PROTECTING ENVIRONMENTAL AND CULTURAL WATER THROUGH COLLABORATIVE GOVERNANCE AND IMPACT ASSESSMENT: INTERNATIONAL, CANADIAN, AND SASKATCHEWAN EXAMPLES

by

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EXAMINING COMMITTEE MEMBERSHIP

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AUTHOR'S DECLARATION

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

DISCLAIMER

Data used in this dissertation were made available by the File Hills Qu'Appelle Tribal Council (FHQTC), University of Regina, University of Waterloo, and other government institutions. Any opinions expressed by the author do not necessarily reflect the opinion of the FHQTC, University of Regina, or University of Waterloo. This disclaimer is part of the tri-partite Data Sharing Agreement (Appendix D).

STATEMENT OF CONTRIBUTIONS

Nathanael Bergbusch was the sole author of chapters 1, 2, and 9 which were supervised by Dr. Simon Courtenay and not written for publication. I use "I" in the thesis abstract and these chapters, whereas chapters 3 to 8 use "we".

Research Presented in Chapters 3 and 4:

Research for publication in chapters 3 and 4 was supported by lab members (Mark Saunders [Ch. 3], Melanie Lo [Ch. 4]), committee members, and supervised by Dr. Simon Courtenay. Nathanael Bergbusch designed the studies, completed the data collection and analysis, and wrote the first draft and edited all subsequent drafts. Mark Saunders was the second screener for the systematic literature review paper (Ch. 3) and helped in the design of the codebook. Melanie Lo worked with Nathanael Bergbusch to complete a document analysis of legislation, policies, and programs for Chapter 4. For chapters three and four, Simon Courtenay, Robert Gibson, Tim Jardine, Kelsey Leonard, and André St-Hilaire helped design the study, draft the research and interview questions, and edited different versions of the manuscripts.

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Research Presented in Chapters 5 to 8:

Research for chapters five to eight was co-created with the Lands, Resources, Environment, and Stewardship Department of File Hills Qu'Appelle Tribal Council. Manuscripts have and will be submitted to File Hills Qu'Appelle Tribal Council's Executive Council for co-authorship approval. As discussed with the Lands, Resources, Environment, and Stewardship Department, the Chiefs Committee will collectively serve as the second author for these papers. Simon Courtenay supervised this work. Peter Leavitt served as a collaborator and provided quantitative data. Simon Courtenay, Peter Leavitt, Robert Gibson, Tim Jardine, Kelsey Leonard, and André St-Hilaire helped design the study, draft the research and interview questions, and edited different versions of the manuscripts. Papers will likely be submitted to *Water Alternatives*, *Ecology & Society*, or other similar journals.

ABSTRACT

Human activities and climate change threaten freshwater resources and Indigenous rights. Developments (e.g., irrigation, dams, mines) cumulatively pollute and alter the hydrology of fresh water, affecting ecosystems (environmental flow/water) and Treaty and Inherent Rights (cultural flow/water). However, development assessment and management may not guarantee the protection or connectivity of water downstream. Regional sustainability-based guidance is needed through collaboration between Crown and Indigenous governments. Through interviews, workshops, ecohydrology, and policy analysis, this dissertation investigates strategies for collaborative governance and impact assessment to protect water for the environment, human uses, and Indigenous rights at three scales: globally, nationally (Canada), and regionally (Saskatchewan's Treaty Four). Treaty Four studies were co-created with File Hills Qu'Appelle Tribal Council's Lands, Resources, Environment, and Stewardship Department (Ch. 2) and informed the design of global and Canadian studies. I systematically reviewed international English-language papers on the collaborative governance of environmental and cultural water to inform practice in Canada (Ch. 3). In Chapter 4, I investigated the uptake of environmental and cultural flows in Canadian legislation and assessment and suggested steps for their protection. Moving to Treaty Four, I examined barriers to water regulation (Ch. 5), developed flow-based sustainability criteria for the Qu'Appelle and South Saskatchewan sub-basins (Ch. 6), tested these criteria (Ch. 7), and proposed regional response options (Ch. 8) for the Lake Diefenbaker Irrigation Expansion and Agricultural Water Stewardship Policy (that promotes continued wetland drainage).

Overall, dissertation findings established that, worldwide, communities need to have a greater role in environmental and cultural water policy, planning, and impact assessment (Ch. 3). In Canada, experts detailed a need for water councils to set needs-based rules for environmental and cultural flows maintenance ahead of development (Ch. 4). In Saskatchewan, water protection is challenged because of abstraction and drainage not triggering assessments, impact and project splitting, a lack of regulation, weak effort to meet the duty to consult, and the absence of regional approaches for identifying and managing cumulative effects of abstraction and drainage initiatives (Ch. 5). Collaborative regional governance (Ch. 8) was identified as needed to support progress towards sustainability through restoration of water and land, equity, respect for Treaties, transparency, climate uncertainty, and procedural justice (Ch. 6, Ch. 7). Together, these studies

demonstrate the opportunity for more collaborative regional governance and impact assessment of environmental and cultural water in Canada and inform recommendations for future management and study, provided in Chapter 9.

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
BBM	Building Block Methodology
BMP	Best management practice
CARE	Collective benefit, authority to control, responsibility, and ethics
Cflows	Cultural flows
Chl *a*	Chlorophyll a
DRIFT	Downstream Response to Imposed Flow Transformations
Eflows	Environmental flows
ELOHA	Ecological Limits of Hydrologic Alteration
FNMPC	First Nations Major Project Coalition
FHQTC	File Hills Qu'Appelle Tribal Council
FHQTC-LRES	File Hills Qu'Appelle Tribal Council Lands, Resources, Environment, and Stewardship Department
LRES	Lands, Resources, Environment, and Stewardship Department
OASIS	Operational Analysis and Simulation of Integrated Systems
OCAP	Ownership, Control, Access, and Possession
OECD	The Organization for Economic Co-operation and Development
PARC	Prairie Adaptation Research Collaborative
PCA	Principal component analysis
PCC	Population, Concept, Context
PICO	Population, Intervention, Comparison, Outcomes
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
NH_4^+	Ammonium
NO_3^-	Nitrate
QU-LTER	Qu'Appelle Valley Long-term Ecological Research Program
SAW	Saskatchewan Association of Watersheds
SRP	Soluble reactive phosphorus
SUMHA	Sustainable Management of Hydrological Alterations
TN	Total nitrogen
TP	Total phosphorus
UNDRIP	*United Nations Declaration on the Rights of Indigenous Peoples*
UNDRIPA	*United Nations Declaration on the Rights of Indigenous Peoples Act*
URegina	University of Regina
USask	University of Saskatchewan
VECs	Valued ecosystem components
WSA	(Saskatchewan) Water Security Agency
WTP	Water treatment plant
WWF	World Wildlife Fund

STATEMENT OF POSITIONALITY

My name is Nathanael (Nat) Bergbusch (he/him), and I am a white, cisgender, able-bodied male of settler descent. I am currently 29 years old and grew up in Saskatchewan. I lived in Saskatchewan for 24 of those years, learning to appreciate the Qu'Appelle River, Calling Lakes, and South Saskatchewan River. These waterways and surrounding lands inspired this dissertation and have broadened my natural and social science expertise. I grew up spending leisure time in the Qu'Appelle River and Calling Lakes and then completed my master's degree in freshwater science at the University of Regina in 2020. I studied the impact of a wastewater treatment plant upgrade on Wascana Creek and the Qu'Appelle River. The relationships I began with university researchers and the Lands, Resources, Environment, and Stewardship of File Hills Qu'Appelle Tribal Council during my master's degree set the foundation for this doctorate

Since fall 2020, I have been a Ph.D. candidate in Social and Ecological Sustainability (Water) in the School of Environment, Resources and Sustainability and the Collaborative Water Program at the University of Waterloo. I now identify as a freshwater scientist and sustainability researcher. My research toolkit includes hydrologic and water quality monitoring, statistical analyses, co-creation and community-based approaches, and social science and policy analyses. I apply these skills to ask research questions about water security, governance, and impact assessment. In particular, I am interested in how to make water decision-making more inclusive of regional communities and ecosystems. I think about water reserved for the environment and Treaty and Inherent Rights and impacts from multiple developments that could cause harm to the environment, people, and rights. Throughout my Ph.D., I have travelled back and forth from Ontario to Saskatchewan and worked on projects across Canada, in Labrador, and Prince Edward Island. These projects are about the development of irrigation, wetland drainage, high-capacity wells for groundwater, and dams. As I continue to develop my research program, I hope to be a social and natural scientist who actively works towards reconciliation, water justice, and conservation.

CHAPTER 1. INTRODUCTION

1.1 Background and Rationale

1.1.1 Effective Water Governance to Sustain Social-Ecological Systems

Water governance is about how societies make decisions about water and the environment (Armitage et al. 2012). Decisions are made based on norms, values, behaviours, laws, regulations, and institutions that shape government actions, policies, activities, and interactions with and between industries, stakeholders, and Rights holders (Rogers and Hall 2003). While water governance is about setting rules and defining responsibilities, water planning refers to developing a framework to establish defined rules for watersheds and water management is how those rules are implemented and operationalized (Harmsworth et al. 2016; Rosso 2025). Key considerations for water and environmental governance are determining who should participate, and have power in, decision-making; at what geographic, political, and temporal scales decision-making should occur; and the role of the private sector and market players in decision-making (Gupta et al. 2013; Plummer et al. 2013; Vörösmarty et al. 2015; Woodhouse and Muller 2017). Effective water governance may take many forms but generally is "open and transparent", "inclusive and communicative", "coherent and integrative", "equitable and ethical", "accountable", "efficient", and "responsive and sustainable" (Rogers and Hall 2023, p. 27-29). While not always essential for good water governance (Jones-Crank 2024), decision-making may often benefit from being collaborative with communities having a central role in making rules about water (Agrawal and Gibson 1999; Lemos and Agrawal 2006). I use the terms collaborative water governance and democratizing water governance throughout this thesis. For the purposes of this thesis, collaborative water governance can reflect a range or spectrum of collaboration from engagement of non-state stakeholders and Rights holders to greater decision-making authority of those actors in policy and programs with the goal of building consensus and agreement (Margerum and Robinson 2015; Brisbois and Loë 2016; Harrington 2017). Democratizing water governance means recognizing human rights and power dynamics to "ensur[e] that the poor, the marginalized and the silenced are given a voice and heeded in planning processes" (Sultana 2018, p. 490). If water governance is decentralized in this way, decision-making may be shared by multiple diverse institutions that operate at different scales to match the social-ecological issues and dynamics being managed (Plummer et al. 2013; Epstein et

al. 2015). However, governing water is challenging because of the complex nature of social-ecological systems.

Social-ecological systems refer to the environment, people, and governing institutions that together are complex, integrated, and self-organizing (Berkes et al. 1998; Epstein et al. 2015). Systems exhibit or experience non-linear dynamics in the form of threshold exceedances (rapid change once a critical point is exceeded), surprises from human intervention (unexpected outcomes if complexity is not understood), legacy effects or time lags (the manifestation of previous effects), and heterogeneity (different people and environments result in different choices and behaviours) (Liu et al. 2007). Systems operate and function within multiple hierarchical spatial, temporal, and institutional scales that interact and can conserve one another (Holling 2001; Gunderson et al. 2002). A resilient system maintains similar functions, structures, and services in the face of perturbations in part because of stabilizing interactions between scales (Walker & Salt, 2012; Walker et al., 2004). Ostrom (2007, 2009) explains that there is no clear panacea (universal solution) for social-ecological system problems, such as fisheries declines, forest harvesting, and water resources losses, but that context-specific, coordinated resource users alongside governance agreements can make progress towards sustainability. To make progress towards sustainability in social-ecological systems, the following sustainability assessment criteria need to be promoted (Gibson et al., 2005a): “precaution and adaptation”, “long-term thinking”, “intra- and intergenerational equity”, “social-ecological system integrity”, “diversity”, “democratic governance”, “opportunity and sufficiency”, “participation and learning”, and “humility and understanding”.

In Canada, effectively sustaining social-ecological systems (watersheds in this case) is challenging because of adverse impacts to water and challenges with water governance. Fifty-three of Canada’s 167 sub-watersheds are already degraded and threatened because of adverse impacts by multiple actors across jurisdictions (Schindler et al. 2012; WWF-Canada 2017, 2020; Mahdiyan et al. 2021; Culp et al. 2023). Water governance in Canada is multi-jurisdictional with roles of federal, provincial, municipal, and Indigenous government actors because the *Constitution Act* (1867, 1982) gives simultaneous (albeit different in many instances) authority to different levels of government (Bakker and Cook 2011). While the federal government has responsibility over navigation and fisheries (inland and coastal), the provincial government has responsibility over water resources and property and civil rights and municipal governments are

delegated water supply powers by the provinces (Renzetti and Dupont 2017; Swerdfager and VanNijnatten 2024). The federal government can intervene when there are transboundary water concerns or a threat to Indigenous Nations and their Treaty and Inherent Rights (Bakker and Cook 2011). Indigenous governments are also reasserting their self-governance and sovereignty over lands and waters (Curran 2019).

Treaty Rights are the basis of the relationship between the Crown and First Nations in Canada. Historic Treaty Rights (before 1975) include setting aside land as reservations for use by First Nations, annual payments given to a First Nation every year, hunting and fishing rights, Crown-paid schools and teachers on reserve, and several one-time benefits (e.g., farming equipment, animals, and clothing) (Government of Canada 2024a). Treaties after 1975 include, for example, land ownership, wildlife harvesting rights, requirements for consultation and participation, and participation in land use and management in specific locations (Government of Canada 2024a). I focus on Treaty Four (signed September 15, 1874) and First Nation Treaty Rights to "pursue their avocations of hunting, trapping and fishing" (Government of Canada 1966) and Inherent Rights which refer to the right to self-govern and self-determination over lands, territories, and resources (UN General Assembly 2007). I often refer to both Treaty and Inherent Rights as Indigenous rights. In section 35 of the *Canadian Constitution Act* (Government of Canada 1982), the Crown affirms "[t]he existing aboriginal and treaty rights of the aboriginal peoples of Canada" (section 35 (1)). Flowing from the Supreme Court of Canada's interpretation of section 35, through Haida, Taku River, Mikisew Cree, Little Salmon/Carmacks, and Rio Tinto court cases, is duty to consult in which "[t]he Government of Canada has a duty to consult and, where appropriate, accommodate Indigenous groups when it considers conduct that might adversely impact potential or established Aboriginal or treaty rights" (Government of Canada 2025a). However, "courts have not ruled specifically on aboriginal rights to water in Canada to date" and the 11 Numbered Treaties in Canada that include fishing rights "do not contemplate specific entitlements to water" (Curran 2017, p. 35). This context sets the stage for the complex water governance landscape in Canada.

Roles of different Crown and Indigenous governments in water governance could change with the new Canadian Water Agency, that launched on October 15, 2024, and foreseeable updates to the *Canada Water Act* (Government of Canada 2024b). Overall, experts have identified that water needs to be governed as a shared resource, in a coordinated and

collaborative way among jurisdictions, to achieve sustainable outcomes (Bakker and Cook 2011; Simms et al. 2016; Phare et al. 2017; Renzetti and Dupont 2017; Bakker et al. 2018). In this thesis, I recognized and found that collaborative water governance is needed in the contexts I was examining. I use this lens as the framework through which the analysis occurs because of an identified requirement for coordination and collaboration in water decision-making between Canadian jurisdictions.

1.1.2 Environmental and Water Justice to Democratize Governance

Movement towards more collaborative water governance processes can occur through the consideration of environmental and water justice. Environmental justice is "[t]he fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (Bullard 1996; Haluza-Delay 2007; Canadian Environmental Law Association 2023, p. 1). Water justice refers more specifically to equity in water decision-making and access to support health, well-being, and self-determination (Harris et al. 2017; Sultana 2018). Environmental and water justice can refer to distributive (equitable sharing of benefits and costs), recognitional (personal dignity of everyone), procedural (inclusion in decision-making), and capabilities (individual's well-being and ability to thrive) justice (Bell and Carrick 2017; Kaswan 2020; Menton et al. 2020). Specific to Indigenous Peoples, Indigenous water justice defined by Robison et al. (2018, p. 841) refers to "water and its multi-faceted connections to Indigenous Peoples' self-determination – more precisely, to the socioeconomic, cultural, and political dimensions associated with Indigenous Peoples' exercise of the right to self-determination."

In Canada, Indigenous communities are disproportionately affected by development projects (Arsenault et al. 2018, 2019), yet relationships with Indigenous Nations are rarely sufficiently meaningful to collaboratively assess those developments (Mascarenhas 2007; Sinclair and Diduck 2017; Udofia et al. 2017; Waldron 2018). Misunderstanding, power dynamics, and neglect that are products of past and current colonialism are the greatest challenges to meaningful relationships (Udofia et al. 2015; Arsenault et al. 2019). The Crown attempted – unsuccessfully – to prevent the generational transmission of Indigenous cultural identities and values by destroying communities' social, cultural, and political institutions through the *Royal*

Proclamation, the *Indian Act*, and the *1969 White Paper* (Hall 2011; TRC 2015; Smith 2021a). The 11 Numbered Treaties (1871-1921) in Canada are interpreted as both a surrender and assertion of Indigenous land title (Macklem and Sanderson 2016; Morris 2018). However, Indigenous governments are re-asserting their rights to self-governance over lands and waters through Treaty negotiations, land-claim agreements, Indigenous laws, and pressure on the federal government to move more quickly on implementation of its *United Nations Declaration on the Rights of Indigenous Peoples Act* (UNDRIPA) (Craft 2014; Clogg et al. 2017; McGregor 2018; O'Donnell 2023a). Commitment to implement the *United Nations Declaration on the Rights of Indigenous Peoples* (UNDRIP) through UNDRIPA in 2021 has led to the creation of an action plan and effort to make federal laws consistent with UNDRIP (Government of Canada 2023a). This is the domestic legislative context within which Canadian water governance and assessment operate. For both water governance and impact assessment in Canada, environmental and water justice opportunities are needed to continue to mend relationships between Indigenous and non-Indigenous peoples and revitalize Indigenous culture, oral traditions, knowledge, laws, and relationships to the land while promoting free, prior, and informed consent and distinction-based approaches (McGregor 2018). Distinction-based approaches respect the unique rights, interests, and circumstances of Indigenous Nations in Canada (Government of BC 2024). To move towards reconciliation in Canada, environmental and water justice need to be more formally included in impact assessment and governance processes (Blakley and Russell 2021).

1.1.3 Environmental and Cultural Flows and Water Science and Governance

"Environmental flows and water" refer to sufficient water quantity and quality reserved for ecosystems and downstream communities (Horne et al. 2017f). In The Brisbane Declaration and Global Action Agenda in 2018, environmental flows have been defined as "the quantity, timing, and quality of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods, and well-being" (Arthington et al. 2018, p. 4). Environmental flows refer more to the delivery of water, whereas environmental water is the amount and quality of water protected for the environment (Horne et al. 2017f). I will use the two terms interchangeably (as with cultural flows and water) to bridge the governance (rely on the term water) and natural science (rely on the term flows) discourses, as done in Horne et al. (2017f). Environmental flows are generally evaluated based on the impact of hydrologic alteration to ecosystems, fish and fish habitat, and social values based on various

approaches ranging from hydrologic analysis and modelling to holistic frameworks (Tharme 2003; Poff et al. 2010; Linnansaari et al. 2013). Setting standards for environmental water quality and evaluating the relationship between hydrologic alteration and water quality is also becoming more common (Pienaar et al. 2011; Arora et al. 2017). Worldwide, Rights holders and stakeholders are beginning to have a greater role in environmental flow and water determinations (both quantity and quality) and have the potential to inform broader watershed governance through these processes (Kosovac et al. 2023; Mussehl et al. 2023).

Historically, attention to the governance and management of environmental flows and water through legislation, policies, institutional settings, and markets has been lacking internationally (Pahl-Wostl et al. 2013). However, emphasis by governments and water governance researchers on needs to investigate and find mechanisms and initiatives to protect environmental water has increased over the last thirty years (Harwood et al. 2017; Horne et al. 2017d; O'Donnell and Garrick 2017a; Macpherson et al. 2018; Wineland et al. 2022; Alexandra et al. 2023). Many countries have now incorporated environmental flow concepts and rules into their legislation, such as, for example, the United Kingdom 1963 *Water Resources Act*, United States 1972 *Clean Water Act*, South Africa's 1998 *National Water Act*, and Australia's 2007 *Water Act* (Acreman et al. 2017). Amendments to these acts and policies have shifted attention from minimum flow levels to more holistic flow regimes and water quality that support broader ecosystem and cultural services (Anderson et al. 2019). Despite enabling legislation, the water science community in 2007 with The Brisbane Declaration (p. 3) and again in 2018 recommended that "environmental flow assessment and management should be a basic requirement of Integrated Water Resource Management; environmental impact assessment; strategic environmental assessment; infrastructure and industrial development and certification; and land-use, water-use, and energy-production strategies." While not explicitly referring to environmental flows or water, integrated water resources management and environmental impact assessments both consider the maintenance and preservation of ecosystems (Acreman et al. 2017). Of particular focus within this thesis is environmental assessment and the need to proactively and collaboratively consider the protection of environmental water ahead of development decision-making at higher regional and strategic levels or planning equivalents – a gap identified by King and Brown (2018). The governance of environmental water has developed significantly in the 21st century, but there are opportunities for more collaborative

governance through processes like integrated water resource management, environmental and socio-economic impact assessment, licence permitting, and water-use strategies.

Emerging in response to deficiencies in environmental flow and water processes in Australia, the concept of cultural flows and water emphasizes non-ecological and ecological needs and decision-making authority and the rights of Indigenous Nations (O'Donnell and Macpherson 2023). Cultural flows are defined by the Murray Lower Darling Rivers Indigenous Nations and Northern Basin Aboriginal Nations in the Echuca Declaration (2007) as "water entitlements that are legally and beneficially owned by the Indigenous Nations of a sufficient and adequate quantity and quality to improve the spiritual, cultural, environmental, social and economic conditions of those Indigenous Nations." Cultural water "demonstrates the power of Indigenous-led, holistic water management" through "sovereignty and self-determination", "connection to place", "responsibilities to country", "cultural experiences", and "emotional and spiritual well-being" (O'Donnell et al. 2023, p. 620). Cultural flows processes are opportunities for Indigenous Nations to reassert their self-governance and self-determination over water (Leonard et al. 2023). While environmental flows are protected to varying degrees through legislation, policies, and regulations across Canada (Horbulyk 2017), cultural flows ideas are newer and have the potential to be applied for greater environmental and water justice.

1.1.4 Cumulative Effects and Higher-Level Impact Assessment in Watersheds

Cumulative effects, considered at different levels of impact assessment, are past, present, and future actions that collectively impact the environment or human well-being (Hegmann et al. 1999; Clogg et al. 2017). The first definitions of cumulative effects focused only on biophysical components, but now there is some inclusion of social, cultural, and economic dimensions (Jones 2016; Clogg et al. 2017). Cumulative effects studies are generally centred on implications for valued ecosystem components (VECs) – something in the environment that is of value to people, such as fish, species at risk, mammals, or more abstract concepts (Beanlands and Duinker 1983; Ball et al. 2013; Van Den Heuvel et al. 2017). VECs are analyzed in response to stressors (e.g., nutrients, heavy metals, hydrocarbons, flow regimes, emissions) produced from one project or many (e.g., agriculture, cities, dams, mining, oil and gas, mills) (Dubé, 2003). Murray et al. (2014) consider four dimensions of cumulative effects: one activity continuously producing an impact, one activity producing multiple impacts, multiple activities producing one impact, or

multiple activities producing multiple impacts. Cumulative effects can be positive or negative and include additive ("total impact = sum"), synergistic ("total impact > sum"), or antagonistic ("total impact < sum") impacts (Foley et al., 2017, p. 123). Recently, there has been an identified need to investigate cumulative effects and environmental and cultural flows together to determine the cumulative effects of diffuse hydrological alteration and water quality change for watersheds (Horne et al. 2017c). Similarly, the cumulative social, health, and mental impacts of water quality and drinking water issues on Indigenous and non-Indigenous communities been recognized by managers and scholars as needing attention (Hackett et al. 2018; Adams et al. 2023; Ansloos and Cooper 2023). Ultimately, the purpose of studying cumulative effects is to put measures in place to mitigate, eliminate, and decrease the risk of development projects' effects interacting to bring adverse changes to the environment and human well-being or inhibit progress towards sustainability.

Impact assessment, has many definitions and is defined by Noble (2021, p. 6) as "identifying and evaluating the potential impacts of proposed development actions, proposing strategies for managing those impacts, and ensuring that development proceeds in a manner that is in the public interest." Impact assessments include scoping, impact identification and predictions, impact mitigation, and sometimes follow-up and monitoring (Noble 2021). Most impact assessments in Canada occur at the project level, meaning that each application investigates the impacts and mitigation needs of one development at one site within defined spatial and temporal boundaries (Gunn and Noble 2009; Muldoon et al. 2020). Project-level assessments have been the norm in Canada provincially and federally since the beginning of impact assessment (Muldoon and Williams 2025). With Canada's 2019 *Impact Assessment Act*, investigation of cumulative effects continues to be completed and mandated mostly at the project-level (Doelle and Sinclair 2019; Gibson 2020). However, the Act promotes and facilitates regional and strategic assessment as ways to consider cumulative effects on larger scales than single projects, acknowledging that within the objectives and scale of single projects (Doelle and Sinclair 2019; Gibson 2020), cumulative effects cannot be understood adequately (Therivel & Ross, 2007). Project-level cumulative effects studies do not allow for consideration of regional development planning issues and goals, understanding system thresholds, determining legacy effects, collaborating effectively with a variety of actors, and future thinking or scenario analysis (Liu et al. 2007; Jones 2016; Foley et al. 2017). These shortcomings have led to a need for more

attention to regional issues and options, including higher-level impact assessments that consider regional impacts and strategic alternatives.

