A Five-Year Provincial Water Quality Monitoring, Evaluation and Reporting (MER) Plan for Lotic Systems.

Water quality for both surface water and groundwater can be negatively affected by human activity and natural processes. Speaking broadly, protecting water quality requires the capacity to manage two kinds of potential contamination: point source pollution and non-point source pollution.

Tributary Stream pH by Subwatershed (2014)

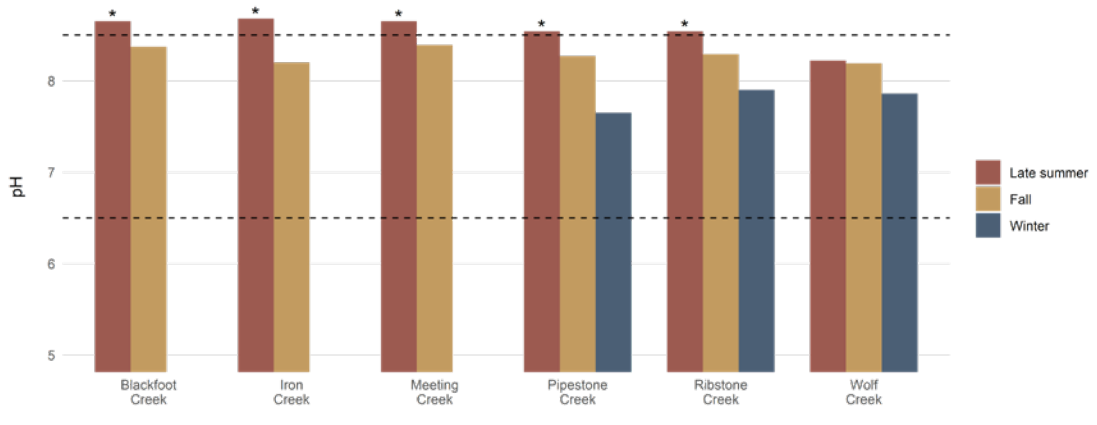


Figure 6.4: pH by season in tributary streams within each subwatershed of the BRW in 2014. *Denotes exceedance of Canada water quality guidelines, shown with a dashed line (Source: Hutchinson Environmental Services Ltd., 2014).

Point source pollution comes from a single, concentrated source such as a leaking septic tank or a chemical spill (Government of Canada 2017a). Non-point source pollution identifies contamination from a distributed source, such as salt water infiltration or runoff from agricultural land that has been treated with fertilizers and pesticides (Government of Canada 2017a). Source water protection is the third important component of effective management of water quality (Government of Canada 2017a).

Besides point source and non-point source pollution, there are a few other terms that can help us to understand what we are measuring when we measure water quality. This includes surface water, source water, and water quality index (WQI). Surface water, according to Statistics Canada, is "the water found in water bodies such as lakes, rivers, and wetlands, and bound up in snow, ice and glaciers," and is a major source of fresh water (Statistics Canada 2010, 20). Approximately 12% of Canada's surface area is covered by rivers and lakes (Statistics Canada 2010, 20). The other major source of fresh water

is groundwater. Statistics Canada defines groundwater as "water located under the soil surface — soil moisture and water stored in aquifers" (2010, 20). Source water refers to the stocks of water where people obtain water for drinking and general usage (Safe Drinking Water Foundation n.d.). This can include water stocks such as aquifers, lakes, and rivers (Safe Drinking Water Foundation n.d.). The source water would be the ultimate source of that stock and could be groundwater (such as an aquifer) or surface water (such as a glacier) (Aboriginal Affairs and Northern Development Canada 2014, 1; Statistics Canada 2010, 20).

A WQI tells us, in simple terms, about the quality of the drinking water from a given water supply (Government of Newfoundland and Labrador n.d. b). The Canadian Water Quality Index (CWQI) was developed under the leadership of the Canadian Council of Ministers of the Environment (CCME), and the provinces have adapted this guideline to their specific needs (Government of Newfoundland and Labrador n.d. a). In general, provincially-specific WQIs are calculated by comparing local water quality data to the Guidelines for Canadian Drinking Water Quality established and published by Health Canada (Government of Newfoundland and Labrador n.d. b). By measuring the scope, frequency, and severity of incidences of compromised water quality, and then combining these three measures into one score, a picture of local water quality can be determined. This calculation produces a score between 0 and 100, where a higher score indicates better water quality (Betis et al. 2020, 121). The scores are then ranked into one of the following five categories (as established by the CCME's water quality guidelines):

1. Excellent (WQI Value 95-100): Water quality is protected with a virtual absence of impairment or threat; conditions are very close to pristine or natural levels,
2. Good (WQI Value 80-94): Water quality is protected with only a minor degree of impairment or threat; conditions rarely depart from desirable levels,
3. Fair (WQI Value 65-79): Water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from desirable or natural levels,
4. Marginal (WQI Value 45-64): Water quality is frequently threatened or impaired; conditions often depart from desirable or natural levels, or
5. Poor (WQI Value 0-44): Water quality is almost always threatened or impaired; conditions usually depart from desirable or natural levels (Canadian Council of Ministers of the Environment 2017, 3).

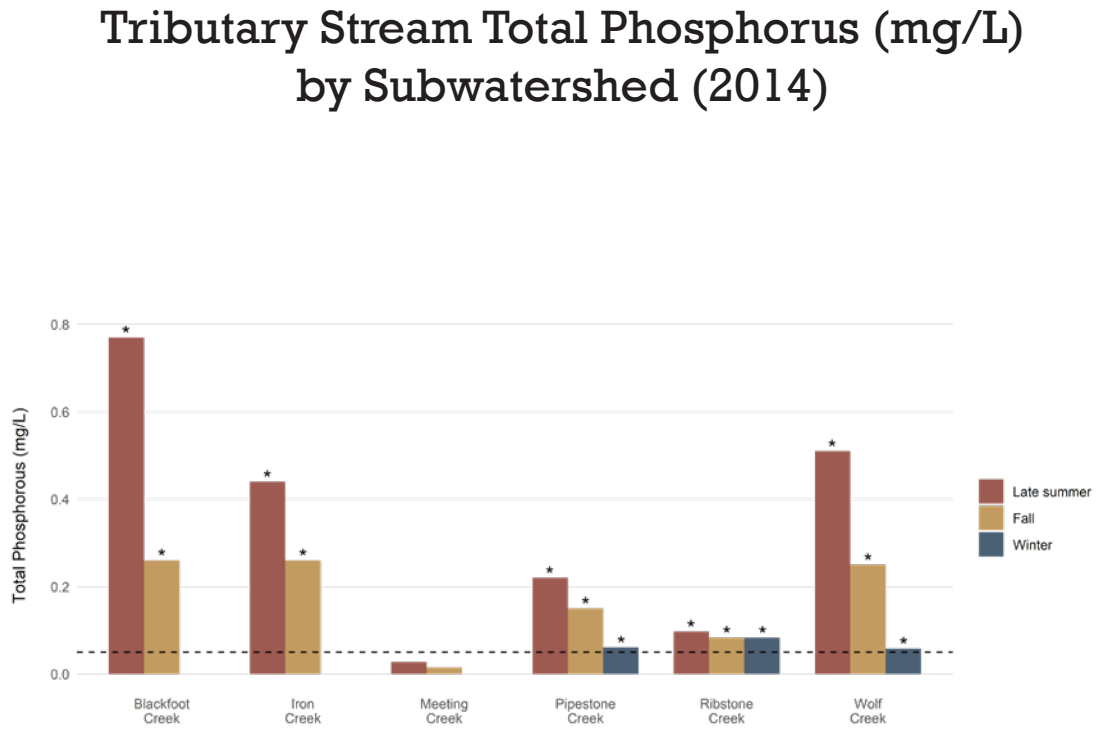


Figure 6.5: Total phosphorus levels (mg/L) by season in tributary streams within each subwatershed of the BRW in 2014. *Denotes exceedance of Canada water quality guidelines, shown with a dashed line (Source: Hutchinson Environmental Services Ltd., 2014).

How have governments responded?

The Alberta RWQI evaluates water quality in the province's rivers according to four criteria: bacteria, metals, nutrients, and pesticides (Land Use Planning Hub n.d.). These variables are compared to the provincially and federally determined guidelines for water quality. Both the LTRN and the TMN conduct "regular collection of flow, water quality and biological data from Alberta rivers for comprehensive assessments of watershed and riverine conditions and how they respond to natural and anthropogenic factors" (Buendia-Fores and Emmerton 2021, 8). The LTRN and the TMN form "the core water quality program" in Alberta (Buendia-Fores and Emmerton 2021, 8). The LTRN and TMN were established in response to AEP's 5-year MER plan, and are supported by shorter-term studies designed to address locally-specific water quality knowledge needs (Buendia-Fores and Emmerton 2021, 8).

Data on surface water quality in Alberta, including data from the LTRN and the TMN, is available through the Government of Alberta website, the Station Inventory, and the Water Quality Data Portal (Government of Alberta n.d. h; Alberta Environment n.d.; Government of Alberta n.d. o). The Regional Aquatics Monitoring Program (RAMP) also collects information on surface water quality for the Athabasca Oil Sands region, including the presence of hydrocarbons and nutrients (Regional Aquatics Monitoring Program n.d. c).

What is being done?

The ALSA (2021), EPEA (2021), the Public Lands Act (2022), and the Water Act (2021) are the primary legislation governing water quality in Alberta. The major purpose of the ALSA is to provide for the establishment of regional plans, which we have discussed in other chapters. Regional plans are intended to be a means for ensuring sustainable development in Alberta, balancing economic, social, and environmental objectives. The ALSA specifies that water is included within the Act's definition of environment (Government of Alberta 2021a, 6). One of the stated purposes of the Act is to take account of and respond to "the cumulative effect of human endeavour" (Alberta Association of Municipal Districts and Counties 2009) on the environment, which in this context specifically implies responding to effects on water quality.

The EPEA's stated purpose is to support and promote "the protection, enhancement and wise use of the environment"(Government of Alberta 2021b, 22). Like the ALSA, the EPEA includes water within its definition of the environment. The Act contains information pertaining to potable water, wastewater and storm drainage, water contamination from substance releases, water treatment and decontamination, and the Oil Sands Monitoring program (OSM) (Government of Alberta 2021b). For each of these areas, that Act specifies a requirement to protect water quality and/or to treat and decontaminate water supplies before they are available for human consumption or released into the general environment (Government of Alberta 2021b, 104-105).

The Public Lands Act affects water quality in Alberta through specifying crown ownership of "the bed and shores of all permanent and [naturally] occurring bodies of water and all naturally occurring rivers, streams, watercourses, and lakes" (Government of Alberta 2022b, 11). The act strictly prohibits any type of disturbance to public lands if it can or will end in an injury to any body of water, bed, or shore in the area (Government of Alberta 2022b, 40-41). It also affects water quality by regulating activities that take place on public lands (Government of Alberta 2022b, 15). 'Crown ownership' means the land is effectively the property of the provincial government first, and any other types of ownership (private ownership by an individual, for example) are ultimately negotiated with and guaranteed by the provincial state (the crown) (Kwasniak 2007, 60-61). Crown ownership is significant to the protection of water quality because this ownership is a justification for the authority of the province to regulate activities that may harm the beds and shores of waterbodies and negatively affect water quality (Kwasniak 2007, 60-61).

Perhaps even more fundamental than ownership of lands associated with waterbodies in the province, the Water Act affirms the province as the owner of all water in Alberta (Government of Alberta 2021e, 18). Here again, ownership is a justification for provincial authority to regulate activities that may affect water quality and quantity. In addition, the Water Act aims to uphold and encourage water conservation and management, which includes distributing and using water in

a well-informed manner (Government of Alberta 2021e, 17). This Act is jointly administered by the Alberta Energy Regulator (AER) and Alberta Environment and Sustainable Resource Development (ESRD) (Alberta Energy Regulator 2014). Because of its emphasis on allocation and conservation, we will discuss the Water Act in greater detail in the policy section for the "Water Quantity" measure.

The Alberta RWQI, through the LTRN, measures water quality at twenty-eight sites across Alberta (Government of Alberta 2015a). Some sites in the TMN are sampled eight times per year, and others are sampled twelve times per year (Alberta Environment and Parks 2019b). Monitoring for both the LTRN and the TMN is conducted by AEP alongside affiliates such as other government agencies, municipalities, WPACs, university researchers, and industrial partners (Government of Alberta n.d. l). In addition to these government, academic, and professional monitoring agencies, volunteer organizations such as the Alberta Lake Management Society also play a role in provincial water monitoring (Government of Alberta n.d. l).

Finally, the Water for Life strategy "is the overarching government-wide strategy for water in Alberta," involving "conservation measures, quality controls for safe drinking water, irrigation" and "the conservation of aquatic ecosystems" (Government of Alberta 2011). The Water for Life strategy has three goals and three key directions for achieving these goals. Safe drinking water and healthy aquatic ecosystems are the two Water for Life goals that are most clearly related to water quality. These goals are to be achieved through building and maintaining Alberta's drinking water and wastewater infrastructure and through environmental planning and monitoring (Government of Alberta 2011).

What could be done?