Regional and strategic assessments are less common than project-level assessments and have been done on an irregular basis since the beginning of impact assessment in Canada in 1995 (CCME 2009; Noble 2021). These processes are often referred to as higher-level, higher-tiered, or higher-order impact assessment because they promote "…higher level decision-making at policy, programme and plan levels, a reaction to the project orientation of most EIA (environmental impact assessment) applications" (Gunn and Noble 2009; Morgan 2012b, p. 7). Regional assessments are completed to assess multiple project developments in the past, present, and future within a defined spatial region (e.g., ecoregions, watersheds, urban areas, planning zones) (Gunn and Noble 2015). Regional cumulative effects assessment generally involves questions about the legacy effects of past projects in a region and how they contribute to the accumulated impact state of current and future projects (Dubé et al. 2013; Gunn and Noble 2009). Strategic assessments refer to the assessments of policies, plans, and programs and how to integrate environmental targets, directions, and sustainability concerns in decision-making (Dalal-Clayton and Sadler 2005; Noble and Nwanekezie 2017). Regional and strategic assessments are often combined to examine the strategic direction of entire regions and to collaboratively evaluate the sustainability of possible alternative futures (Blakley et al. 2020; Gibson et al. 2020). Strategic cumulative effects assessment asks broader questions such as what the cumulative effects of alternative future scenarios might be and what possibilities and constraints exist in regions (Gunn and Noble 2009). Clogg et al. (2017) remark that:

> Much of the heavy lifting with respect to cumulative effects management lies at the strategic level. However, to be effective as a tool for cumulative effects management, such strategic level direction must be integrated into a legal and policy framework that links plans and objectives to actual on-the-ground decisions about land and water use, e.g., project-specific environmental assessment, tenuring and resource approvals, as well as the establishment of harvest levels. (p. 16)

Good strategic cumulative effects assessment involves scenario analysis to determine risks and benefits of alternative possible futures and alternative packages of policies, programs, and projects, desired timelines and scales of development, means to enhance positive impacts and

mitigate adverse impacts on regional VECs, and how proposed projects relate to watershed, marine, and land planning (Clogg et al. 2017). Linked regional-strategic assessments are needed when regions are undeveloped and naturally preserved, severely impacted (socially, culturally, and/or biophysically), and where there is conflict and controversy between industries (Gibson et al., 2020).

Finally, Indigenous-led assessment may occur at the level of one project or transcend different regional and strategic undertakings because of land-use plans, water laws, and Indigenous governance (Gibson et al. 2020). Like regional and strategic assessment, Indigenous-led assessments can be a form of higher-level assessment (Gibson et al. 2020). Indigenous-led assessments are "a process that is completed prior to any approvals or consent being provided for a proposed project, which is designed and conducted with meaningful input and an adequate degree of control by Indigenous parties — on their own terms and with their approval" (Gibson et al. 2018, p. 10). Indigenous-led assessments may refer to Indigenous-led studies, independent Indigenous-led assessments, or collaborative Indigenous-led assessments with the Crown and/or proponent (FNMPC 2020). Cumulative effects may be considered through broader relational thinking in Indigenous-led assessment by considering primary and secondary (indirect) impacts to more inclusive VECs (e.g., ability to self-govern and way of life) (Arsenault et al. 2019; Eckert et al. 2020; Goodchild 2021). However, despite the opportunity for Indigenous-led assessment, the development of meaningful relationships with Indigenous Nations as part of impact assessments has proven challenging because of inflexible timelines, insufficient funding, limited relationship-building and mutual learning, and misunderstanding (Lajoie and Bouchard 2006; Kwiatkowski et al. 2009; Escott et al. 2015; Udofia et al. 2017). Therefore, deeper, systemic challenges to meaningful relationships need to be addressed to fulfill free, prior, and informed consent obligations under UNDRIP (FNMPC 2020). Canada's commitment to implement UNDRIP (UNDRIPA in 2021) is an opportunity for this change through the provision of an action plan that includes 181 measures (Government of Canada 2023a). Measure 51 emphasizes implementing the *Impact Assessment Act* in line with UNDRIP and includes "the need to seek free, prior, and informed consent" (Government of Canada 2023a, p. 37).

Under Canada's 2019 *Impact Assessment Act* and through UNDRIPA there is an opportunity for higher-level regional-strategic assessment and Indigenous leadership in assessment to be more accepted and widespread (Doelle and Sinclair 2019; Government of

Canada 2019; Gibson 2020). However, identifying when these innovative forms of assessment are needed is difficult and choosing the appropriate scale to evaluate development projects is challenging. In many cases, the scale chosen for evaluation of development projects is not adequate to address collaboration, cumulative effects, water and environmental justice, and the protection of environmental and cultural flows (Nowlan 2012; Curran 2019; Craft and Blakley 2022).

1.1.5 Co-Creation and Collaboration in Water Science, Governance, and Assessment

Knowledge co-creation is becoming increasingly important in Canada and abroad to respectfully bridge Western and Indigenous science and inform collaborative water governance (Wilson and Inkster 2018). Indigenous science is a part of Indigenous Ecological Knowledge, which encompasses a plurality of knowledge systems from different Indigenous Nations, a way to conduct oneself throughout one's life, and a governance approach based on relationality between the environment and past, present, and future generations (McGregor 2004; Houde 2007; Hart 2010; Reo and Whyte 2012). Indigenous or Native Science described by Cajete (2018) is:

> …a metaphor for a wide range of tribal processes of perceiving, thinking, acting, and "coming to know" that have evolved over millennia of human experience with the natural world. Native Science is born of a lived and storied participation with a natural landscape and reality. To gain a sense for the essence of Native Science one must also participate with the natural world; to understand the foundations of Native Science one must become open to the roles of sensation, perception, imagination, emotions, symbols, and spirit as well as concepts, logic, and rational empiricism. (p. 15)

Indigenous science broadly includes observation, questioning, monitoring, problem-solving, and adapting based on interdependence and reciprocity with the natural world and a goal of sustainability (Johnson et al. 2016; Whyte et al. 2016; Cajete 2020). Kimmerer and Artelle (2024) describe how Western scientists need to respect and learn from Indigenous science to support knowledge pluralism and Indigenous sovereignty.

In Canada, there has been an increase in collaborative efforts that bridge Indigenous and Western science (Alexander et al. 2019, 2021). However, a key challenge is that Western science and governance systems are often prioritized, leading to colonial relationships, poor

collaboration, and minimal assertion of Indigenous authority and knowledge (Von Der Porten 2012; Von Der Porten and De Loë 2013; Simms et al. 2016). A strategy to address this challenge is through co-creation frameworks so that Indigenous knowledge and rights inform research and management arrangements (Turner 2006; Arsenault et al. 2018; Latulippe and Klenk 2020). The following, covered in Reid et al. (2021), are four key knowledge co-creation frameworks:

1. **Braiding** (Thunderchild First Nation, University of British Columbia): "decisions made together in a mutually defined process; collective accountability; adequate resource-sharing to ensure appropriate and just engagement; [and] attention to different sensibilities" (Jimmy et al., 2019, p. 34). The area between sensibilities is where knowledge co-production can occur.

2. **Etuaptmumk/Two-Eyed Seeing** (Mi'kmaq, Unama'ki): a form of knowledge sight that considers complementary Indigenous and Western science eyes (Bartlett et al., 2012; Reid et al. 2021; Wright et al., 2019). Reid et al.'s framework (2021, p. 13) includes: "long-term relationships", "mutual research interest", "identification of required tools", "research co-development", "co-evaluation and community validation", and "shared recognition and co-benefits".

3. **Kaswentha/Two-Row Wampum** (Hodinöhsö:ni') developed to mean linking arms in research through relationship-building principles: "equity", "authority", "sacred spaces", "contexts", and "knowledge sharing" ("not ownership") (Hill & Coleman, 2019, p. 341).

4. **Waka-Taurua/Double Canoe** (Māori) – Each Waka/canoe represents each group's distinct worldviews, values, and knowledge, with paddles being tools, actions, and approaches unique to each. When the two groups come together, they meet in a shared "engagement" or "negotiation" space for "consented, purposeful engagement" to co-manage and co-govern.

These frameworks describe steps that need to be cultivated to make partnerships meaningful (Gibson et al. 2020; Wong et al. 2020). However, certain Indigenous authorities and scholars oppose combining Indigenous and Western science, suggesting that Indigenous science is meant to inform Indigenous deliberations and leadership separate from Crown government decisions and research (Latulippe and Klenk 2020; Lauter 2023; Kimmerer and Artelle 2024). While knowledge sharing frameworks have been applied through environmental and cultural flow initiatives for greater community authority in water decision-making (Monk et al. 2024), cultural flows frameworks (Indigenous science) have also been asserted to inform Indigenous decisions

that are separate from Crown and Western science processes (Crow et al. 2018; O'Donnell et al. 2023).

1.1.6 Setting the Context: Water Impacts and Governance in the Canadian Prairies

Watersheds in Canada are experiencing impacts from climate change, water scarcity, water quality issues, nutrient pollution, and flow alteration (WWF-Canada 2017, 2020). Governance is also fragmented with jurisdictional and responsible authority challenges between federal, provincial, territorial, municipal, and Indigenous governments (Bakker and Cook 2011; Renzetti and Dupont 2017). Processes to assess and govern watersheds in Canada to ensure continued and adequate water availability and quality could benefit from best practice internationally and nationally. Internationally, countries with similar socio-political (colonial, commonwealth nations like Australia and New Zealand) and geographic (prairie and boreal ecoregions in the United States and European Union) characteristics can potentially inform how environmental and cultural water is governed and assessed in Canada (Acreman and Ferguson 2010; Poff and Matthews 2013; O'Donnell and Macpherson 2023). Nationally, collaborative governance, pluralist legal traditions, and impact assessment arrangements between Indigenous and non-Indigenous governments can serve as useful examples for other areas of Canada where there is a need for greater protection of environmental and cultural flows, such as the Canadian Prairies.

Moving from international, to Canadian, and to local scales, the primary geographic focus of this thesis is the Canadian Prairies in Saskatchewan. Of particular interest for regional water development are the South Saskatchewan River and Qu'Appelle River sub-watersheds – two of the most at-risk sub-watersheds in Canada because of water scarcity, water quality degradation, and climate change (WWF-Canada 2017, 2020) (Figure 1.1). The South Saskatchewan River begins at the confluence of the Oldman and Bow rivers in Alberta, feeds Lake Diefenbaker in Saskatchewan, joins the North Saskatchewan River which flows into Codette Lake and Tobin Lake, and then drains into the Saskatchewan River Delta and the northern side of Lake Winnipeg and eventually Hudson Bay (Newton 2017). The Qu'Appelle River begins at Lake Diefenbaker, moves through a series of lakes (e.g., Buffalo Pound, Pasqua, and Crooked lakes), and then flows into the Assiniboine River which, in turn, flows into the Red River and the southern side of Lake Winnipeg (Marsh 2014). While information for this thesis

comes from both the South Saskatchewan River and Qu'Appelle River contexts, the Qu'Appelle is of central importance because of our research partner, the Lands, Resources, Environment, Stewardship Department of File Hills Qu'Appelle Tribal Council (FHQTC-LRES). The Department represents 11 Member First Nations that exercise their Treaty and Inherent Rights in the Qu'Appelle River Valley.

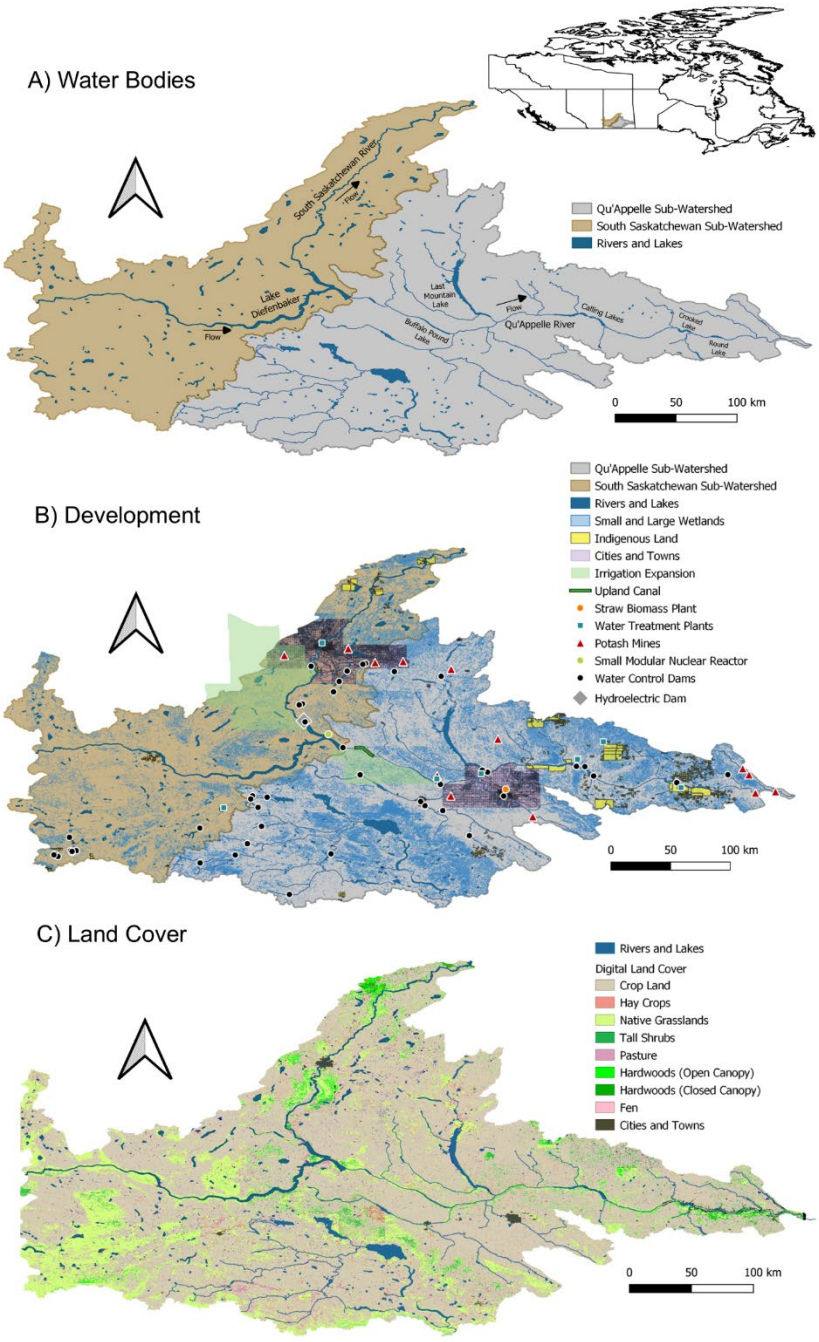


Figure 1.1. A map of the Qu'Appelle and South Saskatchewan sub-watersheds in Saskatchewan, Canada with rivers and lakes (A), development (B), and land cover (C). Land cover is from the Government of Saskatchewan GIS hub and is updated to November 21, 2023. All mapped developments in B) exist, except for the Lake Diefenbaker Irrigation Expansion, which is in development. Possible new potash and grain crushing plants are not displayed here, as their locations are not yet publicly available or determined.

The Qu'Appelle River Valley is a 52,000 km^2 sub-basin of the Assiniboine River Basin in southern Saskatchewan (Leavitt et al. 2006). The Qu'Appelle River Valley includes the lower-order Qu'Appelle River which begins at mesotrophic Lake Diefenbaker and then travels eastward through eutrophic Buffalo Pound Lake, hypereutrophic Pasqua Lake, and onward through a series of lakes before joining the Assiniboine River (Hall et al. 1999). The Qu'Appelle River receives water from upstream Lake Diefenbaker (from glacial-fed South Saskatchewan River), snowmelt off the landscape, and is regulated with the Qu'Appelle Dam at Lake Diefenbaker and water control structures (Haig et al. 2021). The Qu'Appelle River Valley drains farmland and livestock (e.g., winter wheat, canola, mustard; ~70%), cities (Regina, Lumsden, and Moose Jaw), and native prairie grasslands (15%) (Hall et al. 1999; Swarbrick et al. 2021) (Figure 1.1C). While downstream lakes in the Qu'Appelle River Valley are naturally rich in phosphorus (Hammer 1971), city and agricultural nitrogen pollution has created a gradient of mesotrophic to hypereutrophic water bodies from Lake Diefenbaker to Pasqua Lake, with downstream ecosystems and First Nations being most affected (Leavitt et al. 2006; Sardarli 2013). While a wastewater treatment plant upgrade (2017) by the City of Regina has recently reduced nitrogen inputs to the Qu'Appelle Valley (Bergbusch et al. 2021), runoff from urea-based fertilizer continues to pollute this system (Swarbrick et al. 2021). In the future, nitrogen inputs, flooding, and drought may increase with greater agricultural production, wetland drainage, irrigation, and climate change (WWF-Canada 2017; Vogt et al. 2018).

Our partner, FHQTC-LRES, represents 11 Treaty Four Member First Nations, with five distinct official languages and cultures (Nakoda, Saulteaux, Cree, Dakota, and Lakota), who have been using the Qu'Appelle River and chain of lakes since time immemorial (FHQTC 2020) (Figure 1.2). Member Nations include Carry The Kettle Nakoda First Nation, Little Black Bear's Band of Cree & Assiniboine Nations, Okanese First Nation, Peepeekisis Cree Nation, Muscowpetung First Nation, Nekaneet Cree Nation, Pasqua First Nation, Piapot First Nation, Star Blanket Cree Nation, Standing Buffalo Dakota Nation, and Wood Mountain Lakota First

Nation (FHQTC 2020). FHQTC-LRES is governed by an Executive Council, advised by councils (Chiefs Committee, Life Speakers, Women, Youth), and serves 11 Treaty Four Member First Nations (FHQTC 2020). FHQTC has a Tribal Chief, Director of Lands and Resources, Director of Finance and Administration, and various advisory councils. FHQTC-LRES considers water regulation, rights, habitat, quality/quantity, cumulative effects, and water governance. The goal of FHQTC with researchers is to enrich FHQTC, including governance systems, environmental stewardship, and evidence-based research approaches.

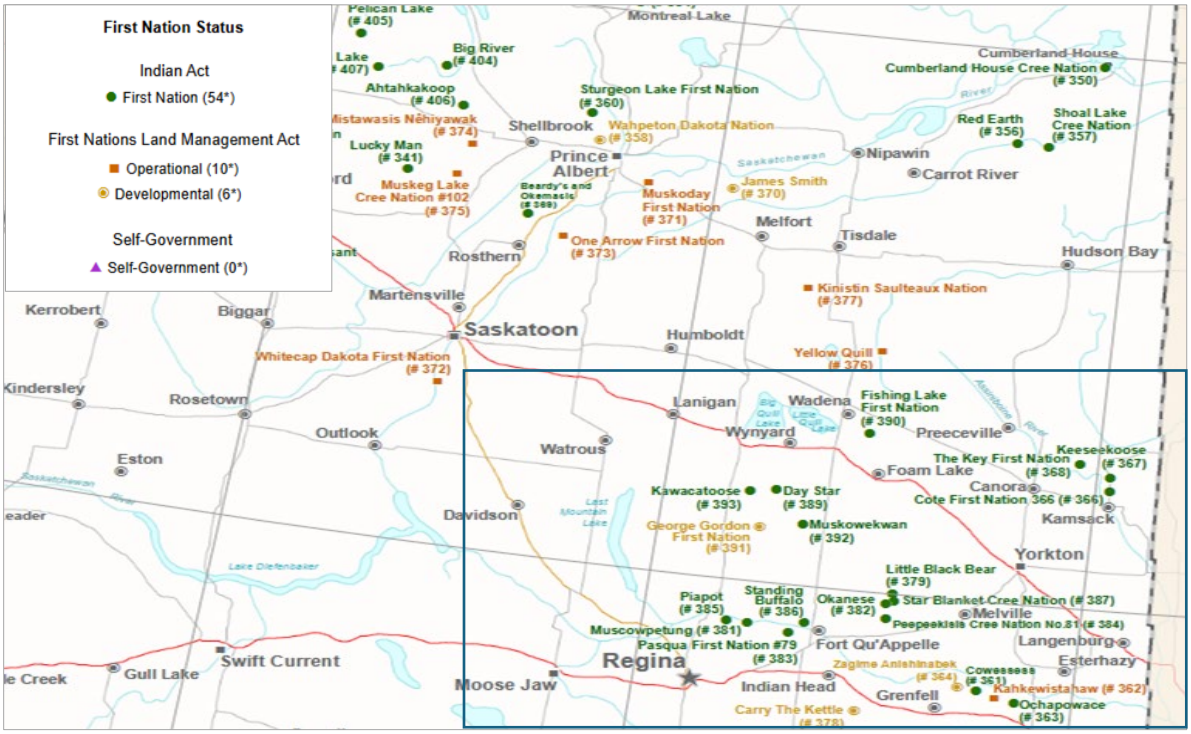


Figure 1.2. A map of Treaty Four and Six First Nations in southern Saskatchewan. The middle to bottom right from Lake Diefenbaker onward is the Qu'Appelle River Valley and is demarcated with a dark blue outline. Green points represent First Nations under the *Indian Act*. Orange and yellow boxes and points represent the *First Nations Land Management Act*. This map was taken from Indigenous Services Canada (Government of Canada 2025b).

File Hills Qu'Appelle Tribal Council's Member Nations are located along different parts of the Qu'Appelle Valley (Figure 1.2). Piapot, Pasqua, and Muscowpetung First Nations reside on the shoreline of Pasqua marshland and lake. Standing Buffalo is located between Pasqua and Echo, and Starblanket, Little Black Bear, Okanese and Peepeekisis are North of Qu'Appelle River mainstem close to Mission and Katepwa lakes. Carry-the-Kettle is south of the Qu'Appelle River before Goose and Crooked lakes. Other nations that have relationships with FHQTC, but

are not formal members, include Cowessess, Zagime Anishinabake, and Ochapawace, which are located near Goose and Crooked lakes. A proposed $4 billion irrigation expansion project and wetland drainage in Saskatchewan, Canada may alter water quantity/quality and potentially limit the practice of Treaty and Inherent Rights in the Qu'Appelle River sub-watershed by the File Hills Qu'Appelle Tribal Council's (FHQTC) Member Nations and Indigenous Nations in the South Saskatchewan River sub-watershed (Glover 2020; Warick 2020; FSIN 2021; Ritchie 2023).

Irrigation and wetland drainage projects have had and will have costs and benefits to the environment and people in the Qu'Appelle and South Saskatchewan River sub-watersheds. For additional abstraction, the Government of Saskatchewan has proposed and begun construction in 2024 (phase one) for the $4 billion Lake Diefenbaker Irrigation Expansion (Figure 1.1B), which will expand river canals at the outflows of Lake Diefenbaker's Gardiner and Qu'Appelle Dams to increase irrigated farmland by 500,000 acres (Glover 2020; Ruttle 2024). Historically, Saskatchewan's agricultural industry has been primarily dryland farming (wheat, canola, flax, mustard), but the new project will expand their irrigation farming base and potentially other water-dependent and polluting industries (e.g., potash mining, wheat straw pulp mills, and canola seed crushing plants) (Leavitt 2021). This planned expansion is occurring in three phases over the next 10 years in the following order: 1) the Westside South Saskatchewan irrigation rehabilitation, 2) the Westside South Saskatchewan irrigation expansion, and 3) the South Water Conveyance at Qu'Appelle (Glover 2020; Ruttle 2024). Co-occurring with water withdrawal is the drainage of small and mostly ephemeral agricultural wetlands throughout the province facilitated through an upcoming Agricultural Water Stewardship Policy (WSA 2023a). Irrigation and drainage have not been formally designated for impact assessment by either provincial or federal authorities (Impact Assessment Agency of Canada 2019a, 2021). The Impact Assessment Agency of Canada has considered the irrigation expansion as three separate projects and that phase three could be designated under the Impact Assessment Agency of Canada's *Physical Activities Regulations* (Impact Assessment Agency of Canada 2021).

Concern by the Federation of Sovereign Indigenous Nations (FSIN 2021), File Hills Qu'Appelle Tribal Council (FHQTC 2021a), scientists (Kurz 2021; Leavitt 2021), and conservation groups (Globalanna 2020) has been expressed about the impacts of water abstraction and drainage. A counter wetland protection bill proposed by the opposition party to

the Government of Saskatchewan features greater collaboration and consultation and assessment of cumulative effects (Ritchie 2023). Consultation of Rights holders for these projects has also been lacking and deemed inadequate by Indigenous authorities (FHQTC 2021a; FSIN 2021; Ritchie 2023). Potential impacts include loss to native prairie grassland, threats to migratory birds, damage to at-risk fish and fish habitat, erosion of shorelines, cumulative effects to water quantity and quality, and breach of Treaty and Inherent Rights of Indigenous Nations (Treaties Four and Six), among others (FHQTC 2021a; FSIN 2021; Leavitt 2021; Ritchie 2023). Federal rules under the *Fisheries Act* (especially the protection of fish habitat under the 2019 Act modernization), *Migratory Birds Convention Act* (certain waterfowl), *Species at Risk Act* (e.g., Piping Plover, Leopard Frog, Whooping Crane, Forster's Tern), and *Navigable Waters Act* (use of waterways by Indigenous people) may be breached because of these projects (FHQTC 2021a; Leavitt 2021; Ritchie 2023). Some of the impacts will be felt locally while others will be felt regionally. Specifically, impacts will occur in Lake Diefenbaker, the South Saskatchewan River sub-watershed, and the Qu'Appelle River sub-watershed. Extensive agricultural land use and upstream water abstraction and drainage projects that affect downstream aquatic ecosystems and Indigenous Nations set the context for this thesis that applies collaborative water governance, water justice, environmental and cultural flows, and impact assessment frameworks and approaches.

1.2 Thesis Objective and Organization

The central question of this dissertation is: how can governments and people protect environmental and cultural flows and water through collaborative governance and impact assessment? To address this question, I explore issues and options in six publishable, co-authored chapters that range from international, national, and regional scales (Fig. 1.3).

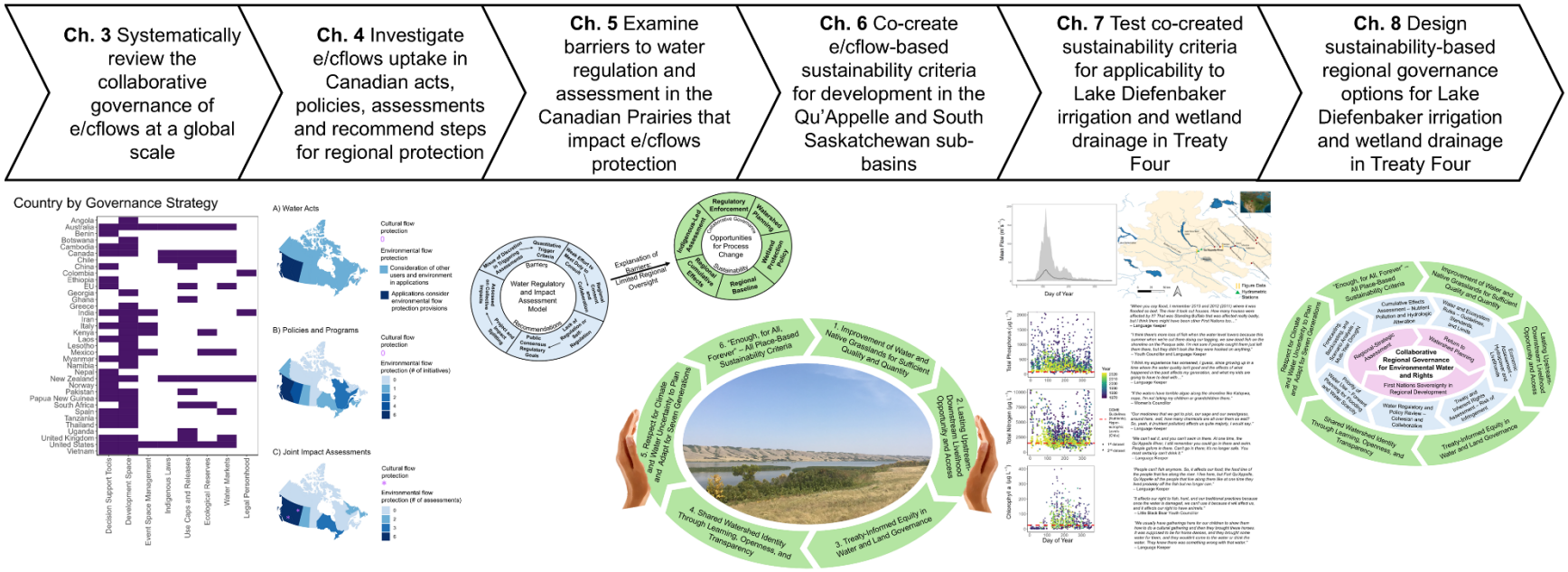


Figure 1.3. A roadmap of co-authored chapters (3-8) and their objectives. Diagrams below are key figures from each data chapter. E/cflows refers to environmental and cultural flows.

Before these chapters (Figure 1.3), I reflect on my relationship building with partners and the methodology that led to the research projects in Chapter 2. I describe the research co-creation process with FHQTC-LRES.

Chapter 3 is an international systematic scoping review of the primary literature on the collaborative governance of environmental and cultural flows. This study was an opportunity to evaluate international environmental and cultural water governance and identify key collaborative governance strategies to inform the Canadian context. The Organization for Economic Co-operation and Development (OECD) Water Governance Principles are employed to evaluate governance criteria from centralized and decentralized watershed governance contexts. This review presents information from six continents: Africa, Asia, Europe, North America, Oceania, and South America.

I then review Canadian legislation, policies, programs, and impact assessments to explore how environmental and cultural water concepts have been considered in Canada (Ch. 4). This synthesis is complemented by interviews with experts and practitioners to discuss how environmental and cultural water concepts are and could be included in higher-level impact assessment. I took a grounded theory approach for this study to first speak with contributors knowledgeable in environmental and cultural flows to create themes that informed conversations with impact assessment practitioners. Conversations and emergent exemplary cases informed steps needed to protect environmental and cultural water at different levels of impact assessment. Exemplary cases described by contributors included the Mactaquac Dam Ecologic Limits of Hydrologic Alteration process, the Mikisew Cree Culture and Rights Assessment, the Strategic Action Plan for Wood Buffalo National Park, the Treaty Three Nibi Declaration, and the Yinka Dene Water Quality Standards and Guidelines.

The next four chapters (5-8), set in my home province of Saskatchewan in the Canadian Prairies, were developed with the FHQTC-LRES and Dr. Peter Leavitt from the University of Regina. These chapters include information from interviews, workshops, and policy analysis but also complementary long-term hydrology and water quality data. The methodology for these studies is case study research with elements of action research. The focus of these chapters is the Qu'Appelle River Valley, but information is also presented about the South Saskatchewan River and Assiniboine River basins. Chapter 5 identifies barriers and opportunities in the current water

regulatory model and environmental impact assessment process in Saskatchewan through reflections on the Lake Diefenbaker Irrigation Expansion, the Quill Lakes Drainage Project, and the Yancoal Potash Mine – projects relevant to water allocation, quality, and rights (i.e., environmental and cultural flows). The next chapter (Ch. 6) documents the development of flow- and place-based sustainability criteria with Rights holder and stakeholders for water development in the Qu'Appelle River and South Saskatchewan River sub-basins. Chapter 7 then tests the suitability of these criteria against regional vulnerabilities, trade-offs, and alternatives of irrigation and drainage in these sub-watersheds. Lastly, I present regional collaborative governance options and initiatives to support sustainability criteria and evaluate existing governmental programs for their ability to substitute for these options (Ch. 8).

Taken together, I discuss a potential package of required criteria and initiatives for collaborative processes to protect environmental and cultural water in impact assessment and watershed governance. I then discuss how this research can inform policy and future academic study and end with concluding remarks (Ch. 9).

CHAPTER 2. CO-CREATION AND METHODOLOGY

2.1 Relationship-Building

A prerequisite of all research co-creation frameworks is an existing, long-term relationship that can be built upon in a mutually beneficial and generative way (Drawson et al. 2017; Jimmy et al. 2019; Reid et al. 2021). In these early stages, I was contemplating different research directions and collaborations, reflecting on how co-created knowledge is gained to fulfill research relationships (Wilson 2001, 2008; Kovach 2011). At the beginning of my doctorate (fall 2020), I had some existing relationships with File Hills Qu'Appelle Tribal Council (FHQTC), and my mentors and colleagues generously offered their long-term social and research networks that I could build on to support this work. My existing relationships were from my master's degree in freshwater science at the University of Regina. These relationships were more from an educational program and development capacity than from a research capacity. During the last two years of my master's (2018-2019), I co-led the University of Regina's contribution to the Treaty Four Gathering with partners within FHQTC. While this relationship-building was not directly with the Lands, Resources, Environment, and Stewardship Department (LRES) (albeit there was communication and coordination between us at the time), being part of FHQTC's Treaty Four Gathering Committee gave me a foothold and relationships and networks to build upon. I am grateful to Peter Leavitt, my former master's supervisor, who offered me these opportunities and extended his network to me. For example, one such connection that I made during the Treaty Four Gathering through Peter Leavitt was Wendall Starblanket, Traditional Knowledge Keeper and Helper from Starblanket First Nation. I remember Wendall Starblanket teaching us to set up tipis for the gathering in September 2018 and 2019 at the Treaty Four Governance Centre in Fort-Qu'Appelle beside Pasqua Lake and the Qu'Appelle River. Peter and Wendall in particular helped set the course for my Ph.D.

At the start of my Ph.D. at the University of Waterloo in Social and Ecological Sustainability, I was living in Regina, Saskatchewan, where I had grown up for 24 years. At this time, I reached out to Wendall, who graciously offered me his time and guidance again. Over dinners and conversations at Wendall's home in the Qu'Appelle Valley in Winter and Spring 2021, we talked about many things but in particular Indigenous Treaty and Inherent Rights and water sustainability, reflecting on proposed developments upstream and around the Qu'Appelle River Valley and South Saskatchewan River. I remember these conversations led Wendall to give

me the gift of braided sweetgrass to, from what I understand, hope for a good research process (Wilson 2008; Kimmerer 2013). Wendall suggested I reconnect with the Lands, Resource, Environment, and Stewardship Department of File Hills Qu'Appelle Tribal (FHQTC-LRES) to see if there were opportunities to work together in a mutually beneficial way.

I reached out to Shannon Thomson, the Director of the Lands, Resources, Environment, and Stewardship Department, and started the beginning of a research partnership. Wendall Starblanket and Peter Leavitt vouched for me during the beginning of this process. The relationship building over the last three to four years was primarily with Shannon Thomson (Director), David Fortin (Environmental Scientist and Program Coordinator), and Advisory Council members (mainly the Language Speakers, Women, Youth). The relationship building was part of the methodology for this work, as there was a mutual recognition of the need to fulfill my obligations to FHQTC-LRES, build a relationship between myself and the research topic, and build relationships with myself and research collaborators (Wilson 2001, 2008). The relationship building was in person and from afar (as I was completing Ph.D. milestones at Waterloo) fulfilling numerous research contracts for the Department, such as for their cumulative impacts and First Nations-led impact assessment portfolios. They graciously compensated me for this work and there were many exchanges online and in person between me, David, and Shannon to build relationships through these research contracts that set the context, trust, and understanding for a potential research partnership. Other relationship building, with the Youth Council in particular, happened in-person through the Youth Water Summit at which I presented and the Cypress Hills retreat, where I led educational activities. This relationship building occurred throughout the research co-creation process but also ebbed and flowed as opportunities emerged. Fundamental to this relationship building process for me was decolonization practice (Grisold et al. 2017; Liboiron 2021; Smith 2021b) – "becoming, unlearning, and relearning regarding who [I am] as a researcher and educator, and taking responsibility for participants" (Datta 2018, p. 2). I am grateful to David, Shannon, and the council members for the opportunities offered to me to unlearn and relearn throughout this relationship building. I also continued to work with Peter Leavitt on projects, who was a vital part of this collaboration.

2.2 Project Development and Co-Creation

Throughout the relationship-building process, I discussed research ideas with the Lands, Resources, Environment, and Stewardship Department. One intention of working on the Department's research portfolios was so that I would understand their governance structure and goals and projects related to the protection of Treaty and Inherent Rights. This then helped create a "mutual research interest" – a criterion of some co-creation frameworks (Reid et al. 2021, p. 13). I learned that the FHQTC-LRES was concerned about how changes to water quantity and quality from development projects and climate change could lead to a breach of Treaty Four and Inherent Rights (FHQTC 2021a; Leavitt 2021). Working on their cumulative effects and First Nation-led assessment portfolios helped us to co-create an area of mutual research interest. The area identified was about investigating water governance and impact assessment processes to make recommendations for higher-level, regional, sustainability-based guidance and Indigenous leadership to protect water quantity and quality. This area was also about furthering an evidence-based approach for the Lake Diefenbaker Irrigation Expansion and agricultural drainage to understand impacts affecting the Qu'Appelle River Valley and neighboring sub- watersheds. Together, we "identified required tools" (Reid et al. 2021, p. 13) or information needed to answer these questions, including interviews, workshops, mapping information, policies and government documents, and long-term hydro-ecological data (Kovach 2009; Candler et al. 2010; Crowe et al. 2011; Morgan 2022). "Research co-development" (Reid et al. 2021, p. 13) then occurred in which these projects were included in the Tribal Council's Impact Assessment Agency of Canada research proposal; I presented to the Executive Council, Chiefs Committee, and other councils at the Treaty Four Governance Centre on August 23, 2022; and David, Shannon, the Youth Council, and my committee helped design the interview and workshop guides.

2.3 Research Ethics and Ownership, Control, Access, and Possession Agreement

This research project underwent research ethics through the University of Waterloo's Research Ethics Board (#44209, #44504, #44463) and FHQTC's Executive Council. This ethics and research process were supported by training I did in Ownership, Control, Access, and Possession (OCAP) Principles; decolonial methodologies; cybersecurity protocols; cumulative effects assessment; and environmental and cultural flows. Part of the ethics process was the creation of a tri-partite OCAP Data Sharing Agreement between the University of Waterloo,

University of Regina, and FHQTC-LRES to respectfully and carefully share social science, natural science, Indigenous Knowledge, and policy information (FNIGC 2024). This Data Sharing Agreement was created to ensure Indigenous data sovereignty.

Indigenous data sovereignty means for Indigenous Nations and Tribal Governance Centres to "control the collection and use of data by and about them" and have "authority over information about the tribes, their resources, and their members" (Tsosie 2019, p. 229). Indigenous data sovereignty includes the CARE principles: "Collective benefit", "Authority to control", "Responsibility", and "Ethics" (Jennings et al. 2023, p. 1549). These principles were demonstrated through 1) mutual capacity building before research and during orientations, ongoing sharing through FHQTC-specific reports, and compensation for research (collective benefit); 2) FHQTC-LRES control of Advisory Council transcripts from workshops and ongoing publication with FHQTC-LRES approval (authority to control); 3) research being driven by FHQTC-LRES's long-term research needs (responsibility; 4) and the creation of a protective data management plan set out in the Data Sharing Agreement and ethics approval by FHQTC's Executive Council (ethics). First Nations data is stored with FHQTC-LRES in perpetuity and at the University of Waterloo for seven years after thesis completion. At the University of Waterloo, data is protected in a password-protected computer and with encrypted folders. Together, the ethics processes and Data Sharing Agreement supported Indigenous data sovereignty through ethical and respectful care of Indigenous data (Kovach 2009; Tsosie 2019; Latulippe and Klenk 2020; Walter et al. 2020; Jennings et al. 2023). The Data Sharing Agreement was fully completed on June 27, 2023, and can be found in Appendix D. As per the Data Sharing Agreement, separate reports were completed for FHQTC with summary information and more specific content from their workshops.

2.4 Research Process

We employed case study research and participatory action research methodologies for this co-created research initiative (Crowe et al. 2011; Vaughn and Jacquez 2020). Action research aligns well within an Indigenous research paradigm because "the idea is to improve the reality of the people with whom you work" (Wilson 2001, p. 178). For this case study, in which a system is researched in-depth with multiple sources of information (Crowe et al. 2011; Priya 2021), we chose proposed developments within the Qu'Appelle River sub-watershed and the adjacent

South Saskatchewan and Assiniboine sub-watersheds. These developments were of interest because they are at the nexus of water governance, impact assessment, Treaty and Inherent Rights, cumulative effects, and environmental and cultural flows (Leavitt 2021). The participatory action research component came from co-designing research questions, holding orientations with councils, and hosting a narrative workshop in a talking circle format to the best of our ability (Hall and Smith 2000; Datta 2018; Vaughn and Jacquez 2020). Tobacco offerings and a prayer by an Elder chosen by the Tribal Council were part of this process in the hope of creating a safe, respectful, and generative environment (Hall and Smith 2000; Wilson 2008; Datta 2018; Vaughn and Jacquez 2020). In this way, "decisions [were] made together in a mutually defined process; [there was and still is] collective accountability; adequate resource-sharing to ensure appropriate and just engagement; [and] attention to different sensibilities" (Jimmy et al. 2019, p. 34). In particular, both the University of Waterloo and the Lands, Resources, Environment, and Stewardship Department contributed funds for the honoraria of orientation and workshop participants. While both knowledge sharing frameworks and the action research methodology include co-evaluation and analysis with the community, I was entrusted with the sole analysis of all interview/workshop transcripts, documents, and long-term hydro-ecological information by the Department because many interviews were with people external to the Tribal Council, there was extensive information to synthesize and collate, and this task was perceived by the Department as my responsibility. However, we are in the process of "community validation" and "shared recognition and co-benefits" (Hall and Smith 2000; Reid et al. 2021, p. 13; Jennings et al. 2023). Note as well that chapters three and four were not directly part of this knowledge co-creation process but set the foundation for the project with FHQTC-LRES and the relationship-building and co-creation process indirectly influenced the design of these projects.

2.5 Lessons for Future Co-Creation

My three main takeaways related to knowledge co-creation are about time management, place-based research, and clarity of objectives. First, two and half to three years of my Ph.D. were spent in the relationship building and project development phases, yet I still think more time could have been spent building relationships, and I believe that relationship building is never finished and should continue. Ph.D. timelines in Canada generally allocate four years for a Ph.D. but, from my understanding, rarely include a year for knowledge sharing and mobilization.

If institutions, supervisors, and funding agencies wish for students to work with community partners (especially if partnerships are formed through the student's connections) in a generative way, they should anticipate the need for funding and timeline flexibility and potentially offer supplementary grants at the end of graduate programs to finish knowledge dissemination and community validation. Second, while relationship building and the research were both in person and online, I wondered throughout the project if I was present in person enough to engender place-based and contextual knowledge sharing and if this work ever constituted "helicopter" or "parachute" science that leads to incomplete stories, conversations, and projects (Jennings et al. 2023; Leonard et al. 2023). However, I was assured by FHQTC-LRES that a lot of this research could occur virtually and there has been a commitment to continued conversation and outputs. Lastly, I came into the research relationship with open-ended ideas and objectives for this project on water sustainability. We then designed research questions and ideas together, but I could have done a better job continuing to articulate the objectives and how they changed to FHQTC-LRES so that there was slightly more clarity throughout the process. However, now that research outputs are being shared, research objectives and mutual benefit are clearer, and I am still continuing to unlearn and relearn.

CHAPTER 3. A SYSTEMATIC SCOPING REVIEW OF THE COLLABORATIVE GOVERNANCE OF ENVIRONMENTAL AND CULTURAL FLOWS

3.1 Overview

This study systematically reviews English-language papers about the collaborative governance of environmental and cultural flows. With mixed-methods analyses, we illustrated that the determination of environmental flow needs is common, with authors in 42 countries across 112 watersheds describing their management. In contrast, cultural flows (characterized by attention to both ecological and non-ecological needs, decision-making authority of Indigenous Nations, and Indigenous rights) were reported only in papers by authors in commonwealth, colonial countries: Australia, Canada, and New Zealand. Evaluated against the Organisation for Economic Co-operation and Development's (OECD) Water Governance Principles, we found that the literature reported efforts that considered appropriate local and regional scales, information and data, regulatory frameworks, and capacity building of communities and authorities engaged in environmental and cultural flow initiatives. However, there was limited consideration of the roles of communities in policymaking, which was more common in jurisdictions with decentralized governance. In jurisdictions with democratic community-based initiatives, environmental and cultural flows have not been approached in merely technical processes to communicate hydro-social-ecological information to decision-makers. Instead, the initiatives have created the context for evaluating new developments at the watershed level in light of communities' social and ecological water goals, collaborating during unique drought and flooding conditions, working to rebalance power in decision-making through water justice, creating ecological and Indigenous reserved water rights, granting legal personhood for rivers, and protecting water for the environment and dependent people in water markets. Going forward, we identify a need for greater attention to community roles in environmental and cultural flows protection in water governance including policy creation and evaluation, regulatory initiatives, strategic planning, and impact assessments.

3.2 Introduction

In this paper, we discuss the collaborative governance of environmental, environmental-social, and cultural flows (Table 3.1). Environmental flows have been defined in the Brisbane Declaration (2007, p. 1) as "the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems." The concept of environmental water is similar to environmental flows in that environmental water is the amount of water protected for the environment, whereas environmental flows refers to the delivery of that environmental water spatially and over time (Horne et al. 2017f). Recent changes to the definition of environmental flows have included more attention to social values and human systems (environmental-social flows). In the 2018 update to the Brisbane Declaration, environmental flows were defined as "the quantity, timing, and quality of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods, and well-being" (Arthington et al. 2018, p. 4). This update has been reflected in recent work by scholars who identify a need to incorporate hydro-social-ecological information and diverse ways of knowing into basin management for surface and groundwater (Anderson et al. 2019; Douglas et al. 2019). In contrast, the concept of cultural flows has emerged as a response to the exclusion of Indigenous Peoples and rights in environmental flow assessments and has been described by Australian Indigenous Nations through the Echuca Declaration (2007, p. 2) as "…water entitlements that are legally and beneficially owned by the Indigenous Nations of a sufficient and adequate quantity and quality to improve the spiritual, cultural, environmental, social and economic conditions of those Indigenous Nations." This definition includes both ecological and non-ecological needs, decision-making authority of Indigenous Nations, and Indigenous rights (Leonard et al. 2023; O'Donnell and Macpherson 2023). Together, these concepts reflect a movement towards the protection of water for the environment, people, and rights in water management.

Table 3.1. Definitions of environmental flows/water, environmental-social flows/water, and cultural flows/water. Words following quoted text are criteria to identify these concepts in collaborative governance settings.

Term	Definition
Environmental Flows/Water	"The quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems" - Brisbane Declaration (2007), updated Brisbane Declaration and Global Action Agenda (2018, p. 2) Ecological needs and inclusive decision-making in the same political system.
Environmental-Social Flows/Water	"The quantity, timing, and quality of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods, and well-being." – Updated Brisbane Declaration and Global Action Agenda (2018, p. 4) Ecological and non-ecological needs and inclusive decision-making in the same political system.
Cultural Flows/Water	"….water entitlements that are legally and beneficially owned by the Indigenous Nations of a sufficient and adequate quantity and quality to improve the spiritual, cultural, environmental, social and economic conditions of those Indigenous Nations." – Echuca Declaration (2007, p. 2) Ecological and non-ecological needs with decision-making authority of Indigenous Nations (a separate sovereign political system), and Indigenous rights.

The Brisbane Declaration and Global Action Agenda, established in 2007 and updated in 2018, made a recommendation to "integrate environmental flow management into every aspect of land and water management" (International River Foundation, 2007, p. 3). However, six years after the Brisbane Declaration, Pahl-Wostl et al. (2013) found limited evidence of the integration of environmental flows principles in water management and governance and no evidence that this recommendation had been taken up in most countries. More recently, scholars have called for greater attention to how environmental flows are characterized in basin planning and governance and how we value water for sustainable development (Garrick et al. 2017; Horne et al. 2017d; King and Brown 2018). Historically, environmental flows studies have focused on new methodologies and approaches (Tharme 2003; Linnansaari et al. 2013; Poff and Matthews 2013), rather than governance change or policy implementation (Opperman et al. 2018; Wineland et al. 2022). Attention to cultural flows has generally occurred as a response to the

shortcomings in environmental flows approaches that omit tangible and intangible social and cultural values, Indigenous rights, and linkages to wider Indigenous decision-making (Finn and Jackson 2011; Moggridge and Thompson 2021b; Woods et al. 2022; Arthington et al. 2023). There is a need then to understand whether and how environmental and cultural flows have been considered in different types of water governance contexts to help with the implementation and application of sustainable watershed governance, especially in countries or regions with inequitable distribution of water resources and water decision-making authority.

In this review, governance refers to "the set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes" (Lemos and Agrawal 2006, p. 298). Governance is about how decisions are made, who is accountable for those decisions, and how the decisions are operationalized (Gupta et al. 2013). Decision-making occurs through both formal (legislation, policies, and guidelines) and informal (behaviours, norms, and relationships) mechanisms to structure how people relate and interact across scales (Cortner et al. 1998). Generally, types of governance include state-based (control by country), community-based (control by community), market-based (market or private mechanisms) or hybrid forms, such as public-private (facilitation between state and private sector), co-governance (shared authority and collaborative decision-making between two sovereign political systems), and polycentric governance (multiple semi-autonomous decision-making centres) (Bourceret et al. 2021). These types of governance that engage non-state actors are more collaborative forms of water governance. Note that inclusive decision-making with non-Indigenous communities in the same political system is different from power sharing with Indigenous Nations that have their own sovereign political system (Table 3.1). Good environmental and water governance is "characterized by polycentric institutions, legitimacy and transparency, empowerment and social justice, diversity of participating actors, and where multilevel institutions are matched with social-ecological dynamics" (Plummer, Armitage and De Loë 2013, p. 20). There has been a shift in environmental institutional arrangements from an emphasis on government to governance, reflecting the need to decentralize decision-making and provide equitable opportunities for collaborations linking local-level grassroots communities, private authorities, markets, and regional government-level managers (Armitage et al. 2012). Structuring governance in this way, with nested scales of decision-making, can be a way to match and manage according to the social-ecological complexity of systems (Epstein et al.

2015). However, finding leverage points and transformative pathways to democratize water governance, while effectively supporting communities in understanding complex connections between scales, is difficult (Meadows 1999; Gupta et al. 2013; Sultana 2018). Water governance that recognizes environmental and cultural flows is a way to address these challenges.

Achieving sustainability and equity in water governance requires greater attention to involvement of communities in management across spatial, temporal, and institutional scales (Vörösmarty et al. 2015; Sultana 2018). The updated Brisbane Declaration (2018, p.12) states, "The full and equal participation of all cultures, and respect for their rights, responsibilities, and systems of governance in environmental flow decisions can strengthen sustainable outcomes for cultures, economies, livelihoods, and well-being." Partnering with communities, Indigenous and non-Indigenous, or building local autonomy and shared governance in water decision-making has proven to be difficult because of limited attention by governments to Indigenous water rights and the Inherent Rights of Indigenous entities to self-govern water management, and to give or withhold free, prior, and informed consent (UN General Assembly 2007; Harmsworth et al. 2016; Robison et al. 2018). Greater uptake of approaches centred on environmental and cultural flows may create more opportunities to democratize water governance. This could occur through a greater understanding of institutional and actor roles and responsibilities in protecting environmental and cultural water (Nowlan 2012; Jackson et al. 2015; Phare et al. 2017; Woods et al. 2022).

Community participation and leadership in environmental and cultural flow initiatives has occurred on a wide spectrum, and in the last decade, there has been a recognition that these processes engender a shared understanding of water systems, which can drive opportunity for innovative and collaborative water management at local and regional scales if there is fairness, legitimacy, and trust in environmental water allocation (Conallin et al. 2017; Godden and Ison 2019; Mussehl et al. 2022; Kosovac et al. 2023). To evaluate this opportunity and identify gaps and opportunities in the governance of environmental and cultural flows internationally, we present a systematic literature review of recent peer-reviewed journal articles and book chapters. This review seeks to uncover how environmental and cultural flows concepts have been investigated and adopted in different watershed governance contexts to support community involvement in decision-making. Our research questions include investigating where the collaborative governance of environmental and cultural water is occurring, how this governance

is characterised (centralized and decentralized), what methods are employed, how OECD Principles are taken up, and through which governance strategies are environmental and cultural water protected. We also identify gaps and directions for further scholarly research and improved governance.

3.3 Approach

In Canada, there has been an identified need to democratize water governance, including regulatory frameworks, policies, and management, through greater community involvement in environmental flow decision-making and the recognition of cultural flows (Nowlan 2012; Curran 2019). This review acts on an opportunity to describe countries' strategies to democratize water governance through flow management processes and inform the Canadian context.

We employed a systematic scoping review method to investigate international peer-reviewed literature related to the adoption of environmental and cultural flows in different governance contexts. While systematic literature reviews are used to assess the effect of interventions and outcomes within well-defined bodies of literature (Petticrew and Roberts 2006), systematic scoping reviews are used to understand and characterize emergent bodies of literature and different approaches and methodologies taken to achieve those actions and goals (Peters et al. 2015; Mueller et al. 2018). Pahl-Wostl et al. (2013) identified a decade ago that environmental flows are rarely related to water governance but should be. Therefore, the intention was to determine how environmental and cultural flows have been addressed in collaborative water governance contexts and characterized from 2010 to 2024. Pahl-Wostl et al. (2013) published a similar review in 2013, so we hoped to examine the literature a decade later and included papers from 2010-2013 in case the previous review omitted these papers due to a lag in time from paper composition to publication. Our approach applied methods similar to those used for systematic reviews in the field of social-ecological systems change (Alexander et al. 2019, 2021; Andrews et al. 2021; Eger et al. 2021) and in recent environmental flows reviews (Owusu et al. 2021).

Our systematic review process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and consisted of four steps (Moher et al. 2015): 1) research questions development, 2) search protocol, 3) inclusion and exclusion through

a screening process, 4) mixed-method data collection and analysis of the sample of literature to investigate research questions.