Activities related to water quality monitoring, such as WQIs, the LTRN, and the TMN, are tools to help us understand what is happening in the environment, especially as a result of human activity. Alberta's water quality monitoring activities operate at both province-wide and regional scales and track long-term and short-term trends and changes (Government of Alberta n.d. l). When we look at Alberta's water quality monitoring system, we can see both strengths and weaknesses of the existing framework. For both the LTRN and the TMN, monitoring sites are concentrated in the southern half of the province. This is especially the case for the TMN, which has only five monitoring stations north of Edmonton (Alberta Environment and Parks 2019b).

Part of the reason for this north-south discrepancy is that monitoring, evaluation, and reporting activities within the Cold Lake, Peace, and Athabasca oil sands regions are conducted under the authority of the OSM (Government of Alberta n.d. d). The OSM is a separate program from the LTRN/TMN, and each program monitors specific sites, but all follow a similar data collection protocol as part of the Quality Assurance and Quality Control Program (Government of Alberta n.d. d). However, the existence of the OSM program does not fully account for the relative scarcity of LTRN/TMN monitoring sites in the north. While the Athabasca Watershed covers a significant area of central and northeastern Alberta, much of the northwest of the province is excluded from both OSM and LTRN/TMN monitoring (Oil Sands Monitoring Program 2019, 28; Alberta Environment and Parks 2019b).

Besides incomplete coverage, monitoring of Alberta's water quality takes place in an environment where water-intensive industries are also financially and politically powerful. Some water monitoring is carried out by industry-funded organizations like RAMP, which conducts monitoring in areas affected by oil sand development (Regional Aquatics Monitoring Program n.d. a). Industry funding does not automatically mean monitoring protocols or data will be suspect, but it does mean polluters, monitoring organizations, and pollution regulators are entangled with each other in ways that may have consequences for the perceived legitimacy of the monitors and regulators (Dore 2015).

Water-Related Advisories

Algae Advisories

Blue-green algae is formed from blooms of cyanobacteria that release the toxin microcystin, a liver toxin that can be damaging to both humans and animals (Alberta Environment and Parks 2020; Alberta Lake Management Society n.d.). Contact with blue-green algae-contaminated water can cause a range of physical reactions including skin irritation, respiratory distress, and hay fever symptoms, while consuming blue-green algae-contaminated water can cause headache, nausea, fever, and abdominal cramping (Alberta Health Services 2020).

Algae blooms can also consume dissolved oxygen in water, reducing levels of available oxygen for aquatic animals and potentially leading to wildlife mortality (Alberta WaterPortal Society 2018). Waterbodies in the Prairies tend to have higher concentrations of phosphorus as a result of fertilizer use, high numbers of cattle, and agricultural runoff, all of which contribute to the likelihood of significant algal blooms during certain times of the year (Orihel et al. 2017; Kalischuk et al. 2006, 1; Alberta WaterPortal Society 2018).

Significant blue-green algae blooms occur in warmer months and can be especially problematic in slow-moving or stagnant water (Alberta WaterPortal Society 2018). The most recent guidelines for cyanobacteria and water quality have been set by Health Canada in the document Guidelines for Canadian Recreational Water Quality: Cyanobacteria and their Toxins (2022). This guideline suggests that total microcystins is the best indicator of human health risk from cyanotoxin, and the maximum concentration for primary contact recreation (also called the health based value (HBV)) for all Canadians, including the most vulnerable, has been set al 10 µg/L total microcystins (Health Canada 2022b, 3-5).

The appearance of a blue-green algae bloom can trigger an advisory from AHS (Alberta Health Services 2020). An advisory is most likely to affect recreational activity, as people are recommended to avoid swimming and to avoid or limit the consumption of fish from water bodies under an advisory (Alberta Health Services 2020). Although municipal water treatment should render water safe for consumption, a high frequency of blue-green algae advisories may suggest significant underlying environmental problems.

Understanding Algae Advisories

Cyanobacterial growth is dependent on two major nutrients: phosphorus and nitrogen. Alberta Lakes are commonly eutrophic, meaning they are 'nutrient-rich' with excessive amounts of phosphorus and nitrogen; therefore, Alberta lakes are especially susceptible to blue-green algae blooms (Alberta Lake Management Society n.d.). This may be largely due to the prevalent agricultural industry in Alberta and the impacts of climate change.

Misuse or overuse of fertilizers and improper drainage can lead to increased runoff, which increases the phosphorus levels in bodies of water (Kalischuk et al. 2006, 1). Likewise, intensive livestock production can result in water contamination from livestock manure, increasing the amount of phosphorus and nitrogen in surface water (Kalischuk et al. 2006, 1). Blue-green algae blooms damage the environment and harm wildlife and livestock. Blooms may result in the closure of beaches, reducing human access to recreational areas. For these reasons, blue-green algae advisories, and especially a high frequency of advisories, may be a signal of reduced community health.

Agricultural Practice

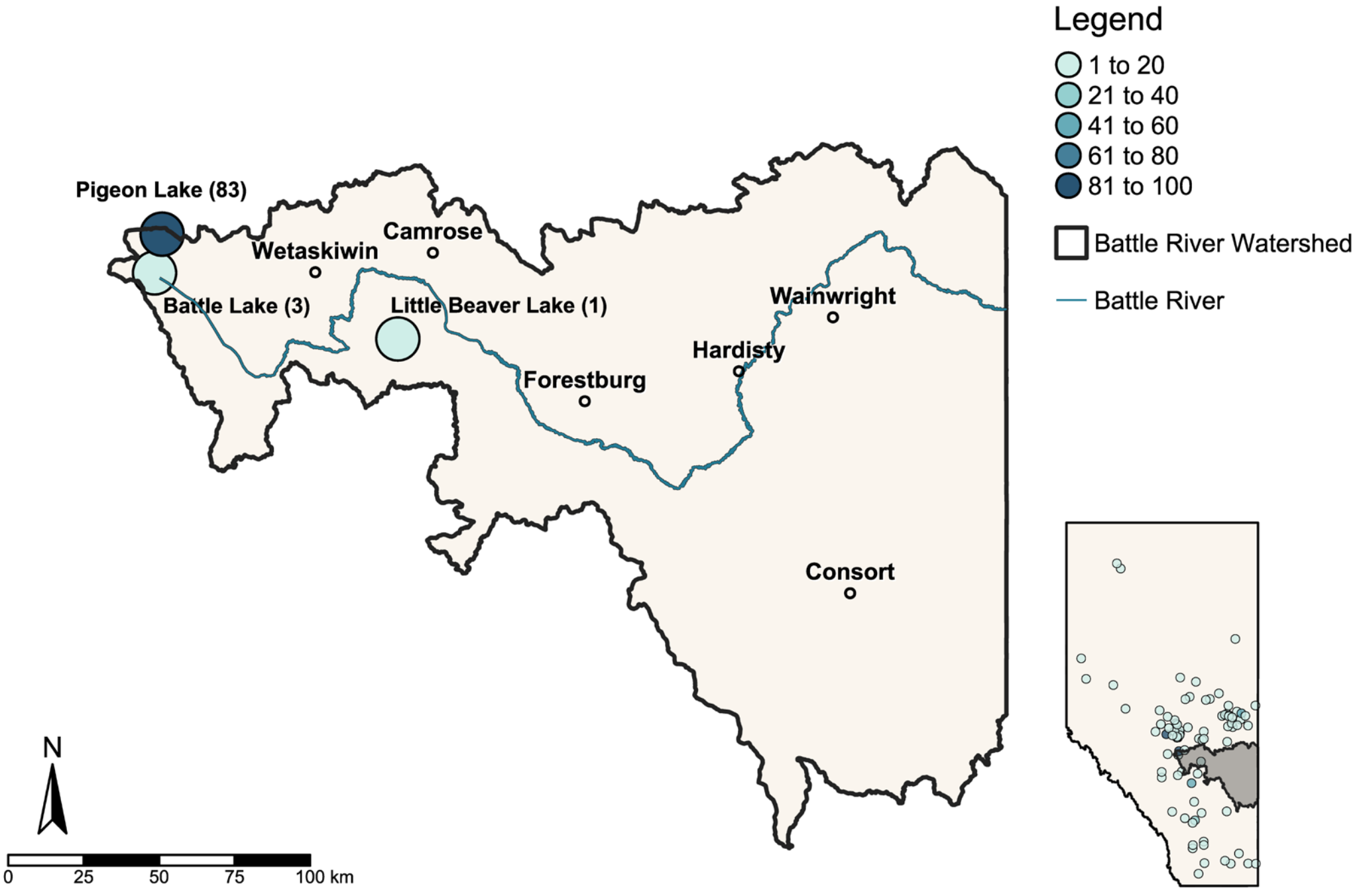
Farmers often use fertilizers and animal manure that contain nitrogen and phosphorus as these elements are essential for crop growth. Runoff of these nutrients from these fertilizers and animal manure can enter water bodies and result in the eutrophication of the rivers or lakes (Kalischuk et al. 2006, 1; Chislock et al. 2013).

Climate Change

Blue-green algae advisories are typically seen in the late spring to summer due to the warm weather allowing for the growth of the cyanobacteria (Alberta WaterPortal Society 2018). Climate change has been of growing concern for the prevalence of these toxic algal blooms (Gobler 2020).

Blue-Green Algae (Cyanobacteria) Guideline Exceedances

of cyanotoxin guideline exceedances from 2012-2021, indicated by >10 micrograms of microcystins per litre of water



Map 6.3: (Source: Alberta Health. 2021. Cyanobacterial blooms in Alberta recreational waters).

Two major ways climate change facilitates greater algae growth are through the warming of the water and through the increased levels of carbon dioxide in the air and water, which algae need to survive (Gobler 2020). Climate change also generates greater periods of rainfall, thus allowing for greater algal blooms (Wells et al. 2015, 77). Since 1950, Alberta has experienced increases in summer temperature (Hayhoe, Stoner, and ATMOS Research & Consulting 2019, 2). Projected changes in Alberta include a 5-10% increase in September to April precipitation (with 5-10% more rain than snow), as well as a 50% rise in the amount of very wet days, and a 20% increase in the recorded precipitation on the wettest day of the year (Hayhoe, Stoner, and ATMOS Research & Consulting 2019, 2).

Consequences of Blue-Green Algal Blooms

Blue-green algae poses a health risk to human beings. Contact exposure to blue-green algae blooms causes health risks such as skin irritation, sore throat and eyes, and stuffy nose (Alberta Health Services 2020). Drinking water that contains blue-green algae can also cause symptoms of diarrhea, weakness, fever, and even liver damage (Environmental Public Health and Alberta Health Services 2018). It also poses an economic risk due to the costs surrounding treatment of the water and cleaning of the water bodies, as well as the decline in the output of fish or livestock in commercial markets (Condon 2016). The toxins of some species of cyanobacteria associated with these algal blooms are toxic to livestock (Alberta Lake Management Society n.d.).

Fecal Coliform and *E. coli* Advisories

Fecal coliform bacteria are naturally found within the digestive tracts of birds and mammals and are a division of a larger family of bacteria known simply as coliforms (Rodrigues and Cunha 2017, 4). While many coliforms are not harmful, some pose a risk to the health of humans and other animals (Rodrigues and Cunha 2017). For this reason, environmental agencies and public health services monitor coliform bacteria levels.

To test for fecal contamination in water, several steps have to be taken. First, a test can be conducted which will show the total number of coliform bacteria present in the water. In residential-scale systems, there should be no coliforms, but if there are total coliform bacteria in a sample, the water must be reanalyzed or retested immediately (Health Canada 2020, 5).

If coliforms are found, the positive test site is to be retested to confirm the presence of coliforms. The test also looks to find the presence of fecal coliforms, mainly *E. coli* (Health Canada 2020, 5).

If total coliforms or *E. coli* are confirmed to be present, further action must be taken. The response can vary between jurisdictions, but oftentimes a boil water advisory is issued, and the source of contamination must be investigated (Health Canada 2020, 5-6). Furthermore, corrective actions, such as increasing disinfectant dosages, will be taken to ensure that the water supply is no longer contaminated (Health Canada 2020, 6).

Besides the presence of *E. coli*, contamination of water with fecal matter also increases the risk the water will contain other harmful microorganisms such as *Salmonella*, *Giardia*, and *Cryptosporidium* (Pandey et al. 2014). Frequent occurrence of fecal coliform and *E. coli* advisories could be indicative of a larger problem within the community, such as improper sanitation, poor containment and treatment of fecal matter, or improper disposal of fecal matter.

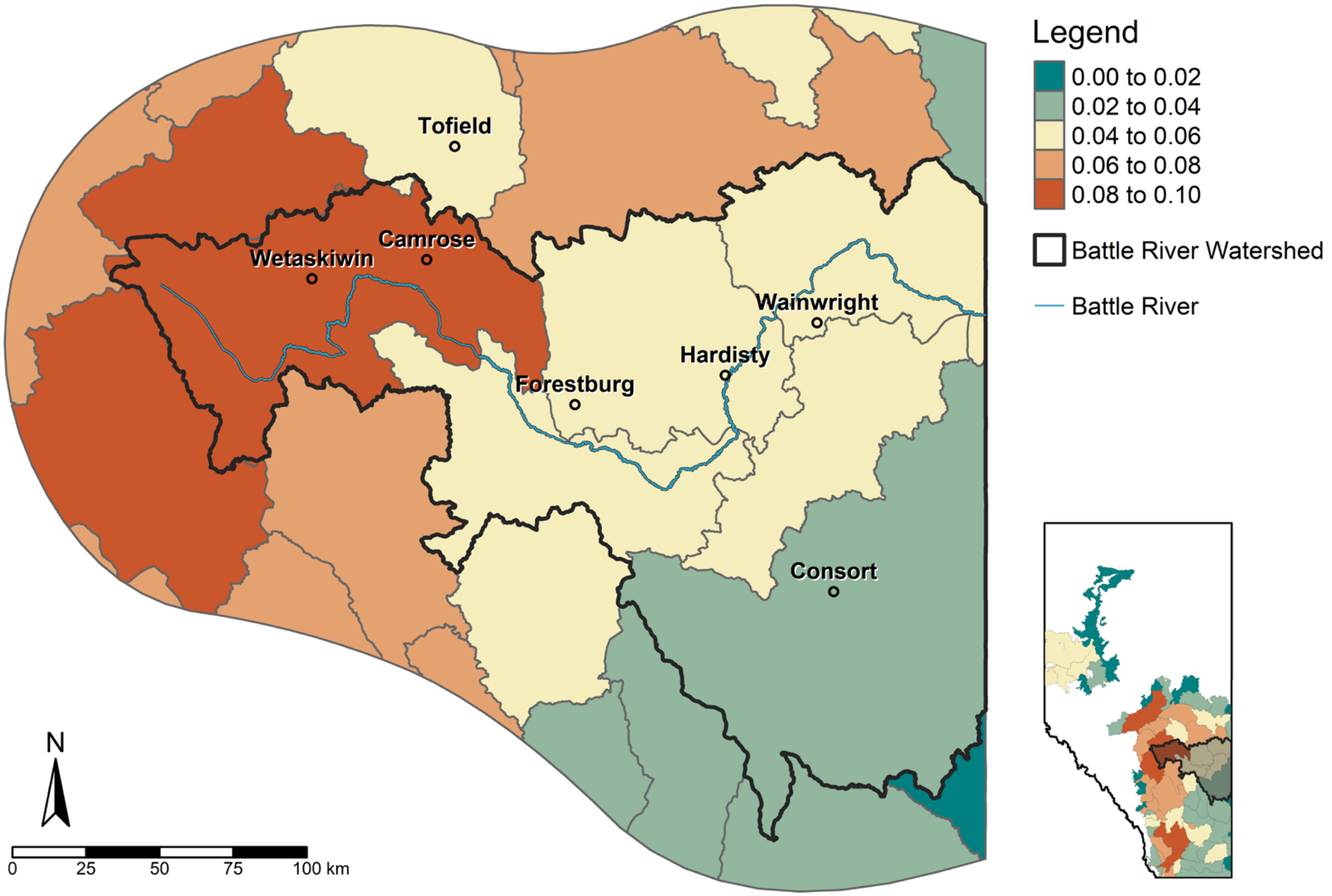
Such contamination poses a significant health risk to water users and may indicate significant underlying ecological problems. Fecal coliform and *E. coli* advisories, while necessary to protect human health, may damage the reputation of a community, which can negatively impact sense of belonging and community pride. Such impacts on community health may be especially relevant in cases of long-term water advisories, and, in these cases, longstanding water advisories may also indicate structural inequalities in access to reliable public infrastructure.

Understanding Fecal Coliform and *E. coli* Advisories

One significant example of *E. coli* contamination comes from the water supply in the rural town of Walkerton, Ontario. This crisis

Risk of Water Contamination by Coliforms from Agriculture

Relative risk of surface water contamination by pathogens from manure such as viruses, bacteria and protozoa



Map 6.4: (Source: Agriculture and Agri-food Canada. 2011. Agri-Environmental Indicator (AEI) - Risk of Water Contamination by Coliforms (IROWC-Coliforms) (ENV_AEI_WTR_CNTMN_RSK)).

is cited as Canada's largest outbreak of *E. coli* disease, with tragic deaths and major illnesses that ensued (Salvadori et al. 2009, S33). With Walkerton being an agricultural area, heavy rainfall resulted in surface runoff which entered a well that supplied drinking water to the community (Salvadori et al. 2009, S33). Agricultural runoff can be contaminated with *E. coli* bacteria from the manure of the livestock (Salvadori et al. 2009, S33).

The Walkerton case is important to highlight as it demonstrates how agricultural areas can pose a risk for bacterial contamination in the water runoff. Agricultural areas are typically at a greater risk for coliform contamination and, from 1981 to 2016, the level of risk in parts of Alberta has slightly increased due to greater animal livestock production, ultimately resulting in growing manure volumes (Agriculture and Agri-Food Canada 2022). The risk is also greater during 'wet' years of heavy snowmelt or rainfall, as this increases runoff volumes and transports the coliforms to surface waters (Agriculture and Agri-Food Canada 2022).

Statistics Canada reported that in 2019, 7% of Albertans relied on water from a private well as their primary source of water (Statistics Canada 2021). The Government of Alberta initiated the Water Act and Regulations to ensure that well owners are monitoring and maintaining the quality of water from their well, which involves testing water samples for bacterial contaminants like coliforms and *E. coli*. Private wells pose a 5 times greater risk of testing positive for *E. coli* contamination than a public well (Invik et al. 2017, 734). A study on private water well stewardship practices found that only 10.7% of respondents (in a sample of 1,014) test their water quality yearly, and only 29% claim they shock chlorinate their well (maintenance procedure to kill bacteria) at minimum once every two years (Caffrey et al. 2020, 188).

Boil Water Advisories in Alberta First Nations Communities (2022)

First Nation	Community	Population	Water System	Date of Advisory
Dene Tha'	Bushe	0 -100 People	Bushe Food And Gas Semi-Public Water System	2022-07-17
Dene Tha'	Bushe	0 -100 People	Four Chief Complex Semi-Public Water System	2022-07-17
Little Red River Cree Nation - Fox Lake	Fox Lake	501-1000 people	Fox Lake Public Water System	2022-05-05
Stoney - Morley	Stoney - Morley	0 -100 People	Morley-Bearspaw Riding Arena Semi-Public Water System	2022-06-29

Table 6.1: First Nations communities under boil water advisory as of August 2022 (Source: Extracted from the Government of Canada Short-term Drinking Water Advisories web site at https://wateroffice.ec.gc.ca/mainmenu/real_time_data_index_e.html).

Drinking Water Advisories

At the most basic level, safe drinking water is essential for human health. Contaminated water has effects on the broader environment and on economic activities that require water. In the watersheds of Alberta, one of the most significant sources of potential water contamination is agriculture, through fertilizer and pesticide runoff from crops and through a variety of possible pollutants from livestock (Alberta WaterPortal Society 2017). Excess nutrients from fertilizers (nitrogen and phosphorus) can lead to algal blooms in surface water resulting in temporary water toxicity, while cattle can introduce fecal coliform bacteria, *E. coli*, *Cryptosporidium*, *Giardia*, and other pathogens into surface water which can infiltrate into ground water

(Alberta WaterPortal Society 2018; Alberta Environment and Parks 2019a, 29-32). These potential contaminants to the water system must be measured and regulated in order to ensure human health and ecosystem health.

Drinking water advisories, or boil water advisories, may be issued for a number of reasons. If drinking water is found to contain a waterborne illness or is suspected to be the cause of an illness, an advisory will be issued (Health Canada 2015, 2). An advisory will also be issued if microbes like *E. coli* or *Giardia* parasites are found in the drinking water (Health Canada 2015, 4; Health Canada 2019).

Advisories may also be issued after water infrastructure maintenance or if there has been damage to water infrastructure. An advisory may even be issued if water is too cloudy at the source. During a boil water advisory, all water should be boiled before ingestion of any kind, be it for drinking, brushing teeth, or washing fruits and vegetables (Environmental Public Health and Alberta Health Services 2022). These warnings are issued on the provincial, territorial, or local level and apply to all the constituents in the prescribed area. Although necessary to protect human health, a boil water advisory can have detrimental effects within a community, including lowered mental and physical health, and restrictions on businesses leading to decreased economic activity (Lucier et al. 2020, 9-10; Health Canada 2015, 5).

Understanding Drinking Water Advisories

Water advisories may arise from the impacts of natural events (droughts, flooding, etc.), anthropogenic causes (agriculture, industrial practices, recreational, etc.), or aging infrastructure of water treatment facilities (Chief Public Health Officer of Canada 2013).

As of August 2022, there are just over 1,000 water advisories in Canada with 16 of those advisories located in Alberta (Water Today 2022). There are 3 types of water advisories defined by the Government of Canada:

- Boil water advisories: issued when there are problems with the water treatment system, and when there is the presence of disease-causing viruses, bacteria, or parasites. This advisory instructs users to boil their tap water for approximately one minute before drinking or using the water for other purposes, such as cooking,
- Do not consume advisories: issued when the water system contains contaminants (such as lead) that cannot be removed through boiling the water. This advisory instructs users to not use their tap water for drinking or cooking until the advisory has been lifted, and
- Do not use advisories: issued when the water poses a serious health risk, the water contains pollutants that cannot be removed by boiling, and when the water could irritate the skin or eyes for reasons such as a chemical spill. This advisory instructs users to not use their tap water for any purpose until the advisory has been lifted (Indigenous Services Canada 2021).

Waterborne Infections

The following is a non-exhaustive list of known cases of waterborne pathogens in Canada, sourced from untreated drinking water and contact with contaminated water (Chief Public Health Officer of Canada 2013):

- *Campylobacter*: bacterium that attacks the digestive system. Symptoms include diarrhea, abdominal pain, and fever,
- *Giardia*: parasite that causes diarrhea, and may result in arthritis after prolonged infection,
- *Shigella*: group of bacteria, characterized by diarrhea, stomach cramps, fever, and may result in death in severe cases,
- *E. coli*: bacterium that impacts the digestive system, characterized by diarrhea, severe stomach cramps, vomiting, and a fever (Chief Public Health Officer of Canada 2013).

Populations at Risk

Access to clean drinking water is a human right, however, First Nations communities in Canada have a disproportionately large barrier in accessing clean drinking water. As of July 2022, there were 31 long-term drinking water advisories in 27 First Nations reserves across Canada (Indigenous Services Canada 2022). Boil water advisories are 2.5 times more frequent for First Nations community systems, and 30% of First Nations

communities in Canada are classified as high-risk systems (Patrick 2011, 386). First Nations communities are also 26 times higher than the Canadian average in cases of water-borne infections (Galway 2016, 1).

Policy Responses to Water-Related Advisories

Water advisories are part of Alberta's water quality and water protection strategy. Water advisories reduce the likelihood of detrimental human health consequences at the point of consumption after contamination to source water has been detected or is suspected. Although it will typically be Health Canada, AHS, a municipality, or First Nations community that will issue a water advisory, the data that inform these advisories can come from several different sources. Information about water quality, including contamination, is collected by Alberta's water monitoring program and shared with relevant stakeholders, including AHS and AEP (Government of Alberta 2015b). Both agencies share information about water quality, including water advisories, with the general public (Alberta Health Services n.d.; Alberta Parks n.d.). Municipalities are required under the EPEA to test their own water supplies regularly (National Collaborating Centre for Environmental Health 2014, 13-14). AHS also operates an Environmental Public Health program which allows individuals and municipalities to submit water samples for testing (Alberta Health Services 2022).

An advisory is usually intended as a temporary measure while the relevant authorities work to eliminate the source of contamination or perform maintenance on the water system (Indigenous Services Canada 2021). However, water contamination can be a complex issue. Contamination can result from natural causes, broken infrastructure, poor or inadequate water treatment, and as a byproduct of everyday economic activity (Indigenous Services Canada 2021; Environment and Climate Change Canada 2018, 5).

For some communities, and particularly for Indigenous communities in Canada, water contamination is a chronic problem that is also rooted in the legacy of colonialism, lack of political power, resource exploitation, and geographic remoteness (Patrick 2011, 387). Water contamination extends beyond human consumption of water into the environment, with consequences for the health of wildlife and vegetation, and potentially limiting effects on future economic activity (Sanseverino 2016, 11, 22).

What is being measured?

The Guidelines for Canadian Drinking Water Quality are part of Canada's Multi-Barrier Approach to Safe Drinking Water (Health Canada 2018). These guidelines are prepared by Health Canada in collaboration with the Federal-Provincial-Territorial Committee on Drinking Water (Health Canada 2022a). The guidelines identify potential water contaminants and impairments to water quality shaped by current, published scientific research which is relevant to aesthetic and health effects, along with operational considerations (Health Canada 2022a).

According to Health Canada (2022a), health-based guidelines are established on the basis of a comprehensive review of the correlated health effects from every contaminant, exposure levels, and the accessibility of analytical technologies and treatment. Aesthetic effects, such as taste and odour, are considered when these influence the determination of whether the water is considered to be drinkable by the consumers (Health Canada 2022a). Operational considerations are taken into account when a present substance can interfere with a treatment process or technology, such as UV disinfection, or if it can negatively impact drinking water infrastructure, such as the corrosion of pipes (Health Canada 2022a).