3.3.1 Research Question Development

Our research question was developed following the PCC (Population, Concept, Context) and PICO (Population, Intervention, Comparison, Outcomes) frameworks (Methley et al. 2014; Peters et al. 2020). Our population was human communities and the ecosystems they depend on within watersheds. Our concept was to discuss the implementation of environmental flows and cultural flows policies, plans, and projects. Our context and outcomes were related to water governance arrangements and potential shifts in governance, and we compared cases from six continents (Asia, Africa, North America, South America, Europe, Oceania) focusing only on those papers written in English, reflecting our own limited capacity.

3.3.2 Search and Screening Strategy

Our search strategy included terms for environmental and cultural flows, governance, and communities (Table 3.2). We used the terms environmental and cultural flows to highlight ecological and social initiatives and collaborative approaches. Literature searches were trialed, completed, and iterated between August and October 2022 and updated in 2024, following strategies from an evidence synthesis workshop. Our search strategy included abstracts, titles, and keywords in SCOPUS and Web of Science, ProQuest (all parts of the document [titles, abstract, key words] except full text), and Informit. We chose these search engines because of their breadth and scope (social and natural sciences), as well as the ability to access journal articles, book chapters, and theses. While SCOPUS and Web of Science are more natural science focused, ProQuest includes many social science (PAIS International, ABI/INFORM, International Bibliography of the Social Sciences) and governance (Worldwide Political Science Abstracts) repositories and Informit is an Australian-based and global search engine that covers social science, legal, Indigenous, and governance scholarship. We investigated other search engines, but these were ultimately excluded because of either few or zero results (JSTOR, Indigenous Knowledge Portal, Oxford Handbooks Online) or no ability to search exclusively for abstracts, titles, and keywords (Google Scholar, Heinonline). Citation tracing was completed to include papers that were missed in the main search, but these papers were included as supportive material rather than part of the main data set, figures, and analysis.

Table 3.2. The final search string implemented in Scopus, Web of Science, ProQuest, and Informit for a systematic scoping review of environmental and cultural flow concepts in decision-making.

Environment and Cultural Flows	Eflows OR "Environmental flows" OR "Cultural flows" OR "Indigenous flows" OR "Ecological flows" OR “Instream flows” OR “In-stream flows” OR “Environmental water” OR “Cultural water”
System	Watershed OR Catchment OR Basin OR "River Basin" OR Floodplain OR "Drainage Area" OR Lake OR Estuary OR River OR Wetland OR Water
Governance	Manag* OR Co-manag* OR Plan* OR Govern* OR Co-govern* OR Sustain* OR "Decision making" OR Polic* OR “Environmental assessment” OR “Environmental impact assessment” OR “Impact assessment” OR Regulat*
Population	Stakeholder OR "Rights holder" OR Indigenous OR Aboriginal OR People OR Communit* OR Human OR Collaborat* OR Partner*

Two levels of screening were completed in an online review tool (covidence.org) based on predetermined exclusion criteria (Veritas Health Innovation, 2023; see Appendix A Figure S3.1). The first level included sifting through titles and abstracts and eliminating documents that were duplicated, published before 2010, not peer-reviewed, in a language other than English and, most importantly, did not explicitly link flows concepts to watershed decision making based on criteria in Table 3. A second level of screening was completed with a second screener (Mark Saunders) on full texts, but with a more meticulous focus on whether decision-making and flows concepts were linked and part of the research question and design. Studies were eliminated if they focused on hydrological, hydraulic, hydro-ecological, and habitat endpoints, or sometimes social, economic, and cultural ones, but did not relate this information to watershed decision making or if watershed decision making was only briefly mentioned in the implications (Table 3). Similarly, we excluded papers that did not actively include community level interests in environmental and cultural flow determinations and management.

The search returned 4571 studies from SCOPUS (n = 1935), Web of Science (n = 1248), ProQuest (n = 1346), and Informit (n = 42) combined; 1403 duplicates were removed, and 2750 papers were deemed irrelevant after the title and abstract screening phase. We then assessed 418 full-text studies for eligibility based on exclusion criteria (Table 3.3) and included 158 after careful reading and application of exclusion criteria, and consultation between two screeners

(See PRISMA diagram in Appendices). Our inter-rater reliability scores for a subset of full text screening were 0.82 for proportionate agreement and 0.61 Cohen's Kappa. Agreement scores are somewhat subjective "since there is no consensus as to which scores indicate 'adequate' agreement, and the concept of 'adequate' agreement is itself subjective" (Pullin et al. 2018, section 6.3.4). However, these metrics can be useful tools to measure agreement between screeners (Altman 1991), and other studies have reported that an agreement level of 80% and greater suggests that the results from the review are replicable (Filoso et al. 2017; Owusu et al. 2021).

Table 3.3. Criteria for exclusion during full text screening. Note that exclusion criteria not displayed here include papers that were not accessible through public institutions (n = 5) and were not in English (n = 1).

Exclusion Criteria	**Rationale Behind Exclusion Criteria**	**Number of Full-Text Papers Excluded (total excluded = 260; total included = 158)**	**Exclusion examples**
Exclude if water governance is not a central focus	Water decision-making must be central to the study research question, not implied.	17 (6.5%)	Borsato et al. 2020. Weak and Strong Sustainability of Irrigation: A Framework for Irrigation Practices Under Limited Water Availability. DOI: 10.3389/fsufs.2020.00017.
Exclude if flow concepts are not a central focus	Flow concepts (ecological, environmental, cultural, or Indigenous) must be central and not peripheral to the study questions.	29 (11%)	Pittock and Hartmann 2011. Taking a Second Look: Climate Change, Periodic Relicensing and Improved Management of Dams. DOI: 10.1071/MF09302.
Exclude if the paper focuses solely on hydrologic, social, or ecological end point	The paper should move beyond hydro-ecological or hydro-social endpoints to broader decision-making.	18 (7%)	Gwimbi and Rakuoane 2019. Impacts of Dams on Downstream Riparian Ecosystems' Health and Community Livelihoods: A Case of the Lesotho Highlands Water Project. DOI: 10.1007/978-3-030-12974-3_12.
Exclude if there is no active involvement of human communities	Human communities must be actively included in the study through the flows implementation process or water decision-making.	122 (47%)	Lane et al. 2015. Environmental Flows in a Human-Dominated System: Integrated Water Management Strategies for the Rio Grande/Bravo Basin: Research & Management. DOI: 10.1002/rra.2804.
Exclude if the paper is a review	There must be individual empirical examination even if the paper is largely a review.	38 (14.5%)	Vorosmarty et al. 2018. Ecosystem-based water security and the Sustainable Development Goals (SDGs). DOI: 10.1016/j.ecohyd.2018.07.004.
Exclude if the paper is not peer-reviewed	Conference proceeding or government, non-government organization report, or thesis	30 (11.5%)	David 2015. Socio-environmental Tradeoff Analysis using Decision Science Tools to Guide River Management. Thesis.

3.3.3 Mixed Methods Data Collection and Analysis

We employed a mixed-methods approach (both qualitative and quantitative coding) to determine how flows concepts have been related to decision-making structures. A codebook (Appendix C) was created in advance partially through an Evidence Synthesis Workshop and data from papers were collected in spreadsheets through ordered sections, including categorical information (e.g., date, author, location, watershed, social and ecological components, types of flows approaches, development type, community composition and involvement, and governance setting) and open codes with text (application of environmental and cultural flows, community involvement, governance context, relationship between flow concepts and governance). Inclusion of these concepts was inspired by gaps identified by Pahl-Wostl et al. (2013).

All analyses were then completed on spreadsheets, which included quotes through thematic analysis and categorical variables through comparisons by country and governance type. Qualitative analysis was both inductive and deductive in that new ideas and theories emerged from coding, but previous governance and community-based typologies were also reflected upon and served as points of inspiration (Agrawal and Gibson 1999; Lynam et al. 2007; Margerum 2008; Medema et al. 2008; Gruber 2010). Papers were grouped under environmental flows if there was generally a focus on ecological considerations, environmental-social flows if both ecological and social needs were included, and cultural flows if the focus was on cultural and ecological concerns, Indigenous rights-based needs, and the decision-making authority of Indigenous communities (Table 3.1).

As a basis for evaluating the identified papers, we adopted the Organisation for Economic Co-operation and Development's (OECD) Principles on Water Governance in environmental and cultural flows governance literature (OECD 2015, 2022). These Principles are 12 internationally peer-reviewed, agreed upon, and endorsed (170+ stakeholder groups or governments) criteria for governments to follow for inclusive, effective, and efficient water policy design and governance processes (OECD 2015, 2022). However, we note that there are ongoing conversations about reforming the OECD Principles to include greater attention to UNDRIP and water justice frameworks (Taylor et al. 2019). O'Donnell and Garrick (2017b) identified criteria for environmental water governance, inspired, in part, by the OECD Water Governance Principles. We chose the OECD Principles because they are reasonably comprehensive of water governance matters, are internationally agreed upon, and have clear indicators and criteria. However, future

research and synthesis could build on similar criteria identified by O'Donnell and Garrick (2017b): effectiveness, efficiency, legitimacy, legal and administrative framework, organizational capacity, and partnership. From our understanding, the OECD Principles as a package are rarely considered in environmental and cultural water governance. We expect this is due to their recent creation and we identify a need for greater consideration of these Principles. For this analysis, we manually coded text from previously coded governance quotes. Note that we did not code text for the engagement of OECD Principles and instead identified that this was part of every paper because of our search criteria. Few papers explicitly included reference to the OECD Principles on Water Governance; rather, these Principles were employed as a guiding framework to code governance-related text and the papers may understate actual adoption and application. We visualized the frequency and relationship of OECD Principles with co-occurrence network diagrams with the R package quanteda (version 3.3.1) (Benoit et al. 2018; Schweinberger 2021).

Inductive codes were created for actions or strategies related to environmental and cultural flows by going line by line through previously created text in codes related to governance and the relationships between flows concepts and governance. Qualitative analysis was completed in NVivo software (QSR International Pty Ltd. 2020), whereas quantitative analysis was completed in R (R Core Team 2022). Quantitative analysis generally involved frequency calculations but also binary logistic principal components analysis through the logistic PCA package (Landgraf and Lee 2020) to correlate the presence or absence of OECD Principles and strategies to govern environmental and cultural flows.

3.3.4 Limitations

Our literature review imposed boundaries that entailed study limitations. Our search strategy was based on communities' involvement in environmental and cultural flows to achieve water governance outcomes; therefore, our searches may have excluded papers that included more legal or market mechanisms because there was no overt involvement of a community or communities. The main reason we focused on communities was that we anticipated the community involvement criterion would help to identify papers that had attention to environmental and cultural flows in decentralized governance. We also excluded search engines like Google Scholar and Heinonline because those platforms are searched through full texts rather than only by keywords, abstracts, and titles. This was inconsistent with our approach. Our focus was also on the academic literature rather than grey literature or initiatives by

governmental (Indigenous and non-Indigenous) and non-governmental organizations that are not reported in published works. We have omitted certain key cases across the world because of these restrictions. However, we believe other papers, such as the World Wildlife Fund's (WWF) global review (2017), have filled this gap. We have also done citation tracing to include papers as supporting material that may have been missed in our search. Lastly, our search was in English because that is the primary language of the authors. We acknowledge that this likely excluded environmental and cultural flows processes in non-English speaking parts of the world including parts of the Global South.

3.4 Findings

3.4.1 Countries that Emphasized the Collaborative Governance of Environmental and Cultural Flows

We found 42 countries and 112 watersheds featured in published English-language academic literature between 2010 and 2024 about the collaborative governance and/or management of environmental and cultural flows (Figure 3.1). Environmental flow initiatives have been adopted by governance structures and investigated in relation to governance regimes in many countries in the Global North and South, especially Australia (e.g., Murray-Darling, Ringarooma catchments), the United States (e.g., Colorado, Columbia basins), and China (Mekong, Yangtze rivers) (Figure 3.1A). Consideration of cultural flow initiatives in governance with authoritative participation by Indigenous communities was only identified in commonwealth, colonial countries: Australia (e.g., Murray-Darling, Coorong), New Zealand (e.g., Kakaunui, Waikouaiti), and Canada (e.g., Okanagan, Cowichan) (Figure 3.1B). However, authors used the expression cultural flows or similar concepts (Aboriginal extreme flows, Indigenous reserved water rights, Indigenous water trusts, Indigenous water allocation frameworks) in watersheds where authors argued there is not yet clear decision-making authority by communities, such as, for example, communities along the Ganges in India (Lokgariwar et al. 2014), Australia's Northern Territory (Mclean 2014; O'Neill et al. 2016; O'Donnell et al. 2022), Canada's Athabasca River (Anderson et al. 2019; Marcotte et al. 2020), Chile (MacPherson and Salazar 2020), New Zealand (Taylor et al. 2020), the United States' Colorado River (Butler et al. 2021) and Waihe'e, Waiehu, Waikapū, and Wailuku in Hawaii (Cantor et al. 2020). Academic papers also described attention to environmental flows with social values (environmental-social flows) in Angola, Australia, Botswana, Benin, Canada, Chile, India, Kenya, Mexico, Namibia,

New Zealand, South Africa, and the United States (Figure 3.1C). Heavily featured watersheds included the Murray-Darling, Edward-Wakool, Fitzroy, Macquarie, and Ringarooma (Australia); Peace-Athabasca (Canada); Lancang/Mekong and Yangtze (China); Ganga (India); Aosta (Italy); Patuca (Honduras); Rio Grande (Mexico, United States); Ebro (Spain); Pangani (Tanzania); and Colorado (United States); among others.

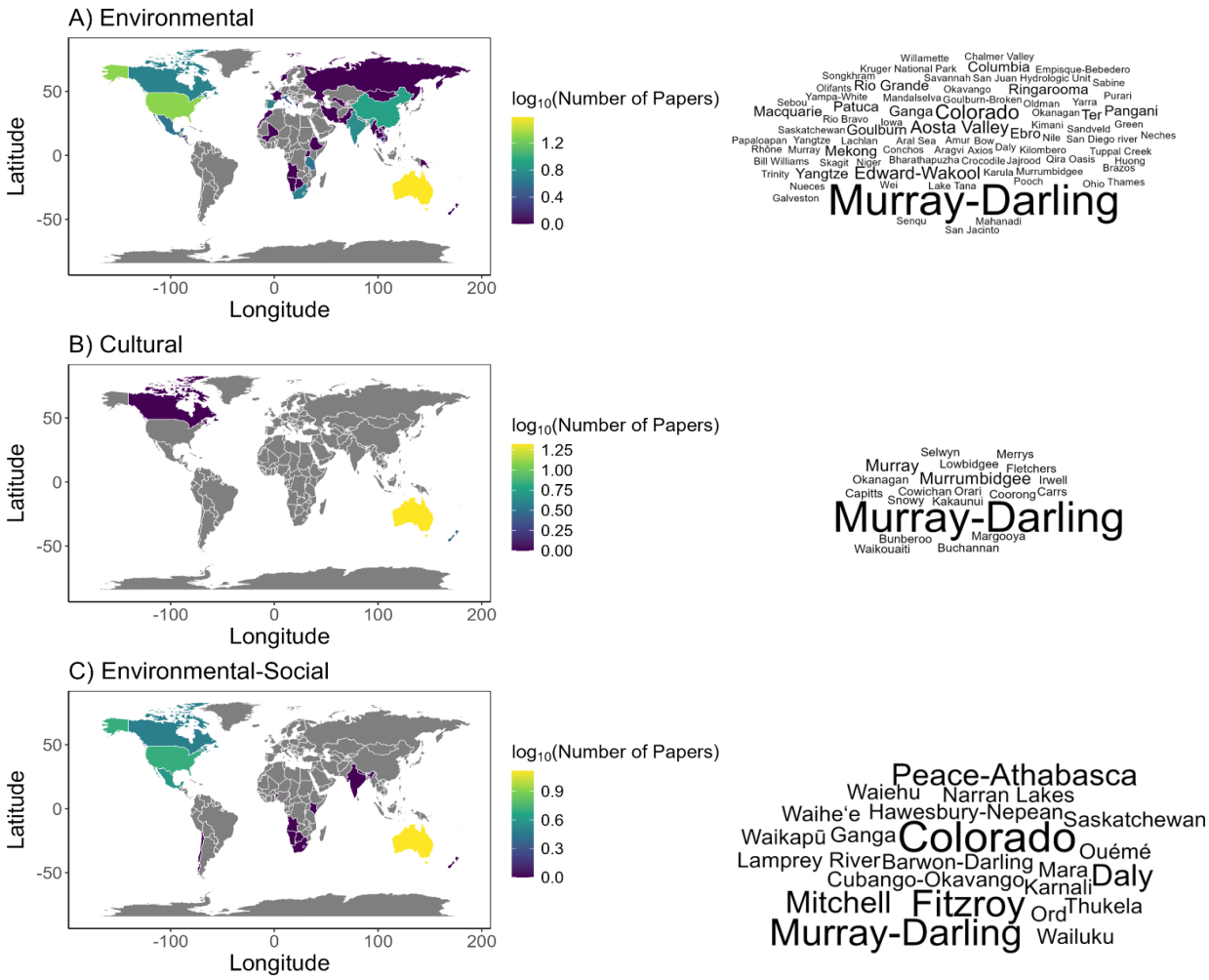


Figure 3.1. Countries (left) and their watersheds (right) in our review that have adopted or investigated environmental (A), cultural (B), and environmental-social flow (C) initiatives in collaborative watershed governance. Colours closer to yellow represent a greater number of published papers between 2010 and 2024.

3.4.2 Countries' Watershed Governance

Watershed governance structures that consider environmental flows were generally centralized and top-down, but there were multi-national agreements and implemented decentralized governance (polycentric, co-governance) in some watersheds. Cultural flows initiatives only occurred in decentralized governance contexts. There were also identified opportunities for decentralization and governance reform in countries with mainly centralized water governance, such as Canada, Chile, Greece, Mexico, South Africa, and the United States (Figure 3.2).

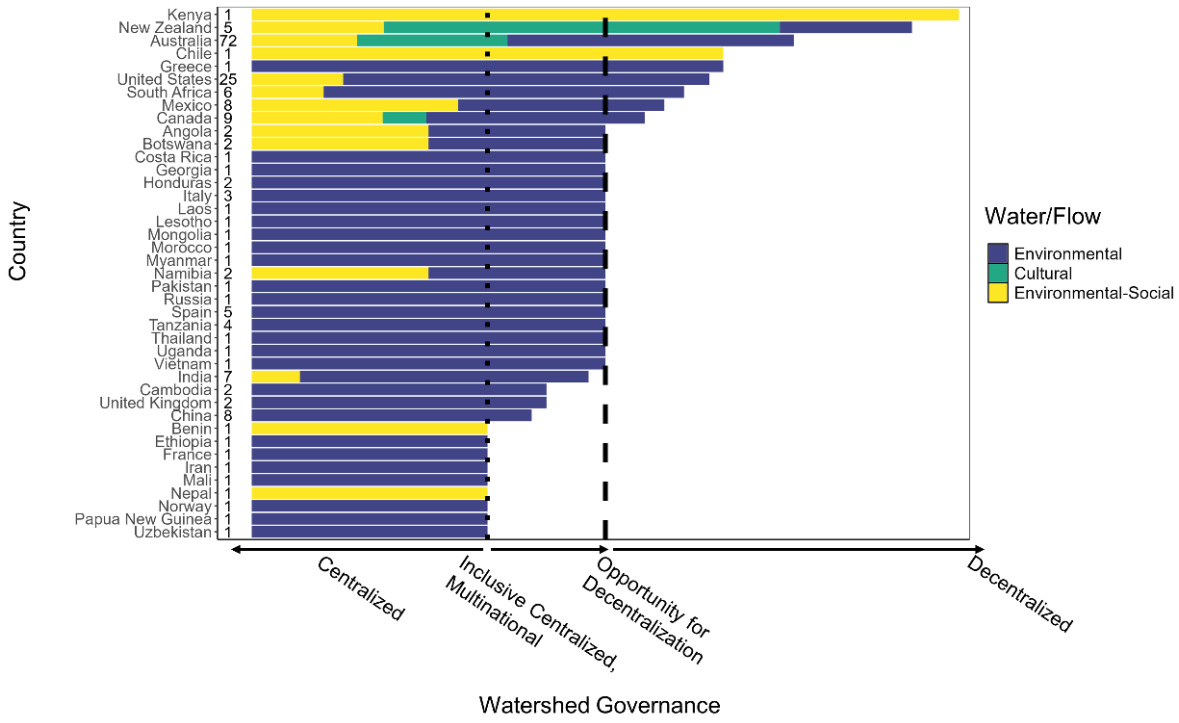


Figure 3.2. The watershed governance of countries in our review that have adopted environment (blue), cultural (green), and environmental-social flow (yellow) initiatives. The dotted line indicates a shift from centralized to more inclusive centralized governance and the dashed line represents the opportunity for a shift to more decentralized governance. Numbers beside bars represent the number of papers that contributed to the calculation. The watershed governance gradient was created by scoring countries within each paper based on whether they mentioned: an opportunity for inclusive centralized governance (score = 1), implementation of inclusive centralized governance (1.5), multi-national governance (1.5), an opportunity for decentralized governance (2), or implementation of decentralized governance (3). The average score was calculated for each country and the percentage of papers describing environmental, cultural, and environmental-social flows is also displayed.

Centralized watershed governance was present to some degree in all countries, except Kenya's water user association system in the Mara River (Richards and Syallow 2018). Countries that were more centralized with some involvement of communities in environmental flow assessments included Benin, Cambodia, China, Ethiopia, France, Iran, Mali, Nepal, Norway, Papua New Guinea, and Uzbekistan, among others (Figure 3.2). Here, more active involvement of stakeholders generally occurred through watershed boards or associations.

Multi-national governance through transboundary agreements that included environmental flows was a focus for five published cases. This included the Amur River in Russia, China, and Mongolia (Simonov et al. 2019); the Colorado River, Rio Grande, and Rio Bravo in the United States and Mexico (Nava et al. 2016; Kendy et al. 2017); the Okavango Basin in Angola, Namibia, and Botswana (King et al. 2014; King and Chonguiça 2016); and the Mekong, Songkhram, and Huong basins in Cambodia, China, Laos, Myanmar, Thailand, and Vietnam (Lazarus et al. 2012). However, Hairan et al. (2021) report that Southeast Asian countries lack attention to environmental flows policies and research. Acreman (Acreman and Ferguson 2010) also described the European Water Framework Directive's uptake of terms similar to environmental flows and requiring member states to have good ecological status in their basins. More recently, the European Union included a definition of ecological flows in their framework guidance document (Ramos et al. 2018; European Union 2024). Other international agreements were not included. For example, while the Columbia River (O'Donnell 2017; O'Donnell and Garrick 2017b) was included in our review, the focus was on the United States rather than the 1964 Canada-United States Columbia River Treaty (The Governments of the United States and Canada 1964) likely because the Treaty includes no explicit attention to the terms environmental or cultural flows. However, there have been recent efforts to explicitly consider environmental flows and Indigenous Treaty Rights in the renegotiation of the Columbia River Treaty (Bode 2017; Baltutis et al. 2018; Cohen and Norman 2018).

Watershed co-governance that considers environmental or cultural flows, while rare, is occurring in Australia, Canada, India, and New Zealand (Figure 3.2). This is watershed governance that we identified as being shared by communities and one or more senior levels of government. In Australia, scholars described co-governance through cultural flows, for example, with First Nations of Wamba Wamba and Ngemba (Jackson et al. 2015), Nari Nari (Woods et al. 2022; O'Donnell et al. 2023), Ngarrindjeri (Hemming et al. 2019), and Ringarooma Water Users

(Ellison et al. 2019) in the Murray Darling Basin, Coorong, Lower Lakes and Murray Mouth, and Ringarooma. In Canada, Curran (2019) describes co-governance in British Columbia with the Syilx Nation, Okanagan Nation Alliance, Yinka Dene ‘Uza’hné; Stellat’en First Nations, Tsleil-Waututh Nation; Stk’emlúpsemc te Secwépemc Nations in Okanagan and Cowichan basins. In India, Kaushal et al. (2019) describe co-governance with the Ganga River Water User Association, which may indicate movement towards the establishment of a protected cultural flow. Lastly, co-governance agreements were described in New Zealand’s Selwyn River, Irwell River, Buchannan's Creek, Merrys Stream, Waikouaiti River, and Kakaunui and Orari catchments with different Māori communities or iwis (such as Ngāi Tahu) (Tipa and Nelson 2012a; Crow et al. 2018; Anderson et al. 2019). What is noteworthy, however, is there is some disagreement between authors or discourse within papers about whether co-governance is truly occurring, such as in Canada (Curran 2019) and New Zealand (Crow et al. 2018; Taylor et al. 2020). In these instances, there could be effort to include water justice in the water governance discourse to elucidate who has power in decision-making (Robison et al. 2018; Taylor et al. 2019).

Polycentric watershed governance that includes community-level participants is implemented, for example, in Australia (Garrick et al. 2012; Jackson 2017), Kenya (Richards and Syallow 2018), Tanzania (Franks et al. 2013), and the United States (Hurst 2015; O’Donnell 2017) (Figure 3.2). This is generally through the combined decision-making efforts of water user associations, Indigenous governments, civil society organizations, water managers and regulators, municipal and state-based governments, and federal or national agencies. Implementation may also include private water licences, market allocation mechanisms, and environmental water managers in countries such as Australia and the United States (O’Donnell and Garrick 2017a). More private-public market-based mechanisms, that may be a part of polycentric governance were described in Australia (Colloff and Pittock 2022) and the United States (Wurbs 2015; Richter et al. 2020; Colloff and Pittock 2022), among others (Owens 2016). The following sections examine the difference between centralized/multi-national (with community level interests) and decentralized governance rather than making a distinction between co-governance and polycentric governance.

3.4.3 Environmental and Cultural Flow Methods Adopted in Watershed Governance Structures

There were differences and similarities between how centralized and decentralized watershed governance structures were applying environmental and cultural flow methods. The Brisbane Declaration (2007, p. 3) recommended that "environmental flow assessment and management should be a basic requirement of Integrated Water Resource Management; environmental impact assessment; strategic environmental assessment; infrastructure and industrial development and certification; and land-use, water-use, and energy-production strategies." Most papers referenced how governing bodies managed environmental and cultural flows through water-use strategies, whereas fewer described legislation and policy mechanisms (more common to decentralized governance, representation across flow initiatives), environmental impact assessment and strategic environmental assessment requirements (centralized and multi-national, environmental and environmental-social flows), dam and energy-production strategies (centralized, environmental flows), and integrated water resources management (centralized and decentralized, environmental-social flows). To our knowledge, there was no clear mention of the incorporation of environmental and cultural flows processes in land use strategies.