In order to be included on the Guidelines for Canadian Drinking Water Quality, potential contaminants must meet the following conditions:

- Negative health impacts to humans can be caused by exposure to the contaminant,
- The contaminant can either be frequently found or likely to be found in a large amount of drinking water supplies in Canada, and
- The contaminant is either found or can be expected to be found at a high enough level that could have significant effects on human health (Health Canada 2022a).

What is being done?

Source water protection is important in preventing contamination of water at the earliest possible stage of water usage. Source water protection is a key part of the BRWA's watershed management planning. As one of the 11 Alberta WPACs, the BRWA is responsible for regional coordination and stakeholder engagement in watershed planning. The BRWA's management planning includes accounting both for point source and non-point source contamination, as well as understanding how the natural characteristics of the watershed, such as soil type and topography, will affect contaminant transport and infiltration (Battle River Watershed Alliance 2013).

Provincial and federal authorities such as AHS and Health Canada issue drinking water advisories, but the primary responsibility for the detection of contaminants in water, that may lead to a drinking water advisory, rests with local and regional authorities. These local and regional authorities also work to develop stakeholder buy-in and compliance with measures designed to limit or prevent water contamination, such as policies excluding cattle from riparian areas or oil and gas well maintenance.

Non-point source pollution, because it does not come from a single monitored source, can be more difficult to monitor. The difficulty in monitoring non-point source pollution leads to a set of challenges for proactive action on controlling contamination. A 2013 policy report from the BRWA on how to manage non-point source pollution emphasized a non-regulatory approach. Instead, they focused on education and awareness of non-point source pollution and the benefits of avoiding it, while making people aware of federal and provincial programs to help rural landowners and stakeholders (Battle River Watershed Alliance 2013).

A number of stakeholders are involved in these non-regulatory approaches, including counties, municipal districts, and agricultural producers. Rural municipalities have additional tools for controlling water pollution, including regulator means, such as Watershed Protection Areas, Municipal Development Plans, and Land Use Bylaws. Non-governmental organizations including Cows and Fish, Ducks Unlimited Canada, the Nature Conservancy of Canada, the Alberta Conservation Association, and regional Land Trust groups also play important roles in managing non-point source pollution through their work with landowners to promote beneficial land-use practices and through wetland conservation and restoration projects and other land management programs (Battle River Watershed Alliance 2013).

In terms of province-led water quality management, Alberta's Water for Life strategy employs a Source to Tap, Multi-Barrier Approach to drinking water safety (Dore 2015). The policy components of this approach are grouped under legislation, drinking water systems, knowledge and awareness, performance assurance, and source water protection. Under the EPEA, all "specified water and wastewater facilities in Alberta have certified operators to supervise and/or carry out day-to-day operations" (Government of Alberta n.d. k). Under the source water protection component of the approach, all WPACs must develop specific water management plans for individual water basins, although as of 2015 not all of these plans had been completed (Dore 2015).

Source water protection includes water sampling and testing. AEP requires drinking water treatment facilities to submit annual and monthly reports containing water testing and quality data (Government of Alberta n.d. a). Besides the standards set by AEP, individual public-approved water systems also have their own posted standards for testing which follow the best practices set by the Guidelines for Canadian Drinking Water Quality. Additionally, they follow the water quality and emergency response framework set by the Communication and Action Protocol for Failed Bacteriological Results in Drinking Water (Dore 2015).

Drinking Water Safety Plans are a more recent policy tool to be adopted by AEP (Government of Alberta n.d. c). They are endorsed by the WHO as a mechanism to move water providers from being reactive to being proactive in risk adaptation (Dore 2015). In Alberta, Drinking Water Safety Plans are authorized under the Standards and Guidelines for Municipal Waterworks, and Wastewater and Storm Drainage Systems (Government of Alberta 2021d). According to AEP, these plans "are meant to complement

and enhance drinking water quality standards and procedures" and "do not replace the Guidelines for Canadian Drinking Water Quality or the drinking water monitoring and reporting requirements under the Environmental Protection and Enhancement Act" (Government of Alberta n.d. c).

What could be done?

Alberta's economic base puts water at risk in particular ways, the most prominent of which are contamination from a large agricultural sector and a result of extensive oil and gas development. Policy tools that regulate agricultural and industrial activity with respect to water contamination are important for protecting source water, as are tools that measure water quality. These tools include Drinking Water Safety Plans, Municipal Development Plans, and land-use bylaws. Such tools can be developed and put into practice by municipalities with help from organizations such as WPACs and non-governmental conservation groups.

In the BRW, agriculture can be a source of contamination to both surface and groundwater through pesticide and fertilizer runoff and through pathogens introduced from cattle. While legislation like the Water Act sets standards for water use, including specifying licensing requirements and outlining requirements for well construction, preventing water contamination also comes down to land-use practices. Some tools for land-use practices that prevent water contamination are found in manuals of best management practices, such as the Environmental Manual for Alberta Cow/Calf Producers. This manual includes specific information that will help agricultural producers make choices about water management that will both support the health of their livestock and protect local riparian areas, surface water, and groundwater, including information about how to locate and construct a well or dugout, and reasons why maintaining the health of local water bodies is important (Alberta Beef Producers, and Alberta Agriculture, Food and Rural Development 2004). As mentioned in Chapter 5, organizations like Cows and Fish also have specific mandates to help agricultural producers make these kinds of management decisions about their operations and implement environmentally beneficial practices.

Regulations and practices both play important roles in water safety and the prevention of contamination for human communities as well. Effective regulation around water system maintenance and water system operations is key to protecting drinking water at the municipal level and in rural areas where there may not be a municipal water system (Government of Alberta n.d. k). Other efforts to improve water safety should focus on those regions and communities subject to more-or-less chronic boil water advisories.

There is a significant gap in water safety between Indigenous and non-Indigenous communities in Alberta and in other parts of Canada. Across Canada, Indigenous communities are under boil water advisories 2.5 times more often than non-Indigenous communities, and waterborne infections are 26 times higher among Indigenous peoples than the national average (Spence and Walters 2012). Addressing drinking water safety in Indigenous communities will ultimately involve some kind of collaboration between First Nations people, federal, provincial, and regional authorities.

Although the province does consult with Indigenous communities about many issues including water safety and sustainability, it is the federal government, and not the provincial government, that is ultimately accountable for Indigenous communities. This can create gaps in governance between Indigenous and non-Indigenous people in Alberta and in other provinces (Lavoie 2013). In British Columbia, the First Nations Health Authority (FNHA) was created in 2013 as a province-wide, tripartite (provincial, federal, and First Nations) authority for Indigenous health (Government of Canada 2021). The FNHA provides a few services that are specifically related to water, including a regular bulletin on current drinking water advisories, and a Drinking Water Safety Program (First Nations Health Authority n.d. b). The Drinking Water Safety Program aims to improve access to safe and reliable drinking water by providing guidance, training, and technical expertise to Indigenous communities about water system infrastructure and maintenance, water quality monitoring and testing, and water safety measures (First

Nations Health Authority n.d. a). An Alberta-based organization like the FNHA, with programs like the Drinking Water Safety Program, might help to bring governance of Indigenous health closer to Indigenous communities. Such an organization might also allow possibilities for collaboration with regionally-focused organizations like Alberta's WPACs.

Given the water-intensive nature of the energy and agriculture sectors of Alberta's economy and the routine fact that infrastructure is subject to periodic shutdowns and occasional failures, drinking water contamination and water advisories will remain a feature of water management in Alberta. However, strategies involving source protection, improved treatment, and proactive management will, if successful, help to prevent avoidable water contamination and thereby reduce the need for water advisories.

Water Quantity

Water Usage

For the Battle River Watershed, and for communities across Alberta, water usage is an important indicator in measuring economic, ecological, and community health. In a typical year, since the 1960s, around half of the water allocated for use in Alberta (measured in billions of cubic meters (m^3)) will be used for agriculture. Other significant uses of water include industrial use (for example, in the oil and gas industry), commercial use (for example, in hotels, restaurants, office buildings, and hospitals), and municipal use (Alberta WaterPortal Society 2013c).

Many kinds of water usage in Alberta require a license. Licensing entitles the holder of the license to divert and use a certain volume of water for specific purposes over the course of a specified period of time. The volume of water a license holder is allowed to use under the terms of their license is called an allocation. Allocations are made based on estimates on the total amount of water that is available for use in a province in a given year. In 2020, nearly 7% (9.8 billion m^3) of the total estimated amount of non-saline water available in the province was allocated for use. About 13% of this total amount (1.24 billion m^3) was allocated for use in the oil and gas industry. According to the AER, the energy industry ultimately used about 26% (just over 320 million m^3) of their allocation (Alberta Energy Regulator 2021a).

While a water license holder may not always use the full amount of their allocation, perhaps giving the impression that water supplies in Alberta are underutilized and abundant, there are reasons to be concerned about water usage in the province. Licensed use of water does not give us the full picture of water usage in Alberta since there is also some water usage that is not subject to licensing. In addition, much of the available water is not actually available for human use since it is in use in the environment in other ways (for example, a habitat, and a source of necessary water for plants and animals).

Some areas of the province are also more subject to limits on water availability than others. The Battle River, for example, is a prairie-fed river, meaning that flow and availability are dependent on precipitation from year to year. The Battle River Watershed has experienced situations where there is a high threat to water availability, meaning that more than 40% of the available water in rivers was withdrawn for human use (Government of Canada 2017b).

For all communities in Canada, a safe and reliable freshwater supply is essential to "maintaining human, plant and animal populations; supporting economic development; and preserving healthy lakes and rivers" (Government of Canada 2017b). Stewarding a safe and reliable freshwater supply may

be especially important to communities, like those in the BRW, where freshwater supplies are subject to environmental and economic pressures.

Understanding Water Usage

In the BRW, water is used for many purposes. The most significant water draws are for municipal, industrial, agricultural, commercial, and water management purposes (Maps 6.5 and 6.6). In 2010, about 750 million m^3 of surface water was allocated for these purposes and just over 1.5 million m^3 of groundwater were allocated for use in municipal, agricultural, industrial, or commercial purposes (Battle River Watershed Association, 2011).

Water Flow and Availability

Water flow and availability is an important indicator of surface water availability and general river health. We know river water flow is seasonally variable, generally following changes in temperature, rainfall, and snowfall throughout the year. Environment and Climate Change Canada (ECCC) measures the water quantity in rivers by measuring water flow, as water flow responds to changes in the environment such as rainfall, snowfall, and temperature (Government of Canada 2022b). While flow and availability data are useful in a variety of contexts, they are especially important in planning for periods of abnormal flow and availability such as drought or flooding.

ECCC tracks a number of environmental sustainability indicators, including indicators related to national, regional, and local water quantity in Canadian rivers. Across the country, a network of 76 monitoring stations located on selected rivers in 23 of Canada's 25 drainage regions records data on water levels on a yearly and seasonal basis. A 2020 report from ECCC suggests that at the national level, between 2001 and 2017, most Canadian rivers had normal water quantities. In addition, since 2001 the number of monitoring sites showing lower-than-normal availability has declined, with only 6% of stations showing lower-than-normal quantity in 2017, and since 2010 the number of monitoring sites showing higher-than-average water quantity has increased, with 26% of stations showing higher-than-normal water quantity in 2017 (Environment and Climate Change Canada 2020).

At the regional level, the picture of water availability is similar. ECCC groups its monitoring sites within regional drainage areas, with 23 of the 25 Canadian drainage areas represented in the collected data. In 2017, of the 23 drainage regions, 16 measured normal, while higher flows were seen in 7. These regions included southern Quebec, along the Ontario border, northern Ontario, along the Hudson Bay, across the middle Prairies, and northern B.C. (Environment and Climate Change Canada 2020).

At the most local level, there is more variability. In 2017, an analysis of the data found at each of the 766 monitoring stations showed water quantity was more likely to be higher-than-normal at monitoring stations in northern British Columbia, Yukon, central Alberta, Saskatchewan, Manitoba, and southern Ontario. Lower-than-normal water quantity was seen more frequently at monitoring stations in southern British Columbia, southern Alberta, and New Brunswick (Environment and Climate Change Canada 2020). In the BRW, by comparison, water quantity data taken at the monitoring station on the Battle River near the Saskatchewan border showed normal water flow for 2017 (Government of Canada 2022a).