The literature reported that governance structures used a variety of processes and methods to assess environmental and cultural flows. Centralized governance regimes employed many approaches with the majority involving holistic frameworks (e.g., ELOHA in Poff et al. (Poff et al. 2010), SUMHA in Pahl-Wostl et al. (2013), BBM in King (2018a), DRIFT in King (2018b)), social-cultural preferences (e.g., surveys and interviews in Rogers et al. (2013)), participatory models (e.g., Bayesian belief networks in Xue et al. (2017), OASIS in Sauchyn et al. (2016)), as well as those within adaptive management planning (e.g., Allan and Watts (2018)). Decentralized governance structures used more Aboriginal or Indigenous water assessment and mapping (e.g., Aboriginal Waterways Assessment tool in Mooney et al. (2019) and Aboriginal extreme flow thresholds reviewed in Anderson et al. (2019)), social-cultural preference (e.g., cultural flow preference study in Tipa and Nelson (2012a)), rights and entitlement, and holistic approaches (Adapted ELOHA in Jackson and Finn (2011), Ngā Puna Aroha water allocation framework in Taylor et al. (2020), among others (see Moggridge et al. 2022)). Scholars in both centralized and decentralized governance contexts investigated how power dynamics are reproduced in how water is allocated (e.g., Andrews et al. (2018)).

3.4.4 Evaluation of Environmental and Cultural Flows Governance Strategies

Environmental and cultural flows decision-making processes reported in this review are meeting some OECD Water Governance Principles, but there are differences between centralized and decentralized governance. More than half of the OECD Principles were considered in the best examples of environmental and cultural flows governance internationally (Table 3.4, Figure 3.3). Appropriate scales, building capacity of communities, regulatory frameworks, roles and responsibilities, finance, data and information, and engagement were common themes that co-occurred in papers (Figure 3.3). Less common was policy coherence, the monitoring and evaluation of policies, transparency across water policies and institutions, and the creation of governance frameworks that assess trade-offs in sectors (Figure 3.3). Centralized governance of environmental water generally considered engagement related to the collection of data and information, appropriate scales, regulatory frameworks, capacity, and roles and responsibilities (Figure 3.3A). There was only a small co-occurrence between regulatory frameworks and roles and responsibilities. In contrast, regulatory frameworks in decentralized governance of environmental and/or cultural water generally co-occurred with roles and responsibilities of communities, capacity building, water finance, and engagement (Figure 3.3B). This potentially suggests communities are only involved in engagement processes or operational management of environmental flows in centralized governance, whereas communities are beginning to have a role in regulatory frameworks and policymaking in decentralized governance. This is consistent with Taylor et al.'s (2019) water justice critique of OECD Principles, which argues that Indigenous Nations need to have roles and responsibilities in policymaking to assert held relationships to water, water entitlements, and water rights. Overall, the academic literature reported greater emphasis on including communities in managing environmental and cultural flows collaboratively than on including communities in related policy development and implementation. This may reflect a gap in governance processes, reporting by scholars, or both.

Table 3.4. OECD Water Governance Framework Principles and their consideration in environmental and cultural flows governance and scholarship.

OECD Water Governance Principle	Emphasis in Environmental and Cultural Flows Governance and Scholarship
1. **Roles and Responsibilities:** Clearly allocate and distinguish roles and responsibilities for water policymaking, policy implementation, operational management and regulation, and foster co-ordination across these responsible authorities.	Papers in this review generally investigated or represented roles and responsibilities within the operational management of environmental water delivery or flow in water use strategies, but roles and responsibilities of stakeholders and Rights holders in policymaking and policy implementation that led to operationalization were less frequently examined. This gap was especially evident in environmental flow and centralized governance studies. In decentralized governance (co-governance in

	particular), there was more attention to roles and responsibilities to reform environment and cultural flow policies.
2. **Appropriate Scale:** Manage water at the appropriate scale(s) within integrated basin governance systems to reflect local conditions, and foster co-ordination between the different scales.	Management of environmental flows at appropriate scales was a major focus of centralized governance papers, especially those that considered strategic planning, strategic adaptive management, integrated water management, and strategic environmental assessment to inform development at a catchment scale.
3. **Policy Coherence:** Encourage policy coherence through effective cross-sectoral co-ordination, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning and land use.	Overall, there was minimal attention to policy coherence through the coordination environmental, social, and economic policies, but there was some attention to trade-offs in the management of environmental and cultural flows (Principle 11).
4. **Capacity:** Adapt the level of capacity of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties.	Building capacity through learning and knowledge-sharing was a major theme across papers with many reporting the need for skill-building and competencies in environmental and cultural flows by all actors to manage water equitably. Many papers also discussed building the capacity of Rights holders and stakeholders to engage in monitoring and research to support their water goals, the need to support networks for future outcomes, and supporting communities as decision-makers.
5. **Data and Information:** Produce, update and share timely, consistent, comparable, and policy-relevant water and water-related data and information, and use it to guide, assess and improve water policy.	Data mobilization was a focus of many papers with monitoring and modelling of environmental and cultural flows being a key opportunity to communicate community needs to decision-makers if data are accessible. This is especially true for papers describing centralized governance of environmental water. To support decentralized governance and the investigation of social and cultural values, there could be greater effort to monitor and share information in respectful ways.
6. **Finance:** Ensure that governance arrangements help mobilise water finance and allocate financial resources in an efficient, transparent and timely manner.	Papers that described governance arrangements that mobilised finance to support environmental and cultural flows initiatives were principally those that described cost sharing between national governments, non-profits, and international funds in multi-national watershed governance and those that supported funding for water transactions or water trusts in water markets.
7. **Regulatory Frameworks:** Ensure that sound water management regulatory frameworks are effectively implemented and enforced in pursuit of the public interest.	Many papers discussed existing regulatory frameworks (e.g., Australia's 2007 Water Act, the European Union's Water Framework Directive, Kenya's 2002 Water Act to define water user associations). In many cases, authors specified that current environmental and cultural flows legislation, policy, and related impact assessment initiatives are not adequate to support involvement of stakeholders and Rights holders in setting water allocation mechanisms.
8. **Innovation:** Promote the adoption and implementation of innovative water governance practices across responsible authorities, levels of government and relevant stakeholders.	Innovative approaches to governing environmental flow processes occurred most in inclusive centralized governance arrangements through integrated holistic approaches, participatory modelling, and interdisciplinarity, among others.
9. **Transparency:** Mainstream integrity and transparency practices across water policies, water institutions and water governance frameworks for greater accountability and trust in decision making.	Few papers spoke of audits to determine the integrity and transparency of bodies governing environmental and cultural flows and whether law enforcement and program implementation is upheld. However, numerous papers advocated for integrity, inclusiveness, and transparency by building understanding, ownership, and trust in environmental and cultural decision-making.
10. **Engagement:** Promote stakeholder engagement for informed and outcome-oriented contributions to water policy design and implementation.	Stakeholder and Rights holder engagement were key considerations in all papers because the inclusion criteria for the review included the need for community involvement. However, stakeholders and Rights holders were mainly involved in management and implementation, not water policy design. This is represented by text coded to Principle one about roles and responsibilities in policymaking.
11. **Trade-Offs:** Encourage water governance frameworks that help manage trade-offs across water users, rural and urban areas, and generations.	Few papers described and assessed water governance frameworks, but many showcased trade-off models that show multiple scenarios and outcomes, often with community input. Trade-offs were those between water use for industry, cities, and then environment but also trade-offs between different environmental and social endpoints (frogs, algae, birds, vegetation, recreation, rights).
12. **Policy Monitoring:** Promote regular monitoring and evaluation of water policy and governance where appropriate, share the results with the public and make adjustments when needed.	While papers evaluated water policy and governance in place, few papers discussed the ongoing monitoring and evaluation of water policy and governance.

Source: OECD (2022). How to assess water governance: A methodology based on the OECD Principles on Water Governance.

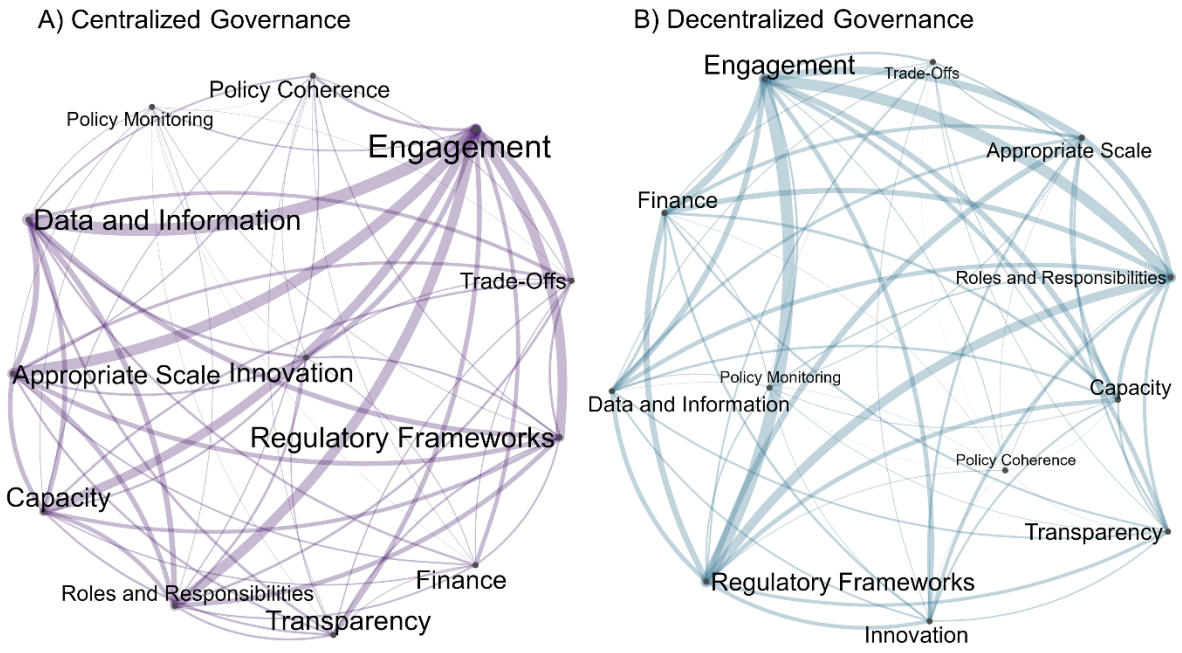


Figure 3.3. A co-occurrence network diagram of OECD Principles for centralized (A) and decentralized (B) governance papers. Size of the link represents the co-occurrence of the Principle in papers. Note that engagement (in the implementation of environmental or cultural flows, not policymaking) was present in all papers because of the search criteria. Principle co-occurrence was calculated based on presence and absence within papers. Multi-national governance was included in centralized governance if there was no clear bottom-up collaboration.

Strategies related to governance democratization have emerged when environmental and cultural flows are managed collaboratively and vice-versa (Figure 3.4, explored in greater detail below). Eight major strategies are identified:

1) Participatory decision-making tools to support the communication of community goals to decision-makers;

2) Delineating water development spaces to balance environmental, social, and economic demands at the basin-scale;

3) Event space management to form collaborations opportunistically during hydrologic extremes;

4) Water justice through the resurgence of customary Indigenous water laws and governance;
5) Restrictions on water entitlement holders (caps on water abstraction, licence conditions and water releases by dam operators);
6) Ecological reserves or Indigenous reserved water rights to protect water for the environment, culture, and rights ahead of consumptive uses;
7) Market schemes in which governments, communities, or non-profits act on behalf of environmental or cultural water trusts; and
8) Legal personhood for rivers.

We examined the relationship between OECD Water Governance Principles and the emergence of these strategies (Figure 3.5). While there is considerable uncertainty in the model (34% deviance), the creation of ecological reserves and establishment of water markets appear to be more common when countries create water allocation regulatory frameworks with communities and support community involvement through water financing. These Principles were also somewhat related to water justice through the resurgence of Indigenous water laws and the legal personhood of rivers. Furthermore, opportunity for higher-level water development spaces and support tools for decision-makers are related to countries' institutional capability to assess trade-offs and collect data and information. Water use caps and releases were related to innovative water governance practices, policy evaluation, capacity, and appropriate scales. Hence, effective governance of environmental and cultural flows potentially occurs when communities benefit from and are involved in regulatory frameworks, there is adequate funding, and there is consideration of trade-offs, sufficient data and information, appropriate scales, innovative practices, and policy evaluation.

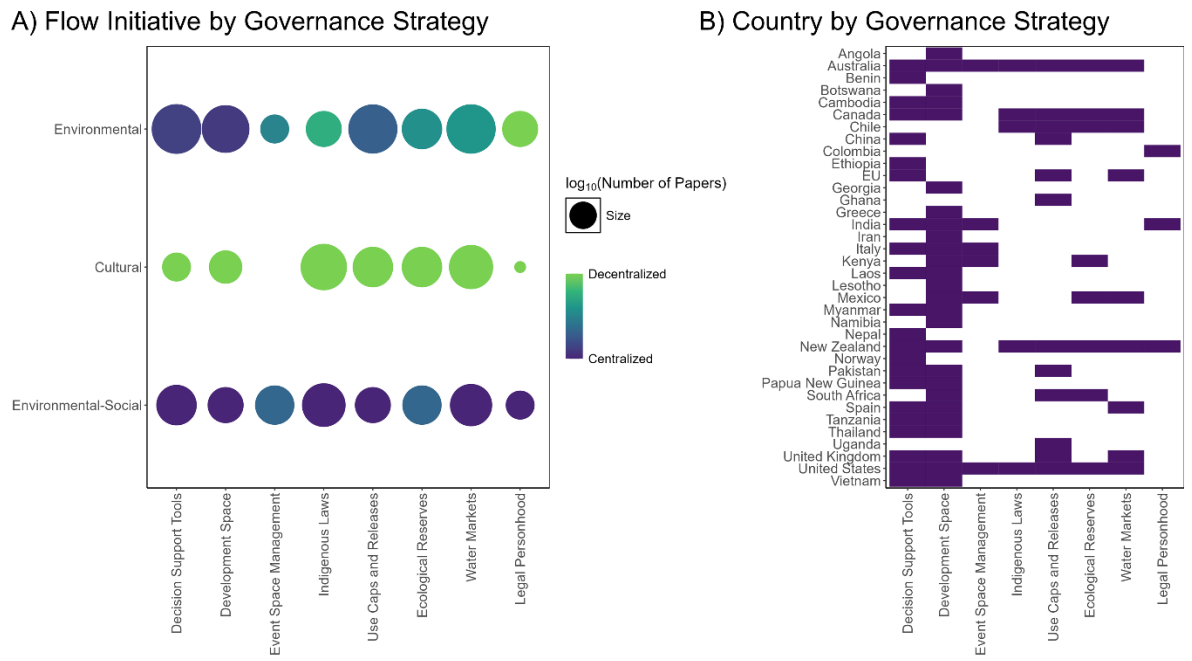


Figure 3.4. Flow initiatives (environmental, cultural, and environmental-social; A) and countries (B) by governance strategies. For A, the size of points and governance gradient was calculated based on the number of papers. Multi-national governance was included in centralized governance if there was no clear bottom-up collaboration. Note that B is not exhaustive of all countries and likely omits both countries and strategies because of how the review was bounded.

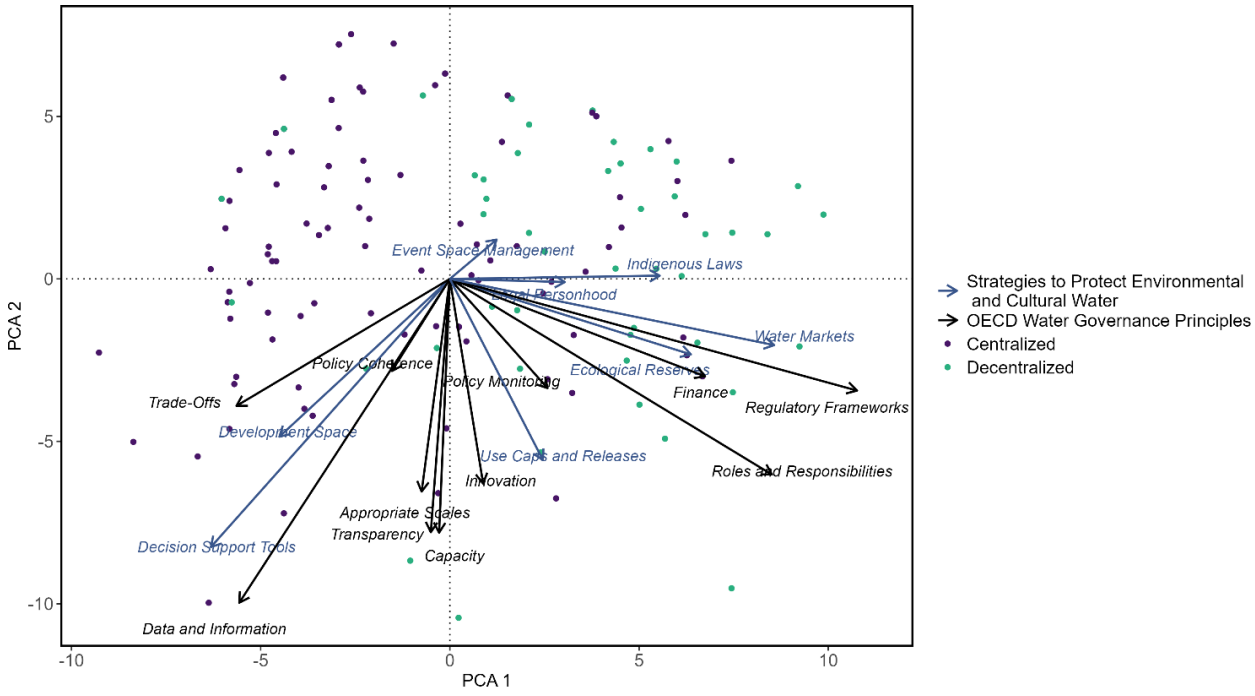


Figure 3.5. A binary logistic principal components analysis correlating OECD Water Governance Principles (see Table 3.3) and strategies to protect environmental, cultural, and environmental-social flows. The model had a deviance of 33.8%. Note that the logistic binary approach employed only has two principal components and does not display the individual variance explained of each axis. Each data point represents an individual paper. Multi-national governance was included in centralized governance if there was no clear bottom-up collaboration.

Strategy One – Decision Support Tools

The norm for environmental flows deliberations in centralized governance is to use these processes as participatory modelling approaches to support more inclusive decision-making (Figure 3.4). Decision support tools were more common to environmental and environmental-social flow initiatives. These approaches were employed to visualize water objectives, anticipate how uses may affect downstream communities and ecosystems, and ultimately communicate the impact of water extraction to decision-makers. Decision support tools, for example, included Bayesian networks (Xue et al. 2017), optimization models (Bryan et al. 2013), game theoretical bargaining (Xu et al. 2019), fuzzy models (Sedighkia et al. 2021), multi-criteria analyses (Girardi et al. 2011; Barton et al. 2020), water evaluation and planning software (Jorda-Capdevila et al. 2016), interactive displays (Ellison et al. 2019), and other techniques. These approaches are a part of a group of multidisciplinary techniques designed to use expert knowledge and available data to weigh ecological, social, and economic factors and scenarios at the nexus of food, water, and energy conflict (Xue et al. 2017). They offer the opportunity to easily communicate ecosystem services and trade-offs of water use with stakeholders and Rights holders to help inform them and prepare them to be at the negotiation table to determine water use strategies (Lazarus et al. 2012; Barton et al. 2020; O'Sullivan et al. 2020).

Decision support tools for environmental flows consideration in water resource negotiation are being used in European countries, Canada, China, Australia, Cambodia, Ethiopia, Italy, Georgia, Papua New Guinea, New Zealand, Uganda and the United States, among others. In the Ringarooma catchment in Australia, for example, Ellison et al. (2019) worked with the Ringarooma Water Users Group using an interactive dashboard and tables to visualize and predict stream flows and precipitation. This platform offered the Water Users Group the opportunity to comment on and negotiate changes to water allocation in real-time and is described as the technical foundation for co-governance (Ellison et al. 2019). In a second example in the Aosta Valley in Italy, Vassoney et al. (2019) describe a multi-criteria analysis with

stakeholders to evaluate water withdrawals in the context of energy, economy, fishing, landscape, and environmental criteria. The synergies, trade-offs, and stakeholder preferences related to these criteria then informed the Valley's strategic plan (Vassoney et al. 2019). As a final example, Sheer et al. (2013) use Collaborative Modelling for Decision Support tools to work with stakeholders in the Bow River, Canada to create a new operating strategy for hydropower and irrigation that sets out greater water storage, release rules, in-stream flow guidelines, and water allocation to licence holders. These cases describe a movement in centralized governance towards the use of participatory models that facilitate greater community representation in water-use strategies.

Strategy Two – Water Development Space

Environmental flow initiatives have been a platform to delineate a water development space ahead of developments, especially in centralized watershed governance (Figure 3.4). The idea of water development space appeared to be more common through environmental flow processes than those considering cultural or environmental-social flow. King and Brown (2010, p. 135-136) suggest that development space is " the difference between current conditions in the basin and the furthest level of water-resource development found acceptable to stakeholders through consideration of the scenarios." Environmental flows processes can be one key consideration to understand water trade-offs and preferences to inform collaborative efforts to set the maximum level of degradation to which a basin can withstand (Lazarus et al. 2012; King et al. 2014). Here, there has been effort by governments who create forums to understand the priorities of different sectors and visions of stakeholders. King and Brown (2018), for example, state:

> An EFlows Assessment can identify: the incremental and cumulative effects of all proposed projects; thresholds in the degree of environmental and social impacts; the least- and most-sensitive river reaches in a basin; barriers to flow, sediment and biota that would be least or most destructive; which tributaries could best be developed and which conserved with natural flows and fish migrations (sacrificial v. sacrosanct); the configuration, design and operation of dams that would best promote biodiversity and support fish populations; which rivers are most important to rural communities and why; and how much water in what pattern of flows would be required to maintain different parts of the river system at various levels of health. (p.3)

Ahead of developments, environmental flow initiatives have been a means to form a consensus development space for watersheds by setting goals for the improvement of water quality and flows to ensure at least the minimum levels for lasting public and ecological wellbeing.

Delineating a water development space is a strategy in Australia, Canada, India, Italy, Iran, Georgia, Greece, Lesotho, Mexico, New Zealand, Pakistan, South Africa, the United States, and multi-national governance in Angola, Namibia, and Botswana for the Okavango basin and Mekong, Songkhram, and Huong basins in Cambodia, China, Laos, Myanmar, Thailand, and Vietnam (Figure 3.4). This theme generally appears in strategic planning, impact assessment, and integrated water resource management. In many of these countries, there is effort to create shared visions for watersheds based on scenarios (Conallin et al. 2017) and several cases identified the maximum level of degradation a watershed can withstand or what benefits must be guaranteed. In the Okavango basin, which is one of these cases, Angola, Namibia, Botswana, and a Global Environmental Facility funded a transboundary strategic action plan, applying the DRIFT (Downstream Response to Imposed Flow Transformations) process, to understand the "costs and benefits of water allocation to river ecosystems, social structures, and local and national economies" (King et al. 2014, p. 786). For the Poonch River in Pakistan, the state completed an environmental flow assessment as part of an impact assessment for the Gulpur Hydropower project, providing strategic guidance for habitat thresholds for Kashmiri catfish, dam location and operation, and a regulated biodiversity action plan (Brown et al. 2019). In these cases, environmental flows were considered in administrative processes at a higher strategic level to facilitate broader co-designed guidance for a water development space.

Strategy Three – Event Space Management

Collaboration between governmental authorities, stakeholders, and Rights holders has occurred more spontaneously or opportunistically during extreme hydrologic events to allow for experimentation in the governance and management of environmental flows. This phenomenon is called event space management reflecting that there is a unique event that alters how people interact, thereby potentially altering the rules and norms of traditional management (Bark et al. 2016). This strategy was more common in papers that discussed environmental or environmental-social flows (Figure 3.4). Applied to environmental flows, in extreme wet and dry years there is a brief event window or space within which non-state decision-makers can have greater influence over water use priorities in a dry year and over decision making on the

movement of water to different social and ecological endpoints to maximize benefits of a wet year (Bark et al. 2016; Gilvear et al. 2017). Gilvear (2017) uses the expression hot moments or hotspots to describe unique moments when ecosystem and cultural services can be delivered through water allocation. These events or hot moments can act as a form of river restoration to confer ecosystem and cultural benefits (Bark et al. 2017; Kaiser et al. 2020). To enable cooperation during hydrologic extremes for the delivery of ecosystem services, authors recognize a need to build trust and legitimacy in environmental flows processes and create strong coordinated multi-level institutional relationships or multi- and bi-national agreements (O'Donnell et al. 2019).

Most papers presented instances in which useful relationships were created because of water scarcity and overallocation, but only a few papers from Australia, India, Italy, Kenya, Mexico, and the United States described how a re-organization of decision-makers can occur spontaneously during environmental water delivery, often because of flooding in wet years or the need to deliver ecosystem or cultural services (Figure 3.4). In Australia's Barwon-Darling (part of the Murray-Darling) catchment, for example, Jackson (2021) describes how shared responsibility for dealing with an excess amount of water in a wet year (environmental flow event) in 2018 created a shared sense of time and space because there was greater transparency in how water use was regulated by water managers. Indigenous leaders could emphasize a wider set of social-cultural relational values of water as it was moving through the waterscape and landscape. This led to a transient experiment in decentralized governance in some parts of the watershed while emphasizing governance deficiencies in others. Jackson describes the deficiencies in flow management when water movement is "objectified, compartmentalized, and represented as apolitical" (p. 468). In Mexico and the United States' Colorado River, flooding in 2014 led to water allocation through bi-national collaboration by many people (non-profits, government, international agencies) who were personally part of an ecosystem servicing process to provide water to areas of cultural and environmental importance (Bark et al. 2016; Kerna et al. 2017; Butler et al. 2021). In India's Ganges River, key moments for greater ecosystem and cultural service delivery have occurred during the Kumbh religious festival because of coordination between the government and supportive irrigators to reduce water for agricultural uses in upstream canals and send more water downstream (Lokgariwar et al. 2014; Gilvear et al. 2017). Authors note that successful planning of such events requires co-development of socio-

hydrological monitoring and modelling. While ongoing environmental flows processes provide a long-term opportunity to build relationships and scale up those collaborations to broader watershed management, spontaneous events can be harnessed as an opportunity to quickly test new forms of decentralized governance.