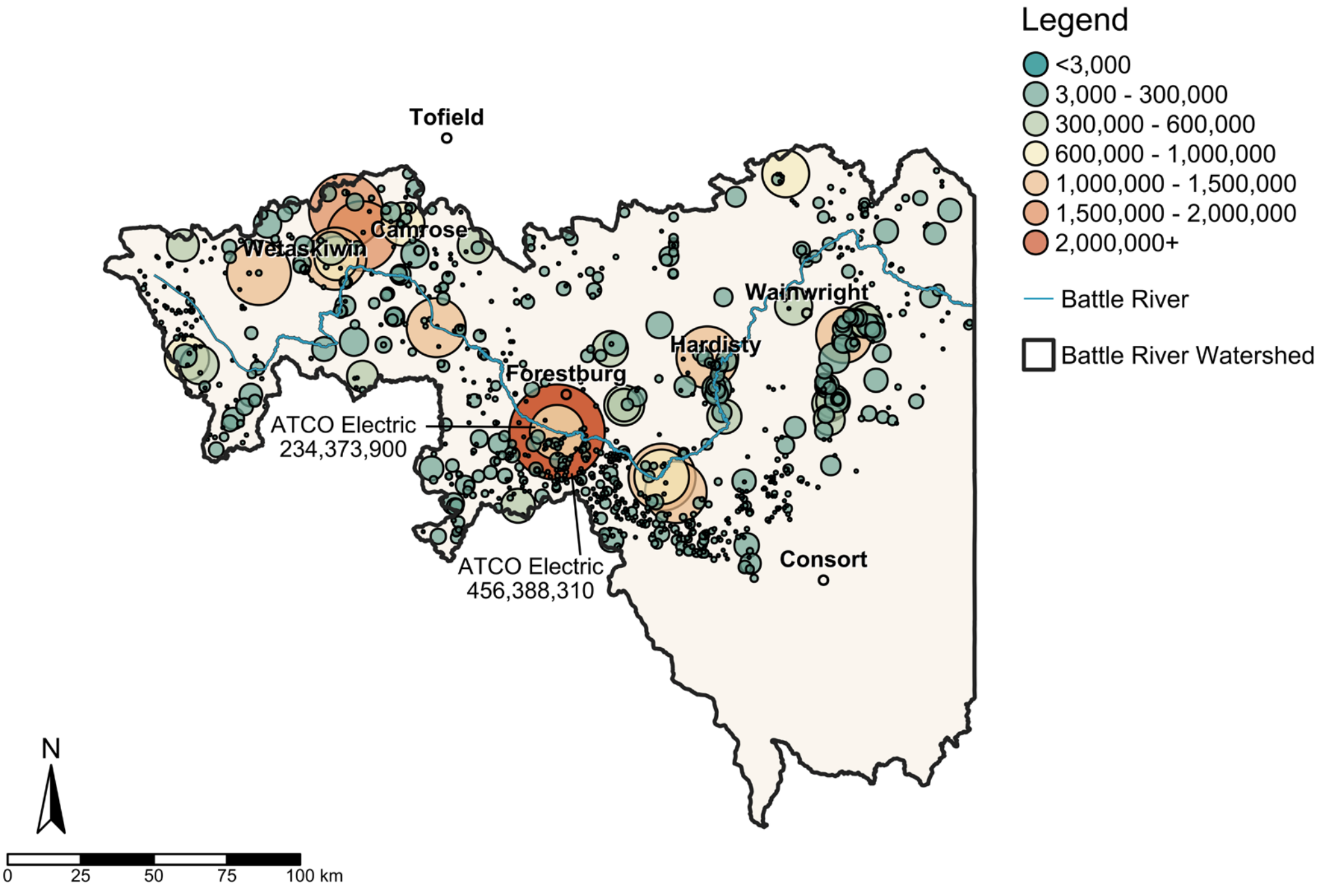
Policy Responses to Water Quantity

In Alberta, we measure water quantity for several important reasons, two of which are (1) the overall availability of water in the province, and (2) the water needs of the Alberta economy. Two of Alberta's major land-use activities, agriculture and the oil and gas industry, require a lot of water, and Alberta has only about 2.2% of Canada's freshwater reserves (Alberta WaterPortal Society 2012). Both agriculture and oil and gas need predictable amounts of water in the right place at the right time in order to carry out their operations and be profitable. Knowing about water flow and availability helps water managers and water users to plan for variable levels of water availability.

Alberta is a province of climactic extremes and significant differences in water availability: some parts of Alberta have a very dry climate, some are subject to periodic drought,

Surface Water Usage by Volume (2009)

Total maximum allowable diversions of water by industry in cubic meters



Map 6.5: (Source: Battle River Watershed Alliance).

and some are also subject to flooding. Water flow and availability in a given river are connected to the water source for that river. Most of Alberta's major rivers have their source in glaciers and mountain snowpacks. The Battle River, however, is what is known as a prairie-fed river, meaning its water supply is entirely from local rain and snow runoff. Depending on rainfall and snowpack, the Battle River's flow varies from year to year (Figure 6.5), with potential effects on surface water availability in the BRW (Battle River Watershed Alliance n.d. a). Measuring water quantity in the BRW, and elsewhere in Alberta, is thus also connected to controlling water and ensuring that there is neither too much water where it could do damage, nor too little water where it is needed.

Water management, planning, and legislation in Alberta do not focus simply on allocating water to water users, but also on conserving and protecting the water supply (Alberta Environment 2000). Water governance in Alberta happens at the personal (or household), municipal, regional, and provincial levels.

At the provincial level, as mentioned earlier, all water in Alberta "is owned by the crown and managed by the province, regardless of whether it occurs on public or private land" (Alberta WaterPortal Society 2012). At the regional level, Alberta has 7 major watersheds which are associated with the Regional land-use plans (RLUPs), 11 WPACs, and 13 Irrigation Districts (Alberta WaterPortal Society 2012). These organizations and planning districts are authorized and required by their respective governing legislation to carry out activities related to the management of water usage, including developing Integrated Watershed Management Plans (IWMP) (a responsibility of the WPACs) and monitoring the operation and financial performance of the irrigation districts (a responsibility the Irrigation Council, a body established by the Irrigation Districts Act) (Government of Alberta n.d. f; Government of Alberta n.d. n).

In terms of legislation, the Water Act specifies three types of water use: (1) household use, (2) licensable use, and (3) traditional agriculture use (Government of Alberta n.d. b). Household users are Albertans who do not receive water from a licensed or municipal supply, and instead get their water from a nearby water body or ground water. These household users are allocated up to 1,250 m^3 of water per year, to be used for sanitation, consumption, and other household needs (Government of Alberta n.d. b). Traditional agriculture use applies to agricultural water users who used water prior to January 1, 1999 (Government of Alberta n.d. j). Licensed use applies to all water users other than household users, traditional agriculture users, or "where use is exempt under the Water (Ministerial) Regulation, for example the diversion of water for firefighting" (Government of Alberta n.d. b).

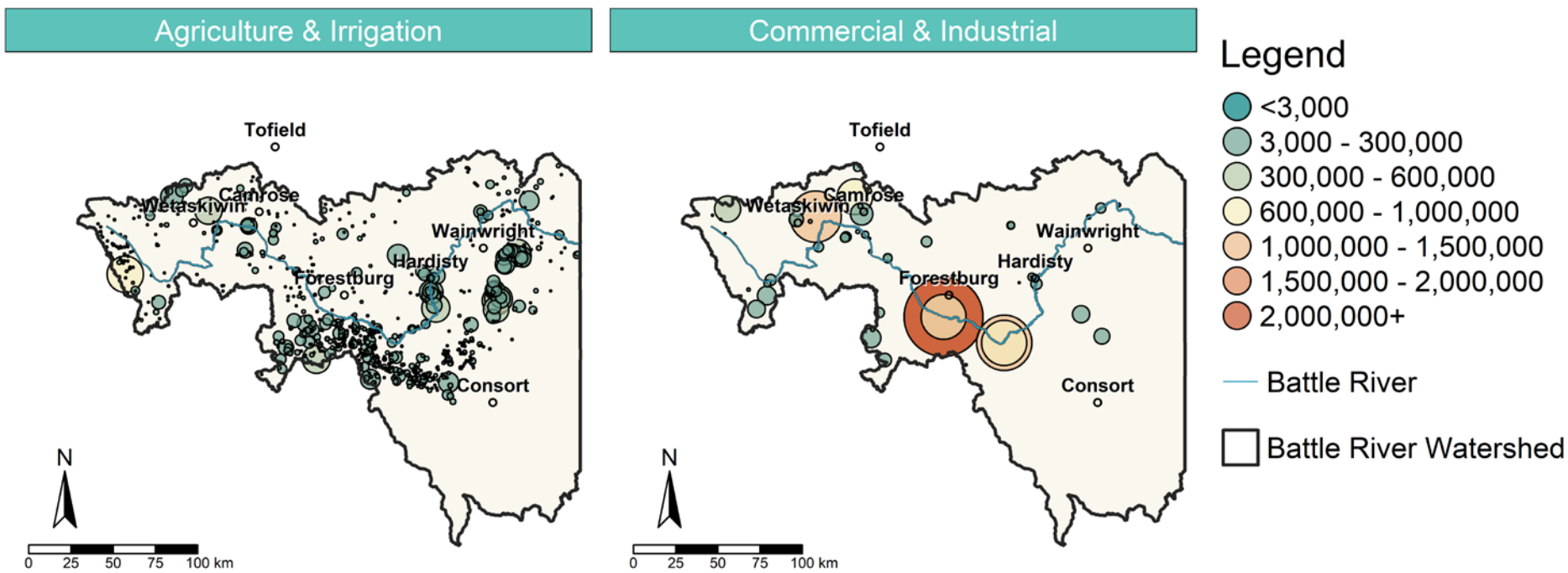
The number and types of licenses affect water flow and availability in a variety of ways (Maps 6.7 and 6.8). Water license holders do not always use all of their allocated water in a given year, but Alberta's water license system has also over-allocated water in certain areas (Ali and Klein 2014). This over-allocation means that if water license holders in a specific area were to use all of their allocated water, the water source for that area could be severely overdrawn. Having accurate information about water usage in relation to water licensing is an important tool for managing the allocation of water and reducing the likelihood of overdrawing water supplies.

How have governments responded?

Monitoring water quantity involves gathering data about and regulating water use. As we mentioned in the previous section, the Water Act identifies household use, licensable use, traditional agriculture use, and exempt use. The most diverse form is licensable use. Licensable refers to the requirement of obtaining a license in order to access and use either surface or ground water. A license "identifies the water source; location of the diversion site; volume; rate and timing of water to be diverted; priority of the 'water right' established by the license; and any conditions the diversion must adhere to" (Government of Alberta n.d. i). A license specifies the right to divert and use water, while an allocation refers to the amount of water specified by a license, and the total amount of water under licensable use in a given period. A water allocation can be for either surface water (surface water usage licenses) or groundwater (groundwater usage licenses) (Alberta WaterPortal Society 2013a).

Surface Water Usage by Industry by Volume (2009)

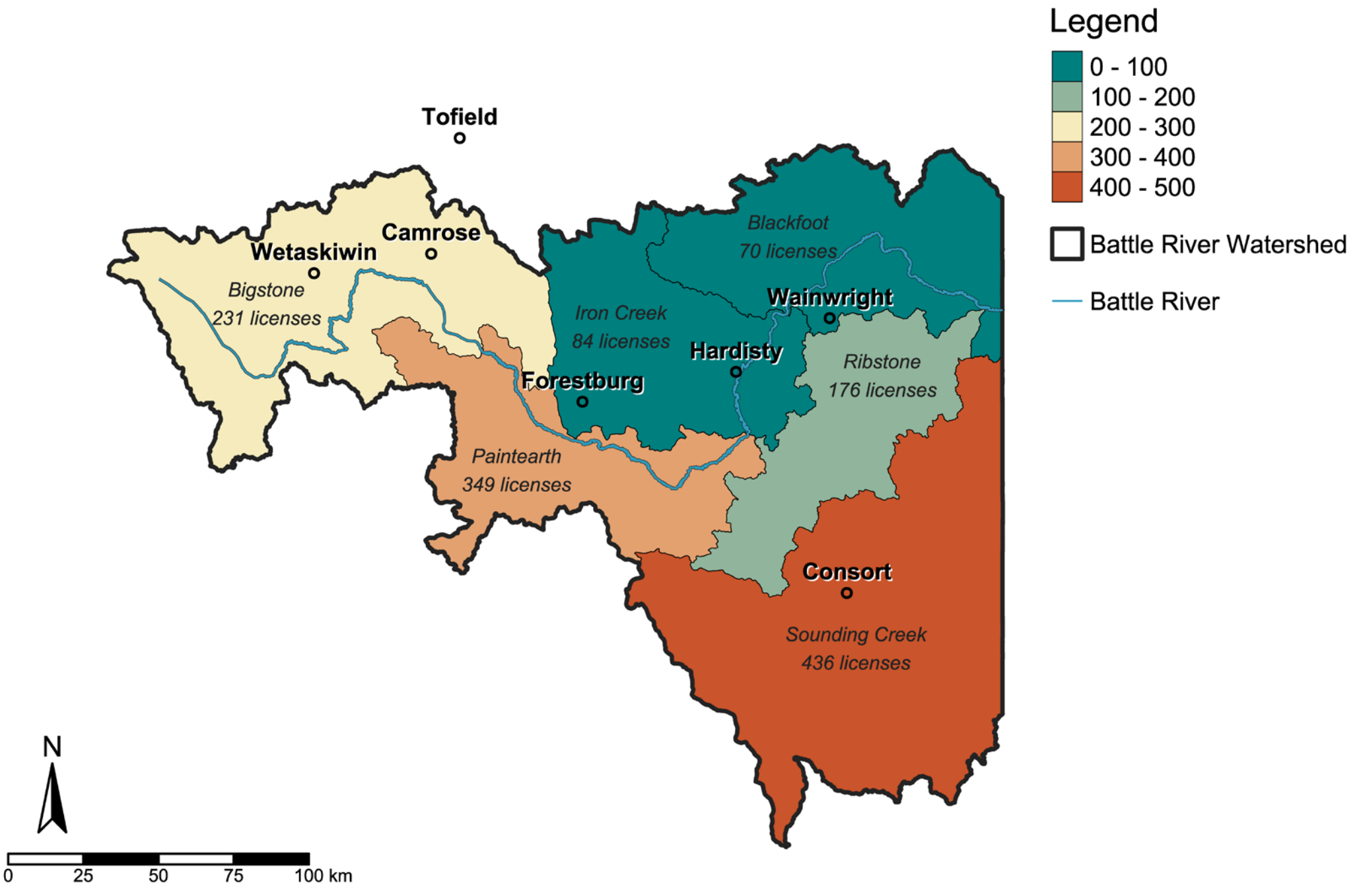
Total maximum allowable diversions of water by industry in cubic meters



Map 6.6: 'Environmental Management' includes habitat enhancement, water management, and management of fish/wildlife; 'Other' includes recreation, dewatering, and disturbance (Source: Battle River Watershed Alliance).