Strategy Four –Indigenous Laws and Water Justice

Cultural flow processes have been platforms for the exchange of diverse water values and asserting of Indigenous water laws and decision-making authority (Figure 3.4). Through political ecology and water justice lenses, flow processes can be an avenue to work towards power redistribution in basin planning. Political ecology is about "an integrated understanding of how environmental and political forces interact to mediate social and environmental change" (Bryant 1992, p. 12). Re-politicizing water means overtly recognizing that water (distribution, quality, and more) choices reflect and reproduce existing power dynamics (Bourblanc and Blanchon 2019; Alexandra et al. 2023). Water scarcity generally results in prioritizing municipal and industrial water use over the environment and for Indigenous Nations (Colloff and Pittock 2022; Wineland et al. 2022; Dourado et al. 2023). Indigenous water justice, explained in Robison et al. (2018, p. 841), is "water and its multi-faceted connections to Indigenous Peoples' self-determination – more precisely, to the socioeconomic, cultural, and political dimensions associated with Indigenous Peoples' exercise of the right to self-determination." Cultural flow processes in particular are an opportunity for water governance that includes Indigenous water laws, legal pluralism, the water back agenda, and treaty agreements (Hartwig et al. 2022; Leonard et al. 2023; O'Donnell 2023a). Environmental and cultural flows deliberations can be venues for explicitly working towards power redistribution and acceptance of diverse knowledge forms in water allocation and quality choices (Hartwig et al. 2022; Moggridge et al. 2022).

Commitment to water justice to improve the governance of environmental and cultural flows is largely emerging in Commonwealth countries – Canada, Australia, and New Zealand – and to some degree in the United States and Chile through the resurgence of Indigenous water laws and governance (Figure 4). In these jurisdictions, attention to a cultural flow through Indigenous water rights is an opportunity to "direct the formation of water policy from a starting point of Indigenous sovereignty, with Indigenous governments adequately resourced to participate equitably in environmental co-governance" (Hemming et al. 2019, p. 223). In Australia, the Murray Lower Darling Rivers Indigenous Nations and Northern Basin Aboriginal Nations

created the Echuca Declaration (2007) to define cultural flows and recognize and reaffirm sovereignty of their waters and lands. Since this Declaration, Australia has begun to move from simply recognizing cultural values in plans, policies, and legislation to creating co-management agreements (Robinson et al. 2015; Bischoff-Mattson and Lynch 2017; Bischoff-Mattsona et al. 2018; O'Donnell et al. 2023). Curran (2019, p. 2) remarks that in Canada the "state depoliticizes decisions about water by directing them into administrative processes like environmental assessment while Indigenous communities are repoliticizing water governance by creating evaluation processes that reflect their own legal traditions and standards." In British Columbia, First Nations (Syilx Nation, Okanagan Nation Alliance, Yinka Dene 'Uza'hné; Stellat'en First Nations, Tsleil-Waututh Nation; Stk'emlúpsemc te Secwépemc) in the Cowichan and Okanagan basins, for example, are creating their own decision-making structures based on their water laws to create community-assessments, cumulative effects management plans, and environmental and cultural flows rules to assert and institutionalize their co-governance of water impacted by development projects in British Columbia (Curran 2019). New Zealand is also moving towards co-governance with environmental legislation that recognises Māori values, principles, and Te Mana o te Wai (authority over water) (Taylor et al. 2020). However, scholars suggest co-designed policy and regulations with Māori need to be created based in Nga Taonga Tuku Iho (a natural resource management framework) and Nga Puna Aroha (a water allocation framework) to protect water for the environment and people (Taylor et al. 2020; Challies et al. 2022). In these cases, there is greater appreciation of relationships to water and the intangible, subjective values therein, such as custodial responsibilities, spirituality, knowledge transmission, and creation stories (Moggridge and Thompson 2021b; Woods et al. 2022). Indigenous self-determination and co-governance arrangements are emerging partially through the recognition of cultural flows embedded in water rights and decision-making authority.

Strategy Five – Water Use Caps and Releases

Water use caps and releases appear to be considered in environmental flow initiatives and to a slightly lesser extent in cultural flows and environmental-social flow initiatives across centralized and decentralized governance (Figure 4). Horne et al. (2017, p. 363) describe three sub-categories that fall into this strategy: "1) cap on consumptive water use; 2) license conditions for water abstractors; and 3) conditions on storage operators or water resource managers." Caps on consumptive water use are a "limit on the total volume of licenses issued and/or the

extraction/abstraction of water against these licenses" (Horne et al. 2017, p 363). License conditions for water abstractors are "conditions listed on the license of individual water users that restrict the volume and/or timing of extractions" (Horne et al. 2017, p 363). Lastly, conditions on storage operators or water resource managers are "conditions on a storage operator prescribing releases from storage for downstream ecological needs" (Horne et al. 2017, p 363). These categories are generally considered as a package, alongside other legal rights, management plans, and ecological reserves (Nowlan 2012; Horne et al. 2017e).

From our synthesis, we identified water use caps and release rules in Australia, Canada, Chile, China, the European Union, New Zealand, Pakistan, South Africa, Uganda, the United Kingdom, and the United States (Figure 4). In Australia, the *Water Act* of 2007 details a sustainable diversion limit and strategic water releases by the Commonwealth Environmental Water Holder in the Murray-Darling Basin (Acreman et al. 2017). In contrast, the European Union Water Framework Directive leaves each country to define flow releases and abstraction rates, though the European Union does have the legal power to suggest an amendment to an abstraction licence (Acreman and Ferguson 2010) . In the United Kingdom (formerly part of the European Union before 2020), the Thames Catchment Abstraction Management strategy calculates the maximum abstraction based on environmental flow indicators, but these indicators did not meet Water Framework Directive guidelines based on high abstractions (Overton et al. 2014). Another example is Uganda where, in 2011, the Environmental Impact Assessment Guidelines for Water Resources Related Projects recognized environmental flows and subsequently the government has guaranteed environmental flows in water abstraction permitting, water release projects from hydropower, and dam weir design (O'Brien et al. 2021). As a final example, in 2005, China's Environmental Protection Administration required the release of environmental flows from hydropower dams and this condition has been included in the operation strategy for the Three Gorges Dam and other ministries' policies (Cheng et al. 2018). These cases highlight consideration of water use caps and releases in countries' regulatory frameworks but also suggest a need for greater community involvement in water use caps, licence conditions, and water releases.

Strategy Six – Ecological Reserves and Indigenous Reserved Water Rights

From our synthesis, ecological reserves appear to be equally considered across environmental, cultural, and environmental-social flow initiatives in more decentralized

governance contexts (Figure 4). Horne et al. (2017d, p. 363) describe ecological reserves as "legally establish[ing] environmental water as a prior right to consumptive water use." Reserve determinations have been considered both in setting aside the required volume of water for an ecosystem or for release to an ecosystem and categorizing the waterbody based on the desired water quality class ahead of consumptive use and development (Pienaar et al. 2011; Brown et al. 2020). Either as part of an ecological reserve or independently, Aboriginal, Indigenous, or cultural reserved water rights have also emerged for Indigenous People to protect and restore waterbodies for rights-based, cultural, and environmental uses (Jackson 2015; O'Donnell et al. 2022). The creation and legitimacy of ecological reserves has been supported through Indigenous title, protected areas and co-management agreements (Costanza-van Den Belt et al. 2022). Recently, scholars have also described how ecological reserves require active management by environmental water managers and holders to release water to achieve environmental and cultural benefits (Horne et al. 2018). However, there are challenges with the implementation of ecological and Indigenous reserved water rights, including frustration by water users and governments because of delayed permitting and development decision-making (Pienaar et al. 2011).

We found that ecological reserves have been considered, for example, in Australia, Canada, Chile, Kenya, Mexico, New Zealand, South Africa, and the United States (Figure 4). In South Africa, between 1999 to 2008 the government received 1,600 requests for reserves and approved 900 (Pienaar et al. 2011) and recent strategic adaptive management processes, in the Crocodile River in South Africa, for example, emphasize transparent and cooperative management between the state, catchment management authorities, and stakeholders (McLoughlin et al. 2021). In Australia, the Murray-Darling Basin ecological reserve offers opportunity for Indigenous Nations to restore aquatic ecosystems, such as the floodplain of the Moorna State Forest, which is managed by the Barkindji as an Indigenous Protected Area (Jackson and Nias 2019). Similarly, Indigenous reserved water rights are in place for commercial use by Nations in some Northern Territory (Australia) water allocation plans and there is opportunity for more ecological reserve designations and strategic planning (Jackson and Langton 2011; O'Donnell et al. 2022). In Mexico, the government released an ecological reserve program in 2012 for 189 river basins (Salinas-Rodríguez et al. 2018). In the United States, the Colorado River has wildlife refuges with entitlements and federal Indigenous reserved water

rights, both of which act similar to a reserve in that a water apportionment is given each year ahead of consumptive uses and Indigenous water rights cannot be lost from non-use and are held in perpetuity (Butler et al. 2021). In Hawaii's Waihe'e River, Waiehu Stream, Wailuku River, and Waikapu Stream, there is also recent use of the public trust doctrine to reserve water for the environment (Cantor et al. 2020). This doctrine has enabled Maui communities and lawyers to work together to restore rivers and have them run without diversion (Cantor et al. 2020). For both Chile (MacPherson and Salazar 2020) and Kenya (Richards and Syallow 2018), environmental flows or reserves for surface waters are prioritized ahead of commercial consumptive uses. In Canada, Nowlan (2012) mentions that environmental flows are considered through reserves, limits on licences, and water management plans. Lastly, in New Zealand, there are water allocations reserved for Māori, but these reservations can be relinquished if an allocation limit is met; therefore, Taylor et al. (2020, p. 36) recommend "Mana Whenua Mana Wai' allocations" to support a clearer allocation hierarchy. While ecological reserves are becoming more common worldwide, our synthesis points to a need for more attention to the implementation of Indigenous and cultural reserved water rights.

Strategy Seven – Water Markets and Trade

In centralized and decentralized governance arrangements, there are opportunities for the purchase of water rights for the environment and culture in water markets (Figure 3.4). These rights can then be traded by public governments, community cooperatives, and Indigenous communities where privatization of water rights is an established tradition. Water markets offer opportunity to adapt to demand and supply through water trade in both formal and informal and urban and agricultural settings(O'Donnell and Garrick 2019; Garrick et al. 2023). A water bank refers to a "network of inter-basin water connections" and transactions (Sheer et al. 2013). Rosegrant and Binswanger (1994, p. 1615) describe how "a system of marketable rights to water would induce water users to consider the full opportunity cost of water, including its value in alternative uses, thus providing incentives to efficiently use water and to gain additional income through the sale of saved water." In the papers we reviewed, most water market schemes were created because of water scarcity and overallocation of water to licence holders. Purchasing water or issuing water licences based on cultural and environmental factors is in large part a response to the need to restore flows either immediately or through long-term storage. Water market schemes may be a way to experiment in decentralized forms of governance.

In our synthesis, we found that schemes to purchase water for the environment are present or proposed in Australia, Canada, Chile, the European Union, Mexico, New Zealand, Spain, the United Kingdom, and the United States (Figure 3.4B). However, this is not an exhaustive list of formal and informal water markets; instead, these countries serve as some useful cases of water markets where Rights holders and stakeholders may have an active role. Australia has a long-established tradition of informal and formal water markets (Seidl et al. 2020). Effective water allocation and governance in Australia is suggested to be a product of water markets, regulation (2007 *Water Act* enables setting a sustainable diversion limit and establishes a Commonwealth Environmental Water Holder in the water market), and collaborative approaches (Crase et al. 2013; Pahl-Wostl et al. 2013). Environmental water managers in the Murray-Darling have had an active role in securing environmental water entitlements because of water buybacks from licence holders and efficient irrigation technologies (Garrick et al. 2012; Costanza-van Den Belt et al. 2022). Additionally, through increased recognition of co-governance in the Murray-Darling basin, there is now emphasis on tradeable Indigenous water entitlements, water buy-back by Nations, and an Indigenous water trust or partnerships with private water trusts (Jackson 2015, 2017; Jackson et al. 2020; Hartwig et al. 2023). However, other scholars report limited uptake of water entitlements and trade by Indigenous communities throughout Australia and in the Northern Territory in particular (O'Neill et al. 2016) and a lack of clarity about how cultural flows will be included in market schemes to support restoration, livelihoods, and rights-based activities (Moggridge and Thompson 2021b). In the United States, Richter et al. (2020) reported that the most successful water purchases for flow restoration have been through funded non-governmental actors and a state water trust, which participated in two-thirds of transactions in the American West. Two examples of water trusts that work to recover water for the environment through market mechanisms include the Colorado Water Trust (O'Donnell and Garrick 2017b) and Washington State's water trust (Hurst 2015). The Colorado River Delta Water Trust "secured over 6,000 acre-feet of water rights from farmers in the Colorado River Irrigation District in Mexico" (Kerna et al. 2017, p. 5). In Australia, the United States, and other countries, water trusts and environmental water managers have been successful in the short-term at recovery of water for the environment and managing water through markets (O'Donnell 2017).

Strategy Eight – Legal Personhood for Rivers

The papers in this review that mentioned legal personhood for rivers were generally related to environmental or environmental-social flows and ranged from centralized to decentralized governance settings, but this was a small subset of our review (n = 7; Figure 4). Note that few papers explicitly related cultural flows and legal personhood, but this was likely a result of our small sample size. O'Donnell (2019a) describes legal personhood for rivers:

> Giving rivers legal rights means the law can see the river itself as a legal person, and the river can take legal action to enforce those rights. Legal personhood confers legal standing (often described as the ability to sue and be sued), which enables rivers to go to court to protect their rights. (p. 1)

However, legal personhood does not grant a river a right to water for protection against extractive activities and extinction (O'Donnell 2020). An indirect form of legal personhood includes environmental water managers – "…organisations with legal personhood, which have been created to acquire and manage water for the aquatic environment" (O'Donnell 2017, p. 503). While environmental water managers hold decision-making power and have responsibility over the environment (Horne et al. 2017; O'Donnell 2017), river rights conferred through legal personhood are represented by a "guardian or loco parentis who is the human face of the river and who interacts with the regulators…" (Davies et al. 2023, p. 405). Legal personhood for rivers is an opportunity to assert the inherent value of waterbodies; however, effective alignment with cultural flows and Indigenous water law is dependent on the guardianship process being localized and context specific (Davies et al. 2023).

Legal personhood of rivers has been enacted in Colombia (Río Atrato), India (Ganges and Yamuna; recently struck down), and New Zealand (Whanganui) (included in Figure 3.4). Indirect legal personhood through environmental water managers is occurring in many countries (principally Australia and the United States but also, for example, Brazil, Canada, Chile, Ghana, and Mexico) (O'Donnell and Garrick 2017a; O'Donnell 2019a). Direct legal personhood for rivers has also been considered or recommended for the Colorado River and Lake Erie (United States), Ethiope River (Nigeria), Saint Lawrence River and Peace-Athabasca-Mackenzie River (Canada), Magdalena River (Mexico), the Margaret and Yarra rivers (Australia), Bangladeshi rivers, Chilean rivers, and rights for nature have also been recognized in Bolivia and Ecuador (Eckstein et al. 2019; O'Donnell 2019a, 2023b; Macpherson 2021; Cárdenas and Turp 2023). We

note, as well, that the Magpie River in eastern Canada and the Marañón River in Peru were recently recognized with legal personhood (Innu of Ekuanitshit 2021; Earth Law Center 2024a), but this was not included in papers in this review. For those rivers that have direct legal personhood, New Zealand and Columbia follow collaborative approaches with co-management agreements to employ legal personhood to assert Indigenous rights and values and create alternative institutions within existing legal frameworks to govern the river, such as Te Pou Tupua (New Zealand) and 15 guardians appointed by the government and community organizations (Columbia) (O'Donnell and Talbot-Jones 2018; O'Donnell 2019b). In contrast, India's legal personhood put forward a competitive model, where most guardians are members of the Indian Government, there is conflict between human industry and environmental advocates, and there is an expectation of a dramatic change in river governance outside of the existing legal framework (O'Donnell and Talbot-Jones 2018; O'Donnell 2019b). Similarly, environmental water managers in the United States are more collaborative, working to change attitudes of water licence holders ahead of securing environmental water (e.g., Colorado and Columbia rivers), whereas Australia environmental water managers are more competitive, operating as a large participant in the water market (e.g., Murray-Darling) (O'Donnell 2017). Taken together, legal personhood is an opportunity for water governance democratization to collaboratively protect environmental water, but there are challenges with assigning guardianship, participating as water users in water markets, and rivers having human rights but not the right to water and to flow.

3.4.5 Gaps and Directions for the Future

A decade ago, Pahl-Wostl et al. (2013) identified gaps in how environmental flows are addressed in governance and others, like Horne et al. (2017b), have set research priorities for environmental water management. We add to the understanding of gaps and their implications to identify needs for governance of watersheds to support environmental, cultural, and environmental-social flow initiatives.

Regarding OECD Water Governance Principles, most papers described collaboration through a water use strategy and the operational management of environmental flows rather than a concerted effort to collaboratively design policy or regulatory frameworks to protect environmental and cultural flows. Of the OECD Principles analyzed, few papers mentioned policy evaluation, coherence, and transparency across levels of governance. Countries should work with Rights holders and stakeholders to create laws and policies that protect flows needed

to meet environmental and cultural demands through water allocation, quantity, and quality strategies (Magdaleno 2018; Wineland et al. 2022; Arthington et al. 2023; Dourado et al. 2023). Implementation of these new law and policy regimes should include ongoing review, including monitoring and evaluation of the coherence and effectiveness of the law and policies in maintaining environmental and cultural flows. We also encourage scholars and governments working on environmental and cultural water to investigate OECD Principles and governance criteria, such as those identified by O'Donnell and Garrick (2017b) (effectiveness, efficiency, legitimacy, legal and administrative frameworks, organizational capacity, and partnerships) that build on the OECD Principles. This should be done at countries' local, basin, regional, and national scales for legislation, polices, programs, and management strategies.

Environmental and cultural flows could be more proactively considered in development decision-making through holistic regional approaches initiated prior to impact assessments, as part of impact assessments (higher-level and project-level), and through links between watershed planning and impact assessment. We found evidence of environmental flow concepts in impact assessment guidance and processes for hydropower projects (McCartney et al. 2010; Brown et al. 2019; Simonov et al. 2019; O'Brien et al. 2021), but gaps in considering Indigenous water rights and cultural flows (Jackson et al. 2014). King and Brown (2018) suggest that considering environmental flows at the level of a project-level impact assessment is insufficient to protect ecological and cultural values and include downstream communities. Instead, they suggest basin-wide attention to environmental flows to inform strategic assessments, cumulative effects assessments, and project-level assessments through the creation of a development space to set the maximum degradation a basin can withstand (King and Brown 2010, 2018). While higher-level oversight is needed, the framing of development space may be an old goal of determining and exploiting maximal sustainable yield, which is an offence against the precautionary principle (Gibson et al. 2005b). Instead, collaborative approaches to environmental and cultural flows processes in development design and evaluation could be an opportunity to ponder how to maximize prospects for lasting benefits and not foreclose opportunities for the future within a watershed (Gibson et al. 2005b). This could be a way to harmonize different levels of basin planning and scope in hydro-social-ecological relationships and collaborations with Indigenous authorities, water user associations, and local and state governments (Anderson et al. 2019;

Curran 2019). Other research should consider how regional as well as project-level impact assessment and environmental and cultural flows are or should be integrated.

Few papers included attention to cumulative effects, particularly the effects of cumulative water withdrawals, on environmental and cultural flows. Horne et al. (2017c) identify the cumulative effects of diffuse hydrologic alterations in the context of environmental water management as a field in need of further inquiry. Cumulative effects are natural and human stressors in the past, present, and future that interact to affect the environment and human-well-being (Blakley and Russell 2021). The overlap and relationship between cumulative effects management frameworks (Dubé and Munkittrick 2001) and environmental and cultural flows processes should offer opportunities for further inquiry to understand how incremental water impacts are affecting the provision of water for the environment and people nearby.

Many papers identified the need for cultural flows to be approached more explicitly in all water allocation initiatives related to water justice, decision-making authority, and tangible and intangible values of riparian Indigenous communities (Morgan 2012a). To move towards cultural flows, many countries need to share and return decision-making authority to Indigenous Nations, honour free, prior, and informed consent in development deliberations, and work to braid knowledge (Phare et al. 2017; O'Donnell et al. 2023). Here, there is a need for emerging approaches that embrace pluralistic water governance regimes, such as the Mi'kmaw concept of Two-Eyed Seeing, where the strengths of Indigenous and other knowledge systems co-exist and are respected (Reid et al. 2021; Arthington et al. 2023). To move towards attention to cultural flows, countries need to create co-management agreements with Indigenous Nations. Lastly, an area for further inquiry and clarification is if the cultural flow concept, or a social flow equivalent, should extend to non-Indigenous communities if there is consideration of non-ecological needs and decision-making authority of stakeholders.

Social-ecological systems were generally considered in relation to environmental and cultural flows only in adaptive management or strategic adaptive management processes (Allan and Watts 2018; Webb et al. 2018). Social-ecological systems refer to how nature and human society interact across multiple levels through resource systems, resource units, and governance systems (Ostrom 2009). To link environmental and cultural flows more explicitly and provide opportunities for environmental and cultural flows processes to have wider sustainability

implications, application of social-ecological systems understandings should be central to any water allocation scholarship or initiative.

Most environmental and cultural flows deliberations have considered the availability, quantity, and timing of water movement to ensure different ecological and social services and functions are met (Tharme 2003). However, the definition of environmental flows has expanded to include water quality and the constituents of water flows (International River Foundation 2007; Arthington et al. 2018). Few papers mention water quality outright, except those referring to classifying water quality through an ecological reserve (Pienaar et al. 2011), so we believe there is a need to recognize that environmental and cultural flows decision-making is also about the flux of particulate and dissolved materials and contaminants (such as nutrients, potentially toxic trace metals, hydrocarbons, pharmaceuticals, sediment, gases) along with other contributions of aquatic systems and components of the hydrologic cycle (Gorham 1991). Determining who has decisioning-making power over the flux of materials between water compartments involves a form of biogeochemical justice and is a possible complementary field of inquiry (Meadows 1999).

While not a central focus of this paper, climate change will certainly affect hydrographs and river, lake, and wetland quality in the 21st century (Grantham et al. 2019; United Nations Water 2020; Baggio et al. 2021; Capon et al. 2021), yet few papers in this review report collaborative governance initiatives to address the impact of climate change on cultural and environmental water. However, there are many recent papers about environmental water management and climate change that were outside the scope of our review (e.g., Poff 2018; John et al. 2021; Judd et al. 2023). The gap we identify, that there is a need for more collaborative governance of environmental and cultural water in the face of climate change, is reflected in a review by Capon et al. (2018). They argue that to address climate change, environmental water management will need greater attention to objectives and targets of environmental water delivery across scales, planning and prioritization of environmental and cultural water goals, monitoring and evaluation of outcomes, and knowledge generation about flow-ecology relationships and human values and benefits (Capon et al. 2018). The review cycle for policies and regulations related to the protection of environmental and cultural flows may need to be shortened as the pace of change of floods and droughts increases (Berthot et al. 2021) and this should be reflected in the academic literature and new research initiatives.

Lastly, we have drawn from the literature eight categories of many complementary and overlapping strategies to assist the governance of environmental and cultural water (decision support tools, development space, event space management, Indigenous laws and water justice, use caps and releases, ecological reserves, water markets, legal personhood), but how these actions effectively come together in a package of mutually supporting approaches needs to be investigated further. For example, we found that the creation of a development space and Indigenous laws and water justice are rarely considered together, suggesting a need for Indigenous decision-making in strategic planning and water visions for the future (O'Neill et al. 2016).

3.5 Conclusion

In our systematic literature review, we found that between 2010 and 2024, countries have included greater attention to the collaborative governance of environmental flows in watersheds, but cultural and environmental-social flows/water warrant similarly greater consideration. More than a decade ago, the academic literature paid minimal attention to environmental flows and governance, despite recommendations to include environmental flows in all levels of water and land management (International River Foundation 2007; Pahl-Wostl et al. 2013). In this paper, we showed that environmental flows, and to some degree environmental-social and cultural flows, are increasingly protected through water-use strategies but less often served through legislation and policies, environmental impact assessments, energy-production strategies, and land-use strategies. Evaluated against the OECD Water Governance Framework Principles, most countries represented in the reviewed literature supported some examples of initiatives that considered appropriate scales, capacity building, data and information, engagement, and regulatory frameworks. However, we identified a need to include communities in policy and regulatory framework development. Most watersheds employed decision support tools to communicate recommendations to decision-makers. Moreover, there were instances of other forms of governance in which environmental and cultural flow processes were treated more experimentally (e.g., through the creation of a development space, event space management, water justice, water markets, ecological reserves and Indigenous reserved water rights, and legal personhood) to broaden and democratize governance. Finally, to improve the link between governance and environmental and cultural flows management, the evidence points to more

authoritative involvement of Indigenous Peoples, local authorities, and knowledge holders in environmental and cultural water policy development, coordination, and iterative evaluation.

3.6 Transition

This paper evaluated the collaborative governance of environmental and cultural flows and provided recommendations for countries like Canada. From this paper, it has become clear that Canada should look to exemplary cases in other British Commonwealth Nation countries like Australia and New Zealand for strategies for more collaborative water governance. There is also a need for greater attention to cultural flows in Canada and more collaboration in legislation and policies. Greater protection of water reserved for the environment and people may also occur through more guidance for strategic planning and impact assessments processes. These gaps led me to investigate the consideration of environmental and cultural flow ideas in Canadian legislation, policies, programs, and impact assessments in Chapter 4 and opportunities for sustainability-based water guidance for higher-level assessment (Figure 3.6).

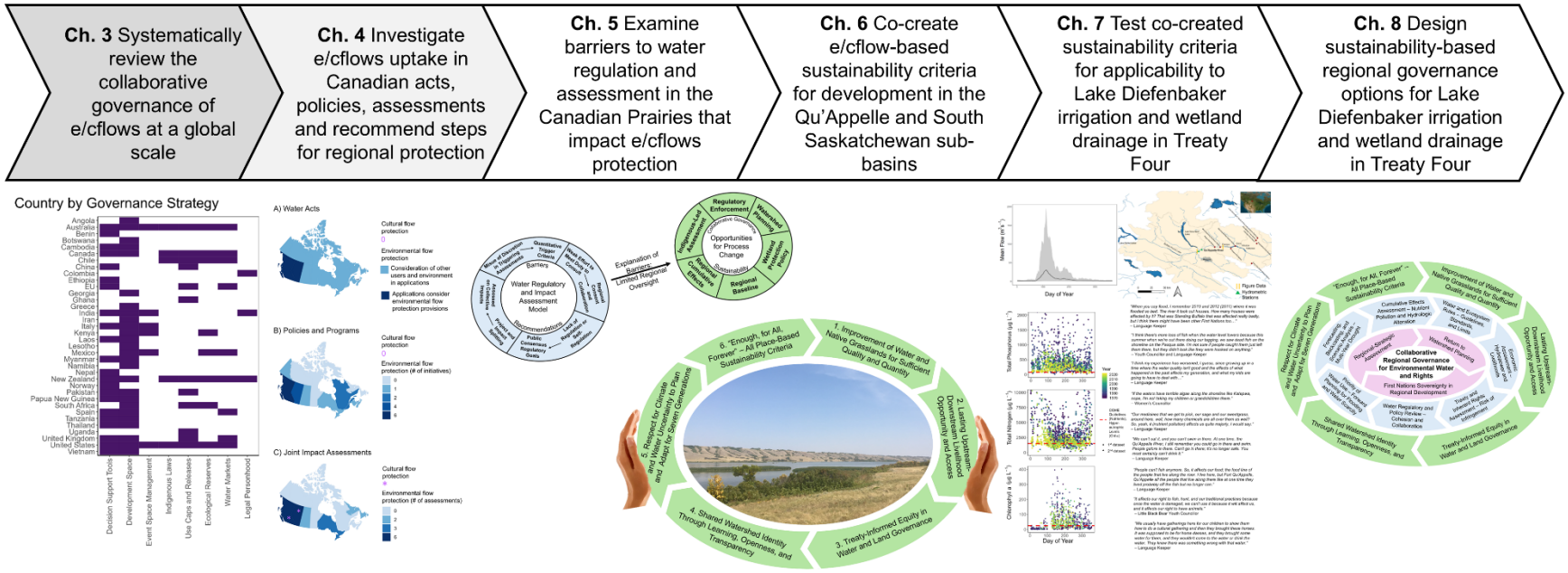


Figure 3.6. A roadmap diagram showing the transition from Ch. 3 to Ch. 4 objectives. E/cflows refers to environmental and cultural flows.

CHAPTER 4. CENTRING WATER IN IMPACT ASSESSMENT: RECONSIDERING ENVIRONMENTAL AND CULTURAL FLOWS IN DEVELOPMENT DECISION-MAKING IN CANADA

4.1 Overview

How to consider regional impacts on downstream water users and ecosystems is challenging in impact assessments. We suggest that environmental and cultural flows processes have the potential to be applied to protect water more comprehensively in assessment but are currently underutilized. Environmental and cultural flows refer to the determination of adequate water quantity and quality for the environment and Indigenous rights, respectively. Through interviews and a scoping review of laws, policies, and assessments, we address how these concepts are and could be embedded within Canadian impact assessments. In Canada, environmental flows have been considered in assessments involving dams, oil and gas, and mining, and the focus has been on fish and habitat, rather than Indigenous Treaty Rights, management frameworks, and cumulative withdrawals. We propose regional readiness through collaborative attention to water councils, water change, and water consensus (three Cs) to prepare watershed actors to protect environment and cultural water flows in impact assessments. Water councils refer to advisory councils dedicated to creating regional visions, objectives, and rules for ecosystem, culture, and rights-based needs. Water change is about assessing hydrologic and water quality alterations through regional data, understandings, and relationships to water. Water consensus is building consensus on the cultural and ecological significance and sensitivity of water bodies to inform development planning and assessment processes. Development of regional readiness and the three Cs follows examples in Canadian water-related assessments and initiatives, such as the Wolastoq Ecological Limits of Hydrological Alteration framework, Athabasca Chipewyan and Mikisew Cree assessments, Yinka Dene Water Management Policy, Grand Council Treaty #3 Nibi Declaration of Treaty #3, and Strategic Assessment of Wood Buffalo National Park. These cases demonstrate how holistic regional approaches to water can link assessments, governance democratization, and Indigenous water laws and rights. A shared understanding of environmental and cultural flows could strengthen how we value and care for water in assessments.

4.2 Introduction

Regional communities' needs and ecosystem functions are challenging to consider in impact assessments of individual projects. Impacts are often cumulative in that upstream stressors from human activities in the past, present, and those projected for the future will interact to affect the downstream environment and human well-being (Clogg et al. 2017; Hackett et al. 2018; Blakley and Russell 2021). In the context of watersheds, ecosystems and communities downstream from projects are often difficult to include meaningfully in impact assessments despite substantial adverse impacts on them (Udofia et al. 2017; Arsenault et al. 2019; Eckert et al. 2020). To enable more inclusive impact assessment processes at regional and watershed scales, scholars and practitioners suggest better coordinated and more inclusive efforts in baseline monitoring, cumulative effects assessment, objective setting, and determining a future that is better than what is promised by current trajectories (Dubé et al. 2013; Jones 2016; Foley et al. 2017). However, how to accomplish this and connect recommendations to decision-making remains difficult in practice.

Environmental and cultural flows concepts may be useful vehicles to enable greater inclusion of communities' concerns and aspirations as well as ecosystem effects in water-related assessment processes. Environmental flows are defined generally as the quantity, timing, availability, and quality of fresh water to sustain waterbodies and ecosystems that support human livelihoods and well-being (Arthington et al. 2018). Cultural flows refer to "water entitlements that are legally and beneficially owned by the Indigenous Nations of a sufficient and adequate quantity and quality to improve the spiritual, cultural, environmental, social and economic conditions of those Indigenous Nations" (Murray Lower Darling Rivers Indigenous Nations and and Northern Basin Aboriginal Nations, 2007, p. 2). Examples may include how water movement and quality relates to navigation, harvesting, ceremony, and Treaty and Inherent Rights (Morgan 2012a; Andrews et al. 2018; Moggridge and Thompson 2021a). Cultural flows processes are a mechanism to uphold Indigenous rights and UNDRIP (Kovach 2011; Anderson et al. 2019). Cultural flows have also been expanded to include non-Indigenous stakeholder values and nature-based needs (Monk et al. 2017). There is an overlap between environmental and cultural flows and water, with environmental-cultural water being the amount of water allocated for people and the environment and flows being the delivery of that water (Stewardson and

Guarino 2018). When we refer to environmental and cultural flows, we also mean environmental and cultural water considerations.

Environmental flows processes include over 200 methodologies (Tharme, 2003), and now there is a growing recognition of this concept as a basis for hydro-social-ecological planning that supports active community involvement and governance negotiation (Pahl-Wostl et al. 2013; Anderson et al. 2019; Douglas et al. 2019). However, past research has shown that despite an international call for inclusion through the Brisbane Declaration and Global Action Agenda (International River Foundation 2007; Arthington et al. 2018), environmental and cultural flows are rarely addressed in impact assessments, except for recommending minimum flow requirements and in some cases linking biophysical considerations (generally fish and fish habitat) to altered flow regimes (King and Brown 2018). King and Brown (2018) discuss the potential application of environmental flows to inform different levels of impact assessment, but there is a need to further substantiate how both environmental and cultural flows could be most effectively considered at different levels of impact assessment (strategic, regional, project-level) to enable greater watershed sustainability, inclusivity, and coordination. We put forward a concept of environmental-cultural flows because of a need to highlight the interconnected ecological, social, and rights-based aspects of water flow, allocation, and quality in impact assessments.

In Canada, a new federal *Impact Assessment Act* was passed in 2019 that enables the use of regional assessments to address multiple project impacts, cumulative effects, and other matters affecting entire regions (Government of Canada 2019). However, although a recent policy frameworks for regional and strategic assessments have been drafted and revised by the Impact Assessment Agency of Canada (Government of Canada 2024c) more guidance is needed, for example, to clarify and elaborate the core expectations and range of possibilities for how regional assessments are to be initiated, what matters the most, what processes and/or methods must/may be used, what results these processes/methods must/may deliver, along with establishment of good practice (Gibson 2020; Hunsberger et al. 2020). Such guidance is especially needed for watersheds in Canada that are part of a fragmented governance waterscape in which Indigenous, federal, provincial, and territorial interests/jurisdictions overlap and may be in conflict with each other (Bakker and Cook 2011). Historically, these water decision-making processes in Canada have not adequately considered related concepts: cumulative effects;

environmental flows; Indigenous rights, assessments, and governance; and social-ecological systems (Curran 2019; McGregor 2021; Lajoie-O'Malley et al. 2023). However, the Indigenous-led assessments in Canada that have occurred have taken a more regional lens than other project-level assessments and have supported broader valued ecosystem components (VECs) related to, for example, way of life, governance, and stewardship (Candler et al. 2015; Squamish Nation 2015; Tsleil-Waututh Nation 2015; Gibson et al. 2018; FNMPC 2020; Nishima-Miller et al. 2024). Overall, the landscape in Canada is beginning to change to reflect more co-governance cumulative effects models (Clogg et al. 2017), but there is a need to find common ground for the representation of diverse voices in assessments (Barnard-Chumik et al. 2022).

How environmental and cultural flow initiatives can contribute to this change is unclear, but Phare et al. (2017) suggest that they may be an opportunity for more collaborative consent in water management and development decisions in Canada. In Canada, high court decisions based on section 35 of the *Constitution Act* have established a legal obligation for duty to consult with Indigenous Nations (Government of Canada 2025a), and commitment to implement UNDRIP (UN General Assembly 2007) in 2021 has furthered opportunities for affirming the right to "free, prior and informed consent" by affected Indigenous Peoples in development decision-making (Government of Canada 2023b). In Canada's province of British Columbia, the POLIS Project on Ecological Governance at the University of Victoria outlines a process called collaborative consent which involves, "Co-governed regional decision-making tables…to propose appropriate regional and site-specific environmental flow standards/thresholds, water reserves, and/or sensitive stream designations and requirements" (Phare et al. 2017, p. 20). A decade ago, Nowlan (2012) reviewed Canadian water acts and found a lack of specific legislation for environmental flows and variable legislative approaches across the country. They suggested that the now superseded *Canadian Environmental Assessment Act* of 2012 may have implicitly offered some protection for environmental flows, but there was limited attention to cultural flows. The degree to which environmental and cultural flows are protected in impact assessment, regional assessments, and the evaluation of policies and plans in Canada today is unclear.

In this study, we focus on the Canadian context to explore how to further embed environmental and cultural flows concepts within impact assessment. We follow a grounded theory process that involves interviews with practitioners, researchers, policy advisors, and regulators, exemplary cases, and a complementary scoping review to address the questions:

1) How have environmental and cultural flows concepts and approaches been incorporated within Canadian laws, policies, programs, and impact assessment?

2) What are existing barriers to the protection of regional and downstream ecosystems and communities in watersheds in impact assessment?

3) Would the use of environmental and cultural flows concepts and approaches be an asset to impact assessments and higher-level planning conducted in watersheds in Canada?

This study is organized with a background section answering question one. This is followed in the results section by an exploration of barriers, described by contributors, about protecting downstream ecosystems and water users from adverse regional impacts. We then explore how a regional approach to environmental and cultural flows protection in impact assessment described by contributors could address some of these challenges. Overall, we synthesize knowledge and opinions to contribute to broader conversations about more appropriate inclusion of regional communities and ecosystems in impact assessment in Canada.

4.3 Background

A scoping review of the inclusion of environmental and cultural flows in Canadian water laws, policies, programs, and impact assessments was completed in 2022-2023. Water acts, regulations, policies, and programs were purposively sampled from government websites (Appendix A Table S4.1). Impact assessment documents were collected from the Impact Assessment Agency of Canada's website. We chose to only investigate federal impact assessment documents because contributors mentioned that environmental and cultural flows are more likely to be addressed in joint panel reviews (both federal and provincial requirements) because of their attention to water-based impacts under federal authority (e.g., the *Fisheries Act*) and provincial authority (e.g., *British Columbia Sustainability Water Act*). We extracted impact assessments from the Impact Assessment Agency of Canada's registry if they, or their supporting documents, included one of the following terms: "instream flow needs", "ecological base flow", "environmental flow", "cultural flow", and "Indigenous flow". Supporting documents also included Indigenous-led studies or assessments if they were linked; however, Indigenous-led initiatives are included to a greater degree in the exemplary cases mentioned by interviewees. We looked for these same words in acts and policies, and regulations were only examined if acts

included these terms. To analyze scoping review documents, we identified key themes through document (Bowen 2009; Morgan 2022) and thematic analyses (Braun and Clarke 2006).

A total of eight federal acts, 19 provincial and territorial acts, eight regulations, 24 policies/programs, and 19 completed impact assessments (39 and then screened to 19 based on completion) were included (Figure 4.1). Of the eight federal acts and 19 provincial and territorial acts identified (Figure 4.1, Appendix A Table S4.1), only two directly aim to protect environmental flows (British Columbia and Prince Edward Island), and none address cultural flows. However, 19 provincial/territorial policies and 19 joint federal-provincial impact assessments from across Canada included environmental flows, whereas two impact assessments referred to a cultural flow/water process.

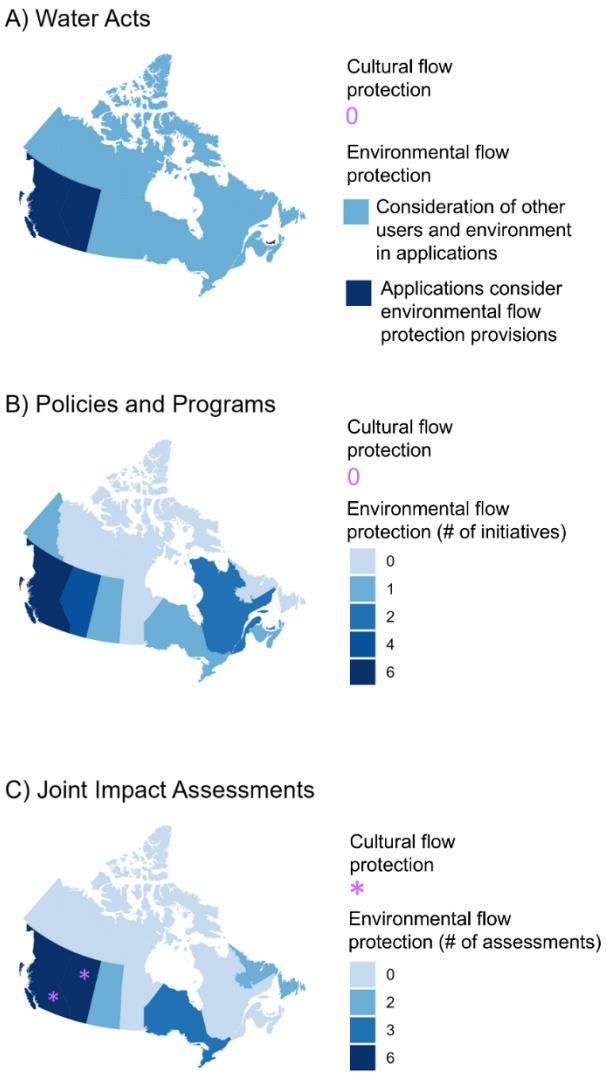


Figure 4.1. Maps of Canada displaying where there is consideration of environmental flows and cultural flows in acts (A), policies and programs (B), and federal impact assessments (C).

British Columbia's 2014 *Water Sustainability Act*, Prince Edward Island's 2021 *Water Act*, Alberta's 2000 *Water Act*, and their regulatory frameworks include greater environmental flow protection provisions compared to other Canadian jurisdictions (Figure 4.1). British Columbia's *Water Sustainability Act* enables that, during drought, if a critical environmental flow threshold has been met, environmental flows can take priority over other water uses (section 22) (Government of British Columbia 2014). British Columbia's *Water Sustainability Act* and *Water Sustainability Regulation* also include information about where water for the environment may not be diverted from, such as sensitive areas or where there are Treaty First Nation or Nisga'a water reservations (retain reserved water in the water body) (sections 40 and 41 of the Act) (Government of British Columbia 2014, 2016). Prince Edward Island's 2021 *Water Act* enables the Minister to stop a water withdrawal approval for commercial, industrial, or recreational purposes if that approval would interfere with the attainment of environmental flow needs (section 8) (Government of Prince Edward Island 2021). However, Prince Edward Island's *Water Withdrawal Regulation* sets out priority use in cases where there is not enough water to meet all demands (e.g., fire suppression, household water, and industries in the public interest supersede environmental flow needs) (Government of Prince Edward Island 2022). While Alberta's *Water Act* does not use the term environmental flows, we chose to emphasize Alberta in Figure 4.1A because the Minister may hold 10% of water transferred from licence holders for conservation purposes (section 83) and order licensees to reduce or stop water use if there is a risk of causing "a significant adverse effect on the aquatic environment" (section 97) (Government of Alberta 2000). British Columbia, Alberta, and Prince Edward Island's water acts enable the consideration of water licences and flow protection provisions in sustainable management plans, and British Columbia's *Water Sustainability Act* promotes the establishment of advisory boards to offer advice on environmental flows (section 115) (Government of British Columbia 2014). Other provincial and territorial acts mention flows, ecosystem protection, sustainability, water withdrawal authorization (e.g., Québec) and licence restrictions to meet purposes such as instream flow needs, and the opportunity for ministers to reallocate water for other uses like instream flows (e.g., Saskatchewan and Manitoba) (Wenig et al. 2006; reviewed in Horbulyk 2017, pp. 36-40). Overall, there is varying consideration of environmental flows in provincial and territorial water acts and no inclusion of cultural flows (Wenig et al. 2006; Horbulyk 2017).

At the federal level, no acts explicitly include the terms environmental or cultural flows. However, through the *Impact Assessment Act*, the Impact Assessment Agency of Canada has prepared tailored impact statement guidelines that require proponents to examine water quality, quantity, fish and fish habitat, and now more social components (Government of Canada 2022a). The *Fisheries Act* does not include the term environmental flows explicitly, but the Minister may make regulations to protect flow for fish, fish passage, and habitats (section 7) (Government of Canada 1985a). The *Species at Risk Act* also indirectly includes attention to environmental flows by protecting wildlife species and their critical habitat (section 58) (Government of Canada 2002). The *Canadian Navigable Waters Act* enables the Governor in Council to make regulations "respecting water levels and water flow necessary for navigation" (section 28) (Government of Canada 1985b). The *Canada Water Act* provides a framework for the different government jurisdictions to collaborate on concerns related to water resources but does not mention environmental flows, cultural flows, or Indigenous water rights (Government of Canada 1985c).

Alberta and British Columbia had the greatest number of policies and program initiatives for the protection of environmental flows and cultural flows to a lesser extent (Figure 4.1). This included, for example, Alberta's *Environmental Flows Program and Projects*, *Future Flows*, *Surface Water Allocation Direction* and British Columbia's *Beneficial Use Declaration, Environmental Flow Needs Policy*, and *Water Authorization Application Assessment and Processing*. Québec also included ecological reserve (not only for fish and habitat but water quality, biodiversity, and tourism) and environmental flows in their *Water Policy* (2002) and *La Politique de Débits Réservés Écologiques pour la Protection du Poisson et de ses Habitats* (1999), respectively. There was no explicit attention to cultural flows other than inclusion of Indigenous rights in BC water policy. This included reservation of water for future uses by a Treaty Nation under BC's *Application of Water Allocation Notations to Water Authorizations* (2021) and First Nations consultation and legal objection under the *Water Authorization Application Assessment and Processing for Applicants* (2019).

Environmental flows are considered to varying degrees in impact assessment in Canada and cultural flows only appeared in two instances (Figure 4.1, See Supplementary Table 4.2 for more information). Nineteen Joint Panel Reviews mentioned some form of environmental flows determination, described as an instream flow need (25%), base flows (20%), ecological flow (5%), environmental flow (30%), or sometimes simply water flow with some reference to

ecological components (20%). Despite Indigenous Treaty Rights (e.g., right to fish, hunt, gather, and navigate) being included in greater than 60% of federal assessments surveyed, only two completed assessments (Jackpine Mine, Blackwater Gold), to our knowledge, explicitly referred to a cultural flow or water process. For example, the Mikisew Cree and Athabasca Chipewyan (AB) Indigenous flows were included in the Jackpine Mine and Frontier Project (cancelled) and the water quality guidelines developed by the Yinka Dene (BC) were included in the Blackwater Gold Project (Candler et al. 2015; Yinka Dene 'Uza'hné 2016a, b). However, some assessments did highlight related social valued components, like navigation, access to land, and rights. Assessments were of mines and minerals (11), dams and reservoirs (6), oil and gas (1), roadways, and an intermodal logistics hub (1) in British Columbia (6), Alberta (6), Ontario (3), Newfoundland and Labrador (2), and Saskatchewan (2). In many cases, the approach to assessing environmental flows was not mentioned, but, while there was no mention of holistic frameworks, there was mention of minimum flows, hydrological models, and hydraulic methods. Additionally, only three impact assessments related environmental flows determinations to a greater water management framework that considers cumulative effects.

4.4 Interview Methodology

We employed a grounded theory methodology, which is used to generate conceptual frameworks based on analysis of collected data and individuals' experiences (Glaser and Strauss 1967; Charmaz 2006; Chun Tie et al. 2019). New interviewees/contributors are recruited based on emergent themes from the analysis and the research process is finished when no new ideas are emerging to inform the new conceptual framework (Chun Tie et al. 2019). This approach is employed to describe a core category that generally represents and explains the entire grounded theory and secondary categories from which the core category was developed (Birks and Mills 2015; Braun and Clarke 2021). We applied this approach, inspired by Baines's (2021) work on cultural flows, to examine the nexus of environmental-cultural flows, impact assessment, and collaboration.

Practitioners, researchers, regulators, and policy advisors with expertise relevant to environmental and cultural flows and/or impact assessment were recruited for this study. This research received ethics approval through the University of Waterloo's Research Ethics Board (#44209). Contributors received a call to participate, an information letter, a consent form, an interview guide, and an information document. We facilitated 30 interviews with 34 contributors

who had diverse backgrounds (Table 4.1). Most contributors drew from their practice across Canada (21 of 34), but there was representation from British Columbia (6), Alberta (6), Saskatchewan (2), Manitoba (1), Ontario (10), Québec (1), New Brunswick (5), Nova Scotia (1), Prince Edward Island (1), and the Northwest Territories (1). Interviews were either individual or dyadic if contributors worked together. Recruitment and interviews occurred in two phases (June to August 2022 and September to November 2022).

Table 4.1. Demographic information about study contributors.

Demographic Information	
	Contributors (*n* = 34), # of Interviews (30)
Location of Practice	(*n*)
Across Canada	21
Specific Province or Territory	13
Background	(*n*)
Environmental and Cultural Flows	9
Impact Assessment	15
Flows and Assessment	10
Expertise	(%)
Hydrogeomorphological	17
Biophysical	43
Socio-Cultural	23
Social-Ecological	20
Rights-Based	20
Assessment Experience	(%)
Project-level	37
Regional and Strategic	30
Policy and Reviewer	23
Law and Regulatory	20
Researcher on Theory and Practice	40
Practitioner	43
Supporting or Representing Indigenous Communities or Organizations	50
Part of Land Management Board	13

The first phase of the Grounded Theory application consisted of eliciting experiences and information from environmental-cultural flows experts that would later inform the discussion with impact assessment experts (phase two). Data were collected through semi-structured interviews over Zoom for 45 minutes to one hour and 15 minutes. The questionnaire can be found in Appendix B. First, recruitment invitations were sent through the Canadian Rivers Institute, the Canadian Water Network, and to participants of the 2018 Natural Science and Engineering Research Council CONNECT Workshop on Environmental Flows (Kidd et al. 2018). This was then followed by the recruitment of contributors based on emergent themes and

recommendations for experts who could speak to new themes. Emergent themes were often highlighted in subsequent interviews. Fifteen contributors were part of the first phase. During and after the first phase of interviews, all emergent themes were coded, and open categories were developed to inform the recruitment of impact assessment contributors. Impact assessment contributors were identified through social networks, publications and reports, the Network for Expertise and Dialogue for Impact Assessment, and impact assessment-related organizations, both Indigenous and non-Indigenous led. Contributors in phase two were provided with information describing potential applications of flow concepts A total of 22 contributors were recruited in phase two. Theoretical saturation was reached in November of 2022 when key contributors (5-10) addressed 80-90% of emergent themes and no new major themes emerged (Guest et al. 2006; Chun Tie et al. 2019) (Figure S4.1).

Data from interviews were coded through thematic analysis that involved open and axial coding manually and in NVivo (Braun and Clarke 2006; Chun Tie et al. 2019). Open coding, coding line by line in transcripts, began after the first interview and continued thereafter to examine emergent themes. Axial coding was used to understand how themes were related and to create new summary categories based on those relationships. Axial coding then informed the creation of a core category (Chun Tie et al. 2019). Contributors mentioned several exemplary cases in Canada that were used to inform the categories.

4.5 Results

4.5.1 Issues and Gaps when Considering Regional and Downstream Impacts to Ecosystems and Communities in Assessments in Canada

Contributors expressed that there are challenges in protecting regional and downstream ecosystems and communities in impact assessments in watersheds (see Table 4.2). Challenges that were spoken about in detail by study contributors are briefly discussed below, including scoping disagreements, inattention to cumulative effects, and coordination of responsible authorities.

Table 4.2. Challenges in protecting downstream ecosystems and water users in impact assessments described by study contributors.

Challenges to Protecting Downstream Ecosystems and Water Users	Description
Capacity and funding	Not enough monetary support or a lack of process in impact assessment and engagement to include regional and downstream Rights holders and stakeholders.
Data gaps	Lacking regional watershed information and data or a process to collate and synthesize natural and social science information and data.
Disciplinary siloes	Compartmentalization of impact assessment disciplines (physical, biophysical, socio-economic) with effort to coordinate but difficulties in practice.
Governance negotiation	The need to negotiate governance goals for watersheds ahead of impact assessments to identify if projects interfere with the ability to govern by Rights holders.
Scoping disagreements	Contention over chosen spatial, temporal, and contextual (institutions/organizations to include) scales to determine impacts on valued components.
Limited regulatory oversight	No legislation to protect environmental and cultural flows and water or broader water goals in impact assessment.
Political bias and screening projects	Regional political agendas and economic motivations interfering with proper assessment of proposed projects or dictating which projects require assessments.
Coordination of responsible authorities	Coordination challenges and a risk of diffusion of responsibility because of multiple jurisdictions with overlapping authority to trigger assessment, regulate assessment components (the *Fisheries Act*, the *Navigable Water Acts*, etc.), or influence decisions that are independent of assessments but affect cumulative stressors.
No existing thresholds	No consensus on limits for water levels, flow, withdrawal, or quality within a region.
Unclear assessment triggers	Not designating an impact assessment because of divergent interpretations of triggers for the process.
Unsatisfactory engagement	Engagement processes that inform communities rather than create mutually beneficial partnerships.
Inattention to cumulative effects	Minimal consideration of broader cumulative effects of multiple project developments within a region.

4.5.1.1 Scale and Scope of Impact Assessments

Narrow project boundaries and scales for impact assessments may limit the protection of ecosystems and communities. A practitioner in Alberta remarked that, “Canada would like to scope down regional impact assessments, and communities and Indigenous groups would like to see these things scoped up, and that's going to be a real problem of expectations not being met.” Contributors in British Columbia and New Brunswick mentioned that the scope and scale of the investigation of water quantity and quality is constrained by project boundaries rather than by environmental or cultural scales of interest.