Surface Water Usage by Number of Licenses (2011)

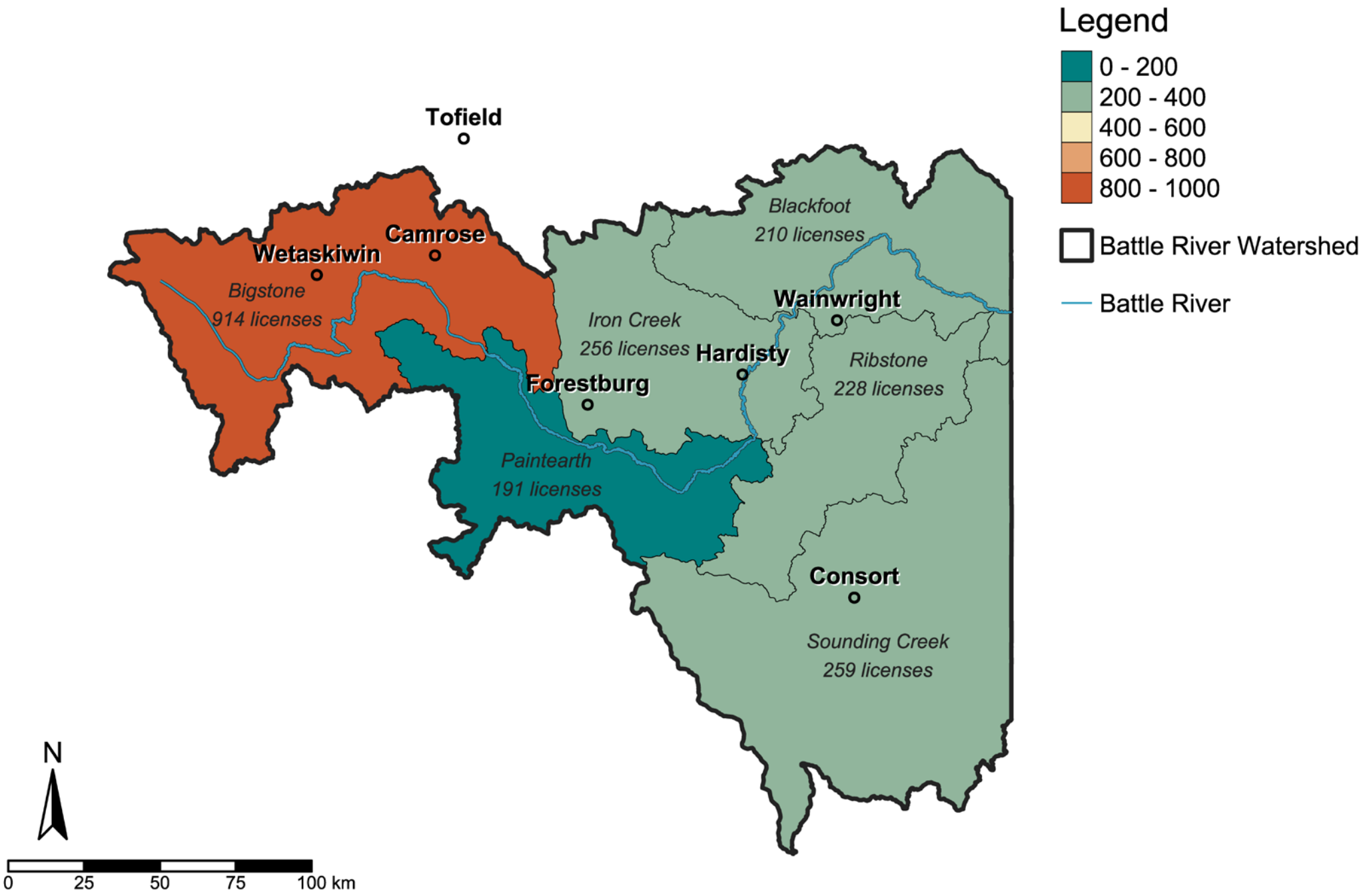
of surface water licenses allocated



Map 6.7: (Source: Battle River Watershed Alliance).

Groundwater Usage (2011)

of water licenses



Map 6.8: (Source: Battle River Watershed Alliance).

Water allocations reflect water managers' knowledge that Alberta's rivers, lakes, and aquifers can only provide water for various human uses now and into the future if water usage is regulated. Water allocations work by assessing the available natural flow of a water source and developing plans for sustainable use. By comparing water usage to the available natural flow, water managers can help to find possible water shortages and potentially identify where water can be conserved and efficiency improved. The Alberta WaterPortal Society notes that allocations represent the maximum quantity of water that the licensee may use, but many users do not utilize the full allocations while others return used water to the environment (Alberta WaterPortal Society 2013a).

Stream Flow (m^3/s) in the Battle River (1980-2021)

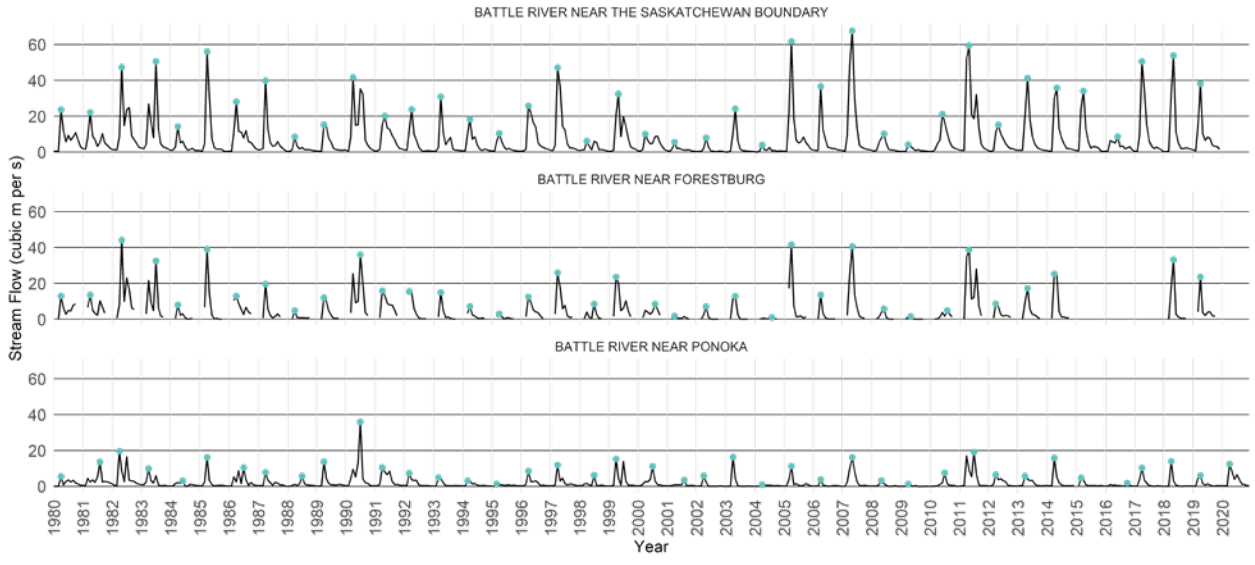


Figure 6.5: Stream flow (m^3/s) at three stations in the Battle River (Map 6.9) from 1980 to 2021 with peak water flow for each year denoted with a blue dot (Source: Extracted from the Environment and Climate Change Canada Real-time Hydrometric Data web site https://wateroffice.ec.gc.ca/mainmenu/real_time_data_index_e.html).

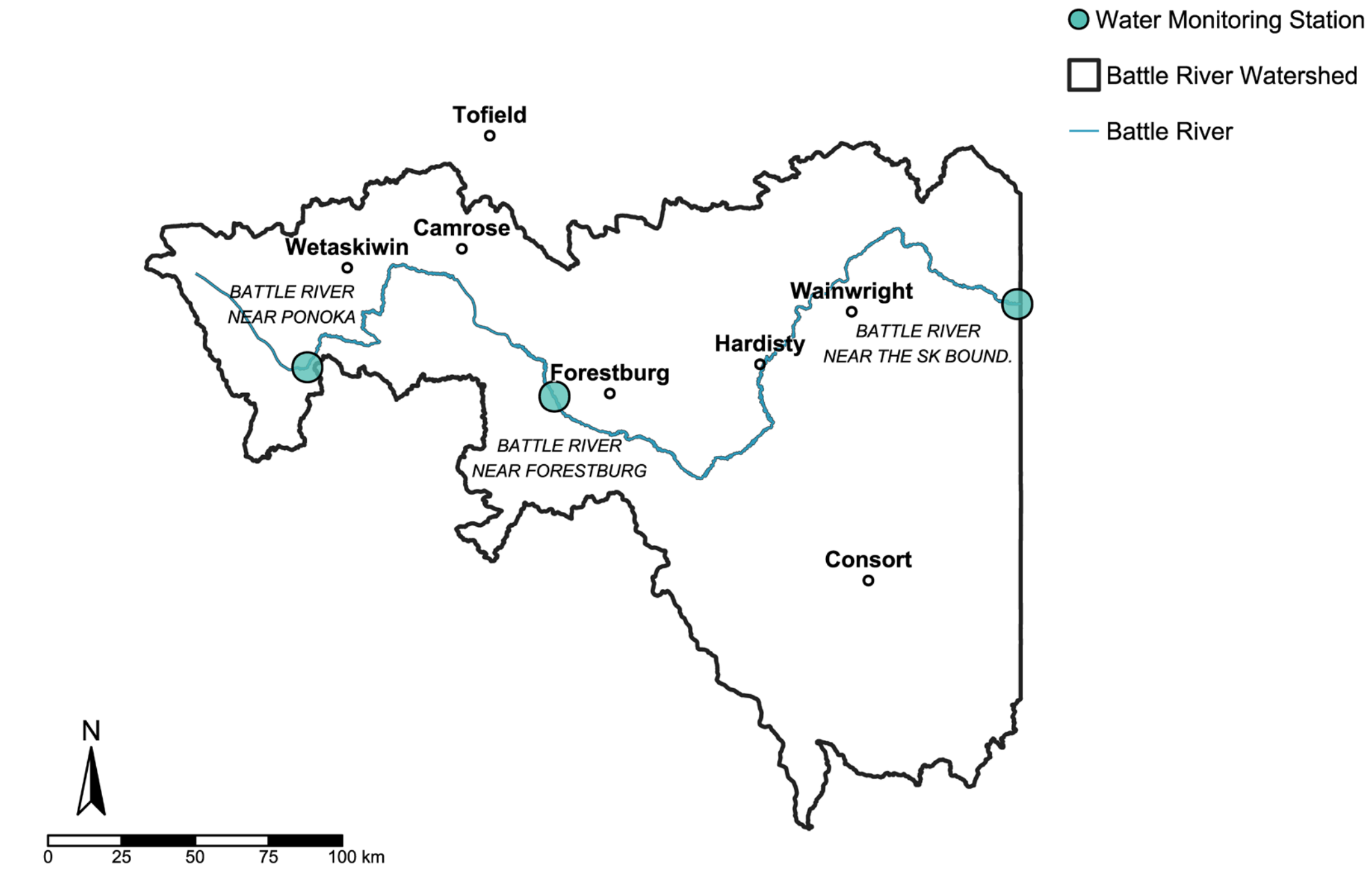
How licensed users actually use their allocated water has implications for calculating water allocations, a situation which we will discuss in more detail later in this policy section when we look at some alternatives to Alberta's current seniority-based water licensing system (He et al 2012). For now, we can note that irrigation, oil and gas/industrial, and municipal use are the three broad categories of licensable use in Alberta, all of which have relevance for the BRW. As of 2010 agriculture accounted for about 4.5 billion m^3 of water allocations in Alberta, out of a total of about 10 billion cubic meters of allocations. Industrial use accounted for just under 1 billion m^3 of allocations and municipal use accounted for just over 1 billion m^3 (Alberta WaterPortal Society 2013a).

Alberta has a variety of management tools that help to balance water usage needs and variable availability with water sustainability. The Water Act outlines such tools as water allocation transfers and water management plans (Government of Alberta n.d. b). A water allocation transfer is a system whereby the holder of a water license may transfer the rights to use a certain volume of water to another user (Alberta WaterPortal Society 2013a).

This system is monitored by the Alberta Government, and is only available under a certain set of circumstances. Authorization of a water allocation transfer can be considered only when the water management plan in place allows it, and the water in question is allocated by a license. A transfer can also be authorized through an order of the Lieutenant Governor in Council (Alberta WaterPortal Society 2013a).

Water management plans are specifically designed under the Water Act in order to provide guidance for decisions that are regulated by

Water Level and Flow Monitoring Stations



Map 6.9: (Source: Government of Canada. Historical Hydrometric Data).

the Water Act. This includes diversion conditions, minimum in-stream flows, and ways to protect the water environment. Water management plans must be approved by the Lieutenant Governor in Council, at which point the plan becomes an Approved Water Management Plan and has to be consulted when making plans that involve water that require approval (Government of Alberta n.d. m; Government of Alberta n.d. n).

Water management plans, authorized under the Water Act, are different from Watershed Management Plans, which are produced by WPACs (Government of Alberta n.d. m; Government of Alberta n.d. n). WMPs, also called Integrated Watershed Management Plans (IWMPs), advise entities, like the various levels of government, that have high level authority to create policies and regulations for environment management. IWMPs are developed on a collaborative basis, employing consensus agreement and incorporating the active engagement and participation of multiple involved parties from the watershed, such as community members and stakeholders (Government of Alberta n.d. m; Government of Alberta n.d. n).

In relation to land-use planning, the province's land-use planning guidance notes that "with the introduction of regional plans, [Integrated Resource Plans]…will remain in effect until they have been reviewed for their relevance and incorporated as appropriate under regional plans, future subregional plans, issue-specific plans or current legislation, regulation or policy" (Government of Alberta n.d. e).

A last piece of the puzzle for water quantity measurement and regulation is the allocation of priority in water rights. Simply put, Alberta's water allocation system gives priority access to water to people who were the first to obtain a license. This is commonly referred to as First in Time First in Right (FITFIR). Important to note in relation to water quantity is that FITFIR creates a sort of seniority during water shortages that protects current licence holders from new users who may create or exacerbate a water shortage. However, this system creates a potential problem where these new users may not receive all of their allocation, while the senior users are not under pressure to save or conserve water. One potential way to address this is that FITFIR allows the government to suspend licences during emergencies and redirect that water for other needs. Licenses are also subject to conditions including use/non-use and proper performance, although the Alberta WaterPortal Society notes that this has not yet occurred (Alberta WaterPortal Society 2013b).

What is being done?

Water license holders in Alberta are required, as a condition of their license, to regularly submit data on their water usage to the province's Water Use Reporting System (Alberta Environment 2006). Because water license holders are diverse, ranging from large industrial operations to small single-operator farms, not all water license holders will have access to the same technology or level of expertise in collecting data to meet their reporting requirements. For this reason, the government of Alberta has issued a water measurement guidebook, describing different methods for collecting water use data (Government of Alberta 2009b).

Alberta's Irrigation Districts were created in 1914 under the Irrigation Districts Act. Today, there are thirteen Irrigation Districts in Alberta, all of which are in the SSRB in the southern portion of the province. The Irrigation Districts Act created a regulated path for landowners to unite and form a co-operative, which then had the legal ability to issue bonds to fund the construction of irrigation projects, with additional assistance from both the provincial and federal governments (Government of Alberta n.d. g).

Beyond the ability to issue bonds, these cooperatives were also allowed to raise local taxes in order to fund the ongoing maintenance and operation of the irrigation systems, as well as the administration costs (Government of Alberta n.d. g). The Irrigation Districts Act remains in place today, having been most recently updated in 2000 (Government of Alberta 2021c). The updates allowed individual irrigators more autonomy over the disposal of their water licenses, including changing the location water is drawn from or sent to, such as an irrigated field, and allows them to transfer water rights to a different land parcel that is also classified for irrigation (Government of Alberta n.d. g).

The purpose of the Irrigation Districts was originally to attract settlers to Alberta and to support the growth of agriculture in the province. Irrigation continues to support agriculture in Alberta because the most highly developed agricultural region of the province (southern Alberta and the SSRB) also receives the least precipitation. Irrigation water in Alberta comes from surface water sources, not groundwater resources (Government of Alberta n.d. g). Although surface water sources are more replenishable that groundwater sources, they vary with precipitation from year to year and require monitoring and careful use to ensure that water is used efficiently and, in high-flow years, to ensure water can be contained and diverted so that it does not cause destructive flooding.

For non-irrigation use, including use in the energy industry, allocated water is also primarily surface water, although some groundwater is also allocated for industrial use. The AER monitors the efficiency of water use by energy industry corporations and encourages water use efficiencies, such as reusing and recycling water and improving industrial processes so that they require less water (Alberta Energy Regulator 2021b).

What could be done?

The most significant source of pressure on Alberta's water supply has been the increasing demand for water resources from agriculture, industry, and municipal use. The province's previous water legislation, the Alberta Water Resources Act, has been in place since 1931 with only minor revisions. Because this Act functioned primarily as a tool for allocating water, by the 1990s it was understood to have become inadequate for managing issues regarding water availability and sustainability. The new Water Act, which came into effect in 1999, "focuses on managing and protecting Alberta's water and on streamlining administrative processes" (Alberta Environment 2000). The Water for Life strategy states there is a need for a provincial water strategy to address pressure on Alberta's water supply, which is increasing as a result of population increases, industrial and agricultural demands, and droughts (Alberta Environment 2003).

Shapiro and Summers (2015) argue that the combined regulation and oversight of the Water Act, the Land-Use Framework (LUF), and the Water for Life strategy show a concentrated push to better manage Alberta's water and see responsive and integrated management as part of a global trend in water governance after 1992 and the International Conference on Water and the Environment in Dublin. The authors elaborate on what responsive and integrated management means in Alberta, where there has been a focus on coordination between land-use and water resources, bolstered by a province-wide regulatory and education system that can also work to address the problems and needs of individual river basins and watersheds, all with a focus on environmentalism and sustainability. The authors caution, however, that the actual recognizable impact of plans, like Water for Life, is not yet known and more time is needed to accurately judge their performance (Shapiro and Summers 2015).

De Loe, Murray, and Brisbois (2019) examine the attitudes of natural resource sector firms towards collaborative management and governance of water resources, with a focus on Alberta. De Loe, Murray, and Brisbois (2019) specifically identify WMPs as a form of this type of collaborative governance, where multiple stakeholders, such as industrial interests, are present with very different goals. While representatives from firms who participated in the study acknowledged that becoming involved in collaborative governance can be challenging, the challenges did not outweigh perceived benefits to the corporation, including the potential to be involved with decision making from the start, allowing them to build relationships with other stakeholders, influence potential regulations, and benefit from the regulatory process. The authors conclude that corporations see a benefit to collaborating and do not see it as inherently risky to their core business (de Loe, Murray, and Brisbois 2019).

These two studies suggest the need for caution and further research on Alberta's current strategy for managing water quantity. First, the Water for Life strategy has been in place for a relatively short time and will require ongoing evaluation to determine if it is meeting its goals. The 2008 renewal of the strategy appears to present a more

streamlined list of goals, perhaps suggesting that the 2003 goals proved unattainable or were not acted upon (Government of Alberta 2014).

The Water for Life Action Plan, released in 2009, does contain timelines for goal achievement, but the timelines have been extended, with short-term goals slated for achievement by 2012, medium-term goals by 2015, and long-term goals by 2019 (Government of Alberta 2009a). Second, as de Loe, Murray, and Brisbois (2019) show, industry partners do not view collaborative governance as restraining economic activity, and in fact, view such governance arrangements as another avenue through which to influence policy. While a robust economy with a base in the natural resource industry is a high priority for the provincial government, partnership with corporate interests in resource governance introduces the possibility of corporate influence over decisions that involve finite resources without the likelihood of influencing corporate behaviour regarding the responsible use of these resources.

Wetlands Inventory

Merged Wetland Inventory

Wetlands are an important ecological feature

in Alberta. According to Alberta's Wetlands Policy, wetlands cover about 20% of the province's land surface. There are also different kinds of wetlands: about 90% of Alberta's wetlands are a type of ecosystem called peatland, which is found primarily in the northern part of the province. Peatland is further divided into the specific ecosystems of bogs and fens. Other types of wetlands in the province include marshes, swamps, and shallow open water. Ephemeral wetlands are also an important form of wetland ecosystem but, because they are seasonal, they are not as likely to be accounted for in policy (Government of Alberta 2013)

Although there are different types of wetlands, they share a common basic ecological definition. A wetland is an area of land that has been saturated with water for a long-enough period of time to form characteristic water-altered soils and support the growth of water-tolerant vegetation. Many water-loving or water-dependent wildlife species depend on wetlands, including migratory waterfowl. Other ecosystem functions performed by wetlands include flood mitigation, water filtration and storage, and groundwater replenishment (Government of Alberta 2013).

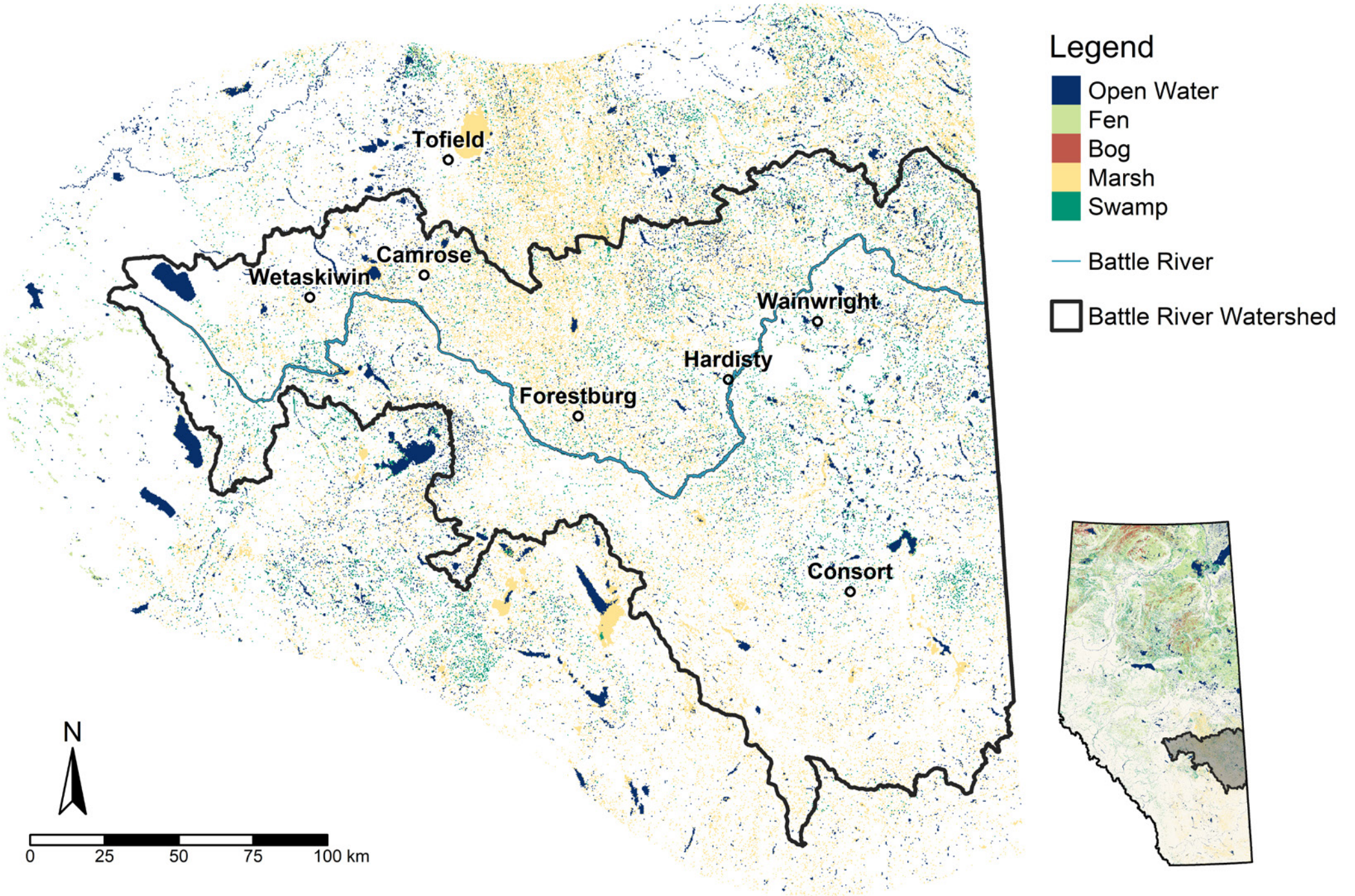
The Alberta Merged Wetland Inventory (AMWI) is a provincial dataset that depicts wetlands from 1998 to 2015, with the goal of showing the extent and variety of wetland ecosystems in the province. Wetlands depicted in the inventory are classified according to the five major types outlined in the Canadian Wetland Classification System (CWCS). These five types are (1) bog, (2) fen, (3) marsh, (4) swamp, and (5) shallow open water (Government of Alberta 2022a).

The Alberta Wetland Policy notes that wetlands in Alberta have been subjected to loss and degradation as a result of colonization, settlement, and development. Agriculture, urban expansion, oil and gas exploration and development, forestry, and mining can result in "direct wetland loss" or the impairment of wetland functionality through "fragmentation and disruption of natural hydrological pathways" (Government of Alberta 2013).

The BRW is located in the White Zone of the province (also called the Settled Zone), which has lost an estimated two-thirds of its historic wetland area (Government of Alberta 2013). This loss is ongoing, and threatens the survival of hundreds of species of plants and animals and many ecosystem services, including clean water, drought protection, and food production.

Wetlands (2021)

Land cover by wetland type



Map 6.10: (Source: Alberta Biodiversity Monitoring Institute. 2021. ABMI Wetland Inventory).

Policy Responses to Wetlands Inventory

The provincial government introduced the Alberta Wetland Policy in 2013. The new policy was formulated in accordance with the goals of the Water for Life strategy, and replaced an interim policy and a restoration guide. The 2013 Alberta Wetland Policy applies to all types of wetlands in the province, including "restored natural wetlands and wetlands that have been constructed for the purpose of wetland replacement" (Government of Alberta 2013).

The Alberta Wetland Policy seeks to minimize the loss and degradation of wetlands in Alberta while also still allowing economic growth and development. The policy recognizes the benefits of wetlands to the environment, human wellbeing, and the economy, and aims to conserve, protect, restore and manage wetlands in Alberta. At the same time, the policy also introduces the concept of wetland value, finding that not all wetlands are of equal value and that factors like biodiversity, flood reduction, water quality, and others all contribute to the value of a wetland. This means some types of wetland will be more vulnerable to degradation and loss as a result of development than others, making it especially important to gain an accurate picture of the environmental, economic, and social benefits of intact wetlands whatever ecological type they are and inclusive of whether they are permanent or ephemeral. The policy also stipulates where negative effects on wetlands as a result of development occur, and could not be minimized or avoided, then a wetland replacement must be established (Government of Alberta 2013).

The AMWI contributes to our understanding of areas covered by wetlands in Alberta by merging a previously existing non-collaborative mix of regional and local wetland maps and data sets, many of which contained differing levels of detail and resolution. By combining these regional data, a more comprehensive picture of wetlands in the province became available. However, the Alberta Merged Wetland Inventory (AMWI) notes that combining these different maps and data sets is difficult, as different entities often used different gathering standards and methods, sources, and timelines (Alberta Biodiversity Monitoring Institute 2021).

The ABMI has recently launched an Alberta-wide Wetland Inventory (Map 6.10), looking to augment the AMWI by examining the entire province in a single inventory using a consistent topographical approach to examine the province from border to border, while still being mindful of regional characteristics (Alberta Biodiversity Monitoring Institute 2021).

How have governments responded?

The AMWI classifies wetlands according to the five major classes in the CWCS: bog, fen, marsh, swamp, and shallow open water. Classification according to type is not the only challenge in mapping wetlands, however. The ABMI recognizes that wetlands can be difficult to work with as they are often transitional (depending on season and precipitation), can be in remote areas, and are dynamic in their changes. The ABMI Wetland Inventory attempts to address some of these complications through the previously mentioned consistent topographical approach to inventorying the entire province (Alberta Biodiversity Monitoring Institute 2021). Neither the AMWI nor the ABMI inventories are meant to replace specific or regional-level studies, maps, and inventories, but both are attempts to understand the presence and extent of wetlands at the provincial scale.

The ABMI inventory also notes the existence of regionally distinct wetlands in Alberta, and divides the province into three areas to better capture each area. These three areas are (1) the Boreal and Foothills, which are "characterized by large peatland and swamp complexes," (2) the Prairies, "where wetlands usually occur in small seasonal potholes," and (3) the Rocky Mountains, "where wetlands are constrained to narrow valleys" (Alberta Biodiversity Monitoring Institute 2021).

Of most relevance to this Atlas are the small seasonal pothole wetlands of the Prairies. These wetlands highlight the need to account for seasonality and temporality in wetland policy. An ecologically important wetland is not only one that exists year-round or that stays in the exact same location from year to year. These seasonal or ephemeral wetlands may host high concentrations of biodiversity at some times of the year but not at others.

Alberta's wetland policy judges wetlands according to their value, but there is a need to ensure that judgments of value are nuanced enough to capture the ecological and social importance of small, seasonal wetlands (Battle River Watershed Alliance 2017b).

Wetlands in the BRW, in addition to being prairie wetlands, are specifically subject to damage from high nutrient levels in the environment. The BRWA document Wetland Management: Implementation Guidelines gives guidance on best practices and policies to create beneficial management of wetlands and improve their health. Although the BRWA's watershed management planning process is non-regulatory, meaning that it is a concentrated group effort by stakeholders, residents, and decision-makers to enact the policies and procedures that the BRWA recommends. Having the guideline in place sets a standard for management and offers a template for regional-level, stakeholder engagement wetland stewardship (Battle River Watershed Alliance 2017b).

In addition to provincial-scale and local inventories, it is also a requirement under the Water Act for any development proposal which will potentially harm a wetland to submit a Wetland Assessment and Impact Report as part of the project regulatory application (Government of Alberta 2015c). The Alberta Wetland Policy requires projects to conform to a stated mitigation hierarchy. Projects should first seek to avoid disturbance to wetlands, then minimize disturbance, and, in the event of an inevitable disturbance, replace wetlands with adequate restoration or an acceptable constructed alternative (Government of Alberta 2016). The Wetland Assessment and Impact Report requires mapping, wetland classification, species surveys, a thorough description of the anticipated impacts on the wetland, and any other relevant documentation such as water quality reports and hydrology reports (Government of Alberta 2015c). These reports are used to assess the viability of a proposed project, to compare anticipated impacts against real impacts, guide requirements for reclamation or offsetting damage, and also guide compliance requirements in the case of unauthorized impacts.

Wetland Land Cover by Subwatershed (2021)

Subwatershed	Wetland Cover
Blackfoot	22.7%
Iron Creek	22.0%
Bigstone	16.1%
Ribstone	15.3%
Paintearth	14.6%
Sounding Creek	12.4%

Table 6.2: Percent of land comprised of wetlands by Subwatershed in 2021 (Source: Alberta Biodiversity Monitoring Institute, 2021).

What is being done?

Besides inventories, the Alberta Wetland Policy lists several tools that will be required to help identify, assess, and protect wetlands in Alberta. These tools include:

- A provincial wetland value assessment system,
- A wetland value assessment tool,
- A wetland database and reporting tool,

- An inventory of wetland restoration opportunities,
- A repository of research priorities and needs,
- Certification systems for wetland assessment specialists and wetland restoration agencies,
- An education and outreach program (Government of Alberta 2013).
-

The need for a wetland database is addressed by the AMWI and by the ABMI inventory. The Alberta Wetland Rapid Evaluation Tool – Actual (ABWRET-A) serves as the province's value assessment tool for wetlands. This survey must be completed for all development applications that may impact wetlands. For activities that are subject to reclamation requirements under the EPEA, the Public Lands Act, or the Water Act, applicants are "not required to complete the ABWRET-A assessment to determine the relative wetland value" (Government of Alberta 2015c).

Restoration, reclamation, reconstruction, and replacement are also important components of wetland policy in Alberta, and wetland restoration in Alberta is seen as a technical, professional enterprise that must follow the mitigation hierarchy discussed in the previous section.

Wetland restoration policy in Alberta distinguishes between mineral wetlands and peatlands: mineral wetlands are "characterized by mineral soils and/or organic soils that have either no accumulation of peat or peat layer of less than 40 cm deep," while peatlands are wetlands "with more than 40 cm of accumulated peat" including "bogs and fens and some swamps" (Alberta Environment and Sustainable Resource Development 2015). Mineral wetlands, such as marshes, shallow open waters, and many swamps, are more common in the southern half of the province.

The Alberta Wetland Restoration Directive (2016) provides direction on wetland restoration for mineral wetlands and supports the Alberta Wetland Mitigation Directive. Wetland restoration plans must be authorized by a professional member of an organization that is governed in accordance with the rules and regulations set out by the Professional Responsibilities in Completion and Assurance of Wetland Science, Design and Engineering Work in Alberta (Government of Alberta 2016).

The Wetland Restoration Directive describes three different types of wetland restorative replacement: (1) wetland restoration, (2) wetland construction, and (3) wetland enhancement. Restoration refers to the renewal of the water processes, wetland environment, and natural vegetation in a previously existing wetland areas. Construction refers to the establishment of a new wetland area on land that was previously a different land type, or as part of an artificial environmental support system. Enhancement refers to the restoration of a neglected or damaged wetland to improve its health and environmental contribution (Government of Alberta 2016).

Peatlands, while not common in the southern half of the province, are especially vulnerable to disturbance from oil and gas exploration and extraction in northern Alberta and in the province's oil sands regions. The Requirements for Conservation and Reclamation Plans for Peat Operations in Alberta (2016) document outlines the regulatory requirements for conservation and reclamation plans for peatland restoration, in accordance with the EPEA and the Conservation and Reclamation Regulation. This document requires reclamation projects to meet the Wetland Policy's intent of "equivalent land capability," meaning the "land or site must be returned to a use similar to what existed prior to disturbance, or to uses that are compatible with adjacent properties, or to an alternate use" (Alberta Environment and Parks 2016).

Although wetland restoration in Alberta is a technical and regulated process, sometimes involving the reclamation of sites that have been massively disturbed by industrial processes or other alterations in land-use, many conservation, and non-profit organizations also play important roles in restoration.

Communities and community groups may become stewards of reclaimed or restored wetlands, as in AEP's Wetland Replacement Program (WRP). This program is quite new, coming into effect in January 2020 (Alberta Environment and Parks 2021). Under the WRP, AEP partners with local municipalities, Ducks Unlimited Canada, and interested non-profit organizations to establish wetland replacement projects.

To date, the program has "signed memorandums of understanding…to establish wetland replacement projects" with "municipalities

including the City of Leduc, City of Red Deer, County of Grande Prairie, County of Leduc, Lac La Biche County, Municipal District of Greenview, Parkland County, Strathcona County and Sturgeon County" (Alberta Environment and Parks 2021). Once a wetland project has been assessed and approved, the WRP supplies funding for the completion of the project. This funding can also include incentives in the form of financial reimbursement for private land owners who allow wetland replacement projects to occur on their lands (Alberta Environment and Parks 2021).

What could be done?

The BRWA provides policy advice, best management practices, and implementation guidelines for wetland stewardship and restoration. The Wetlands Management: Policy Advice (2017) document states that the condition of wetlands in the BRW and Sounding Creek watersheds is not well known, but there has been loss, alteration, and problems in the past (Battle River Watershed Alliance 2017c).

In the context of a region where the condition of wetlands is generally unknown, policy should support management and stewardship activities that increase local ecological and social knowledge about wetlands, and generate a sense of care and stewardship. To this end, the BRWA policy document emphasizes a detailed inventory of the various wetlands in the watershed, with the intent of learning their condition and how to manage them better. The wetland management goals elaborated in this policy document are:

- "Increase knowledge and understanding of the status, functions, and values of wetlands in the Battle River and Sounding Creek watersheds,
- Strategically restore altered and drained wetlands within the Battle River and Sounding Creek watersheds by addressing social, economic, and regional spheres of influence, and
- Maintain existing wetland area and function within the Battle River and Sounding Creek watersheds by addressing social, economic, and ecological spheres of influence" (Battle River Watershed Alliance 2017c).

The BRWA's watershed management planning process is non-regulatory and relies on the various involved and affected parties and their cooperation with policies and direction. The BRWA does have the power to connect a wide network of people into local watershed management activity. This network should include people from municipal, provincial, federal, and First Nations governments, business and industry developers, residents of urban and rural locations, community organizations, environmental groups, academics, various watershed stewardship groups, and other stakeholders.

Other watersheds in Alberta have similarly limited knowledge about the state of their wetlands. Documents like the BRWA's Wetlands Management: Policy Advice, Wetland Management: Implementation Guidelines (2017), and Wetlands Management: A Review of Policies and Practices (2017) may help regional actors, like WPACs and watershed stewardship groups, throughout the province to create and implement better guidelines, policies, and procedures for gaining knowledge about local wetlands and managing these wetlands on a voluntary, inclusive basis. Working at the local/regional level may help to address some of the gaps that currently exist in wetland management, since most existing programs come from the provincial or federal level of government, and do not focus on creating stakeholder involvement from a diverse constituency of local people and wetland users (Battle River Watershed Alliance 2017a). The BRWA sees addressing differing societal values and perceptions in relation to wetlands within the watershed as key to being able to generate useful knowledge and sustain robust conservation and restoration programs that are supported by a wide cross-section of local residents.

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