4.5.1.2 Cumulative Effects of Water Withdrawal and Degradation

The effects of water withdrawal and degradation are difficult to understand because cumulative effects are generally only investigated at the project level. A practitioner in Alberta added that there is no clear “articulation of how much is too much (water withdrawal and

degradation)" and mentions that there is a need to consider ecohydrology for "greater mitigation and reclamation to ensure environmental flows are established and maintained." When the cumulative effects of water withdrawals are mentioned in impact assessments, a regulator in Ontario suggests that these are generally "listed" but not substantiated.

4.5.1.3 Coordination of Responsible Authorities

The fragmented water governance and impact assessment landscape in Canada makes the protection of ecosystems and communities difficult. A reviewer in Alberta noted: "If Canada does regional assessments, what does that mean in terms of managing cumulative or project-specific effects if they're not the ones issuing the [water] licences." A regulator in the same province reflected on values that might underpin decisions: "Water as a resource is considered by provincial regulators through their water act, but the values that are driving the regulatory regime are transactional and commodity based, not ecological or culturally based." Collaboration with Indigenous Nations, the province, and the federal government is needed for greater jurisdictional coordination and appreciation of water values.

4.5.2 Steps to Protect Environmental and Cultural Flows in Impact Assessments Conducted in Watersheds in Canada

4.5.2.1 Core Category – Regional Readiness

To deal with these challenges and protect downstream and regional ecosystems and communities in watersheds and direct assessment processes towards ecological- and cultural-based goals, we propose regional readiness as the core category in our grounded theory. This was informed by 11 themes (Table 4.3), key categories developed from those themes (the three Cs: water councils, change, and consensus), and exemplary cases related to environmental and cultural flows. Regional readiness can be understood as a state of preparedness that those engaged in the governance of a watershed can reach for acting in the interests of human communities, ecosystems, and their interactions. This includes the ability to create a water development space ahead of developments based on agreed upon water visions for the future (King and Brown 2018). Figure 4.2 depicts steps required to reach regional readiness. Investigating how to protect environmental and cultural water ahead of assessment is important to:

1. Scope in environmental and cultural water values – "The place where society more appropriately values water from an ecological or cultural lens is not at the level of an impact assessment. It happens way sooner" (Regulator in Alberta).
2. Capture the hydro-social-ecological system – "Environmental-cultural flow is the status of the whole social-ecological-hydrological system that is necessary to keep that interconnected system healthy" (Policy advisor in British Columbia).
3. Create a water-centred process – "Decision-making must consider what the ecosystem needs first…without that, we take what we need and there's a death by a million cuts. Eventually, you have a baseline that is continually shifting until there's nothing left" (Lawyer in Alberta).

The development of regional readiness emerged from discussion of themes about water councils, change, and consensus, which are inspired by contributors' reflections on exemplary cases.

Table 4.3. Recommendations and requisites for the protection of environmental and cultural flows ahead of, and as part of, impact assessments. These emergent thematic codes from interviews were created during the open coding process and include themes from phases one and two. The interview percentages refer to the percent of interviews that spoke to this recommendation and the number of thematic codes are the total number of lines of text and text blocks coded to recommendations.

Theme	Recommendations and Requisites	Interviews (%)	Thematic Codes (#)
Baseline	Sufficient hydro-social-ecological information to assess a new project within a watershed. This baseline information could include, for example, long-term knowledge of water flow between seasons (e.g., spring peaks and groundwater baseflows) and historic water quality degradation (nutrients, toxic algal blooms). Second, consider connections of hydrology and water quality to floodplain connectivity, fish habitat and spawning, sediment transport, estuary formation, seed dispersal, benthic invertebrates, nutrient cycling, navigation, fishing, ceremony, and practice of Indigenous rights.	73	35
Cumulative effects	Examine the cumulative effects of water abstraction, drainage, and pollution for watersheds based on small and large dams, agricultural drainage projects, mines, and projects that have and have not been historically designated for impact assessments ahead of new development.	80	27
Early collaboration	Strengthen the pre-planning phase of impact assessments for greater linkages between watershed planning, strategic and regional assessments, and project-level assessments.	80	45
Inclusive scoping	Broaden the temporal and spatial scales of impact assessments and form collaborations based on transboundary water contexts.	63	37
Knowledge sharing	Exchange knowledge about water goals ahead of assessments by building trust and relationships between Indigenous Nations, government agencies, and proponents.	80	47

Rights and culture	Appreciate impacts to rights and culture for Indigenous Peoples downstream of development projects.	70	36
Screening projects	Determine what projects should undergo assessments and be approved based on the ability of a watershed to support new developments while achieving environmental and cultural water goals.	24	7
Systems thinking	Include greater appreciation of social-ecological systems in assessments in watersheds. Social-ecological systems describe linked human systems and ecosystems with resources, resource users, and governance.	67	33
Tiering	Set ecological and cultural goals at the watershed level and use that information to inform plans, policies, and programs, and then apply these goals to project-level assessments that could then inform regional water supply and allocation strategies (project to watershed to region and vice-versa).	60	27
Water Relationships	Understand how communities relate to and steward water systems, both through tangible (e.g., fishing and recreation) and intangible (e.g., connection to nature) expressions.	67	37
Water standards	Develop water standards based on evaluating the sensitivity, importance, and sacredness of water bodies.	33	18

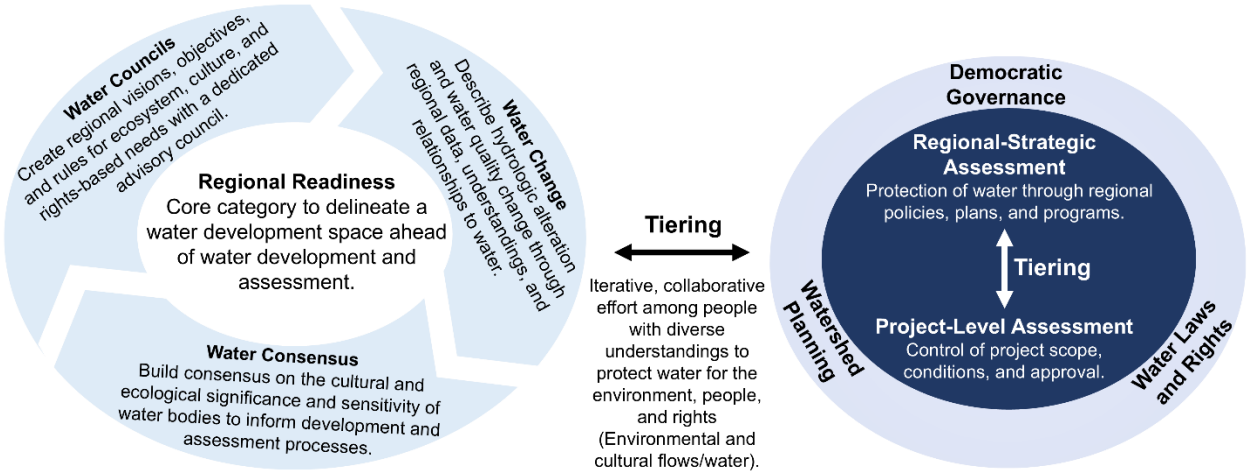


Figure 4.2. The grounded theory structure for the application and protection of environmental and cultural flow/water concepts ahead of and in impact assessment planning processes.

Exemplary cases are discussed in this paragraph and in more detail in Table 4.4. The Wolastoq ELOHA is an ongoing process in New Brunswick where there is discussion and quantification of region-wide ecosystem and societal needs that depend on water flows and quality to inform the operation of the Mactaquac Hydroelectric Dam (Monk et al. 2017). The Athabasca Chipewyan and Mikisew Cree undertook a process to investigate flow alteration in the Athabasca River from the oil sands, climate change, and declining flows and set Aboriginal

Base Flow and Extreme Flow thresholds, which have been referenced within Teck Frontier's impact assessment and Mikisew's own assessment process (Candler et al. 2010, 2015). The Yinka Dene (Nadleh Whut'en and Stellat'en) have created a Surface Water Management Policy and Water Quality Standards to classify waterways in their territory in British Columbia and offer duty to consult steps that must be met ahead of assessments like the Blackwater Gold Project (Yinka Dene 'Uza'hné 2016a, b) The Treaty Three (western Ontario and southeastern Manitoba) Women's and Grandmother's Councils created a Nibi Declaration to assert water relationships that Anishinaabe citizens and others living within the territory should have and this is beginning to be applied to protect water in policy and development decision-making (Craft and King 2021; Grand Council Treaty #3 2023). Lastly, the Wood Buffalo National Park Strategic Assessment led to an Action Plan to protect environmental and cultural flows in the Peace-Athabasca Delta (Parks Canada 2018, 2019). These cases are mentioned in the next section.

Table 4.4 Description of exemplary cases across Canada that include or relate to environmental and cultural flows and water considerations, their relationship to impact assessment, and outcomes. These examples are key cases mentioned by contributors.

Title of Process	Actors Involved	Description of the Process	Relationship to Impact Assessment	Outcomes	Source
Wolastoq Ecological Limits of Hydrologic Alteration (ELOHA) Process for Mactaquac Dam	University of New Brunswick, Canadian Rivers Institute, St. John River Society, New Brunswick Power	They employed the Ecological Limits of Hydrologic Alteration approach to have workshops and discuss ecosystems that depend on water (monitor nutrient and flow changes at six river habitats) and society's activities, uses, and feelings towards water (surveys and online mapping software to create a story map).	Evidence for the impact assessment of the decommissioning of the Mactaquac Dam, but the proponent (N.B. Power) and province ultimately decided to refurbish the dam instead.	The framework for water connections will help in setting water quality levels, future monitoring, management actions, and target flow needs. They continue to test the connections across the watershed and identify flow and water quality needs.	Monk et al. 2017
As Long as the River Flows: Athabasca River Knowledge, Use, and Change	Athabasca Chipewyan First Nation, Mikisew Cree First Nation, and the Firelight Group	They investigated river alteration from oil sands development, climate change, and declining flows. With interviews with Elders, knowledge holders, and leadership they measured navigability, practice of rights, use and occupation, and knowledge transmission about water. They identified an Aboriginal Base Flow (water levels sufficient to fully practice rights and ensure access) and Aboriginal Extreme Flow (low water level below which disruption to rights and way of life would result).	These thresholds have been referenced within the Teck Frontier Oil Sands impact assessment in Alberta and part of Mikisew Cree's own culture and rights assessment of the Teck Frontier Project called Wîyôw'tan'kitaskino (Our Land is Rich) that highlighted key valued components: Way of Life, Harvesting Rights, and Governance and Stewardship	The Frontier Project ultimately did not proceed and was terminated because impacts were considered too significantly adverse. The study recommended that the Crown "sit with" both Nations to establish an Athabasca River Consultation and Accommodation Framework to govern future water management.	Candler et al. 2010, Candler et al. 2015
Yinka Dene 'Uza'hné Surface Water Management Policy) and the Yinka Dene 'Uza'hné Guide to Surface Water Quality Standard	Yinka Dene (Nadleh Whut'en and Stellat'en), Yinka Dene Environmental Staff and Consultants, Project Proponents	Yinka Dene and consultants created a water management policy and surface water quality standards to classify waterways and inform waterway capacities for supporting further development. They set Class I (Waters of high cultural and ecological importance), II (Sensitive waters), and III (Typical waters and waterways) based on measuring and calculating water quality standards and then qualifying standards based on narrative water management objectives: unique cultural uses, special assemblages, at-risk species, and traditional resource uses.	This process was used in the assessment of the Blackwater Gold Project in British Columbia by Carrier Sekani First Nations whose Water Law included the Yinka Dene 'Uza'hné process. Here, project proponents must complete 11 steps laid out in these documents in consultation with Yinka Dene environmental staff to complete the Duty Consult requirement of impact assessments.	Yinka Dene 'Uza'hné guidelines were used to influence decision making concerning the treatment of effluent discharge and limits from ecological and cultural indicators, design and implement monitoring programs that support effective environmental management and create reclamation and closure plans.	Yinka Dene 'Uza'hné 2016a, Yinka Dene 'Uza'hné 2016b
Nibi (Water) Declaration of Treaty Three	Treaty Three Women's and Grandmother's Councils, University collaborators, Territorial Planning Unit	This Declaration was established for formal recognition of governance processes in water-related policy and decision-making processes across Treaty Three. Information came from engagement sessions, feedback, surveys, and thematic content analysis, and Anishinaabe visual thematic organization. Four key pillars emerged: Governance, Ceremony, Community-Based Monitoring, and Outreach/Education. This Declaration outlines water relationships that Anishinaabe citizens and others living within the territory could and should have.	A Territorial Planning Unit works with Treaty Three Leadership to protect the lands, waters, and resources and evaluate resource developments following the Nibi Declaration.	The Grand Council Treaty Three Territorial Planning Unit in Manitoba and Ontario is applying the Anishinaabe Nibi Inakonigaawin (water law principles) to protect water in policy and development decision-making.	Craft and King 2021, Grand Council Treaty #3 2023
The Action Plan and Strategic Environmental Assessment for Wood Buffalo National Park	Parks Canada, Environment and Climate Change Canada, UNESCO, B.C. Hydro, Indigenous partners, and Alberta, British Columbia and Northwest Territories	This process was spurred by remarks from Indigenous Nations to UNESCO that the Peace-Athabasca Delta and Wood Buffalo National Park were not being correctly managed as a world heritage site, in part because of the effects of the Site C and Bennett Dams in the Peace River and oil and gas development in the Athabasca watershed. Studies identified hydro-ecological endpoints and documenting Indigenous uses through interviews.	Environmental-cultural flows objectives were defined in the Action Plan after the Strategic Assessment for the Wood Buffalo National Park. The objectives included ecologic and hydrologic integrity, the exercise of Aboriginal and Treaty Rights, and informed decision-making (building baseline knowledge).	In the strategic assessment, information was gathered and considered through a shared water governance framework and Action Plans that support the assessment of policies, plans, and programs related to environmental-cultural flow requirements in the Peace-Athabasca Delta.	Parks Canada 2019

4.5.2.2 Steps Toward Regional Readiness

Water Councils – Create regional visions, objectives, and rules for ecosystem, culture, and rights-based needs with a dedicated advisory council.

A dedicated forum for regional water discussions prior to developments is necessary for greater knowledge sharing and for commitments to build relationships. This is generally true for all the exemplary cases, and 16 contributors spoke to this theme. For example, the Action Plan for Wood Buffalo National Park was created with Parks Canada, Environment and Climate Change Canada, UNESCO, B.C. Hydro, Indigenous Nations, Alberta, British Columbia and Northwest Territories to define environmental and cultural flow requirement in the Peace-Athabasca Delta. Consultants in British Columbia described how practitioners and proponents could engage if decision-making tables were able to "set the tone": "If you're able to have a regional working group that was able to proactively pull together data and come up with their goals around cultural and environmental flows and we knew that upfront, we could work with that group (Rights holders or stakeholders)." Similarly, a regulator in Ontario remarked:

> We have an opportunity to set in place the processes, have discussions about the objectives that we want for aquatic ecosystems and our economy, and how we want to administer our authorities for enabling that and aligning our decisions towards achieving those objectives.

If this occurs, contributors mentioned that dedicated and early regional visions for allocating water for the environment, people, and rights could be an opportunity for more inclusive and democratic assessments. Evaluating the degree to which regions have a dedicated water forum with diverse actors is necessary to protect environmental and cultural flows and seek consensus prior to and as part of impact assessments.

Water Change – Describe hydrologic alteration and water quality change through regional data, understandings, and relationships to water.

Regional readiness requires an appreciation of water change and interrelationships between ecosystems and people – both valued components and relationships – and joint consideration of environmental and cultural water. Twenty-three contributors spoke to this theme and the Wolastoq and Athabasca River (Athabasca Chipewyan and Mikisew Cree) cases in particular describe research processes to understand hydro-social-ecological change and

relationships, including ecosystem needs and water quality/quantity interactions; use, activities, and feelings towards water; navigability, practice of rights, use and occupation, and transmission of knowledge about water. The challenge, as described by a researcher and practitioner in Nova Scotia, is that:

> We need to attend to the concept of impacts as something that is experienced by communities in a complex social-ecological way. When you alter the water chemistry of a river system because of a mine, traditional impact assessment says, "Okay, what's the impact?" So, we do baseline studies and then we look and say, "Well, how much cesium is in the water before and after?" One of the hardest things for the impact assessment process to embrace has been the testimony of stakeholders, Indigenous and non, to say "Well, you're changing a water system, and this is not simply about biochemistry."

A water system is composed of relationships that can be represented by both natural and social sciences and Indigenous Knowledge. A policy advisor in British Columbia describes this: "We look at the full suite of water indicators: the spiritual, intellectual, biophysical, financial, economic, emotional, and social. I think that is where the power is." One anonymous contributor adds to this by speaking about roles and responsibilities: "What is most transformative is if using the cultural-environmental flows concept could change how we relate, like how we see our jobs and our contributions [such as, stewardship, household water conservation strategies, teaching, community-based monitoring, ceremony, actions to take, to maintaining that regional environment." This is similar to the Nibi Declaration of Treaty Three that describes how people should relate to the watershed (Grand Council Treaty #3 2023). There is a need to have a full understanding of water change and the roles and responsibilities to maintain environmental and cultural flows ahead of, and as part of, assessments.

Water Consensus – Build consensus on the cultural and ecological significance and sensitivity of water bodies to inform development and assessment processes.

Building consensus through management objectives and guidelines on the understood cultural and ecological significance of waterbodies is necessary ahead of development and assessment. This was identified by twelve contributors, and the Yinka Dene Water Management Guidelines are a good example of how Class I (Waters of high cultural and ecological importance), II (Sensitive waters), and III (Typical waters and waterways) were determined

ahead of assessment. These guidelines about water sensitivity inform 11 steps that proponents must undertake before duty to consult obligations are met. This includes, for example, that proponents must work with Nadleh Whut'en and Stellat'en environmental staff to set out steps of water management plans, set the ecological and cultural sensitivity of water bodies under development, evaluate water standards against sensitivity, establish water quality and discharge limits consistent with standards, and develop monitoring and adaptive management programs (Yinka Dene 'Uza'hné 2016a). A practitioner in British Columbia spoke to this process:

> Proponents would know at the outset: this is the framework that I need to work under, these are the water bodies that are off limits, this is the goal for this water body over time. We need to design our project in a way that fits within that continuous improvement framework.

This goal is to build considerable detail about the value of water allocated to an area for spiritual, stewardship, and rights-based practices or protected ecosystems, what particular existing cumulative stresses (water withdrawal, drainage, and pollution) need to be mitigated or eliminated, and if water should be reserved for environmental and cultural purposes in advance of assessments and as part of consent processes.

4.5.3 Integrating Environmental and Cultural Flows into Higher-Level Assessment (Regional/Strategic)

If strategic-regional assessments are designed to explicitly consider environmental-cultural flows (as one of several pre-planning considerations) as a starting place to delineate a watershed's development space, different water values based on ecosystem, culture, and rights-based needs can be scoped in (see Table 4.5). An environmental regulator in Alberta said:

> My view of a regional assessment would be to assess the degree to which the bigger picture is being looked at and whether those values, concerns, thresholds, and indicators have been set or not and if they can be. The response on the regulatory side is going to lag behind and that's a problem. We recommend that a regional vision is established before those impacts are allowed to occur. I do not see the [current] regional impact assessments doing that.

Environmental and cultural flow initiatives can provide guidance for ecosystem, cultural, and rights-based needs at a higher-level of assessment to inform individual developments.

Table 4.5. Applications of environmental and cultural flows at different stages of project-level impact assessment based on contributors' ideas and assuming use of regional/strategic assessments.

Stage	Application of environmental-cultural flows	Quotes and Ideas
Pre-Project Planning	Opportunity for proponents/consultants to know how regional actors have already classified the watershed and identified what parts are capable of supporting and otherwise prepared for development.	"Federal environmental impact assessment would then look at that framework and say, 'where does this project fit within that set of values that was laid out?'" (Regulator in Alberta).
Screening and Scoping	New context to screen in, scope projects, and develop baseline information based on how projects are situated within diverse and better understandings of water.	"If we think of environmental-cultural flows as values-based, we can start to open our hearts, minds, intellect, and emotions to embracing different meanings of water and that will allow more comprehensive, fulsome, deeper impact assessments" (Policy advisor in British Columbia).
Impact Assessment	Impacts on connections between water, ecosystems, and people are evaluated based on scenarios, participatory approaches, and local and Indigenous knowledge and science.	"There is a broader lens on what we would choose as our valued environmental components, but also our valued environmental relationships or our valued cultural relationships" (Anonymous contributor).
Significance and Follow-Up	Impacts' significance can be assessed considering how ready water bodies and their actors are for developments. Impacts will need to be managed in waterways to ensure relationships of different actors to ecosystems are maintained.	"If you were to have a region that said, 'we are laying out our values and our proposed use of water as a resource to protect downstream users,' then the impact assessment would need to respect that in their decision statement and their determination of significance" (Regulator in Alberta).

4.6 Discussion

In summary, to improve impact assessments and link watershed planning, regional assessment and impact assessments, the authors, informed by interviews with practitioners and policy advisors, argue for greater consideration of environmental and cultural flows and water across scales. To do this requires knowledge sharing and collaboration about regional water goals; appreciation of Indigenous water stewardship and rights-based needs; implementation of guidance related to the determination of environmental and cultural water requirements based on Western and Indigenous science-informed baseline data; and evaluation of the cumulative effects

of on-going water abstraction, drainage, pollution, and climate change. We propose a framework to prepare regional actors to act in the interests of water users, ecosystems, and rights ahead of impact assessment based on the three Cs: water councils, water change, and water consensus. Key questions for practitioners for regional readiness to protect environmental and cultural water are described in Table 4.6 based on a summary of this study, relevant literature, and the co-authors' ideas.

Table 4.6. Applications of environmental and cultural flows at different stages of project-level impact assessment based on contributors' ideas and assuming use of regional-strategic assessments.

Stage	Application of Environmental and Cultural Flows	Quotes and Ideas
Pre-Project Planning	Opportunity for proponents/consultants to know how regional actors have already classified the watershed and identified what parts are capable of supporting development and are otherwise prepared for it. Valued components and relationships can be collaboratively developed based on multiple impacts to water systems.	"Federal environmental impact assessment would then look at that framework and say, 'where does this project fit within that set of values that was laid out?'" (regulator in Alberta).
Screening and Scoping	New context to screen in, scope projects, and develop baseline information based on how projects are situated within diverse and better understandings of water.	"If we think of environmental-cultural flows as values-based, we can start to open our hearts, minds, intellect, and emotions to embracing different meanings of water and that will allow more comprehensive, fulsome, deeper impact assessments" (policy advisor in British Columbia).
Impact Assessment	Impacts on connections between water, ecosystems, and people are evaluated based on scenarios, participatory approaches, and local and Indigenous knowledge and science.	"There is a broader lens on what we would choose as our valued environmental components, but also our valued environmental relationships or our valued cultural relationships" (anonymous contributor).
Significance and Follow-Up	Impacts' significance can be assessed in light of how ready water bodies and their actors are for developments. Impacts will need to be managed in waterways to ensure beneficial relationships of different actors to ecosystems are maintained.	"If you were to have a region that said, 'we are laying out our values and our proposed use of water as a resource to protect downstream users,' then the impact assessment would need to respect that in their decision statement and their determination of significance" (regulator in Alberta).

4.6.1 Incorporation of Environmental and Cultural Flows within Past Canadian Laws, Policies, Programs, and Impact Assessments

There has been a moderate increase in the uptake of environmental, but not cultural, flows principles in the last decade in laws, policies, and impact assessment practice in Canada, as in other countries. Australia, New Zealand, South Africa, and the United States for example, include recognition of environmental flows in their water acts (Harwood et al. 2017). In Canada, Prince Edward Island, Alberta, and British Columbia included greater attention to environmental flows in their water acts and policies. This is likely a result of groundwater preservation for daily use by farmers in PEI (PEI Department of Fisheries and Environment and Environment Canada 1996); a water strategy to promote water sustainability and collaboration with Indigenous Nations in British Columbia (Joe et al. 2017); and consideration of water licence overallocation, drought, and protection of the aquatic environment in Alberta (Bjornlund et al. 2013). In Canadian impact assessments, cultural flows receive little attention and environmental flow processes and management frameworks are largely done retroactively after project completion. Aside from some notable cases of attention to environmental flows in impact assessment internationally (Russia, China, and Mongolia (Simonov et al. 2019); Uganda (O'Brien et al. 2020); Ethiopia (McCartney et al. 2010); Pakistan (Brown et al. 2019); Australia (Jackson et al. 2014); and the European Union (Acreman et al. 2009)), this is similar to most countries that appear to finish impact assessments without proactive consideration of environmental or cultural flows (Brown et al. 2019).

4.6.2 Environmental and Cultural Flows as an Asset to Impact Assessment and Pre-Planning

To our knowledge, impact assessment and water management do not usually consider an idea of readiness. The one exception we are aware of is the Mackenzie Gas Project in which the joint review panel included "cumulative impact management and preparedness" in one of its five core criteria categories for evaluating the project as proposed in light of alternatives centred on pipeline throughput (MGPJRP 2009, p. 7). Our idea of preparedness is slightly different in that it is about the capability of regional actors to represent ecosystems and riparian communities in water-related impact assessments and development decisions.

One step of regional readiness refers to dedicated water advisory councils with diverse actor groups (e.g., government, Indigenous Nations, agricultural producers, non-profits,

municipalities) to democratize water governance during preparations for impact assessments or other water-related decision making (Sultana 2018). This is about creating a space where different perspectives can be shared to help pluralize ideas and decision-making (Arsenault et al. 2018; Wilson and Inkster 2018; Hania and Graben 2020). While there are many knowledge-sharing approaches (Alexander et al. 2019, 2021), such as Two-Eyed Seeing (Wright et al. 2019; Reid et al. 2021), Two-Row Wampum (Hill and Coleman 2019), and Braiding (Kimmerer 2013; Jimmy et al. 2019), a generative water-centred space for deliberations before development could allow for the emergence of new, context-specific knowledge-sharing approaches (Gibson et al. 2020) To realize this space, there could be an effort towards establishing public trust and organizational capacity (e.g., human, institution, financial, and physical resources) of councils (O'Donnell and Garrick 2017b).

Another step is attention to water change (water, ecosystems, and society) and the roles and responsibility needed to maintain a regional water environment. Holistic environmental flow approaches (e.g., ELOHA, BBM, DRIFT) have been used to identify connections and the effect of hydrologic change (Poff et al., 2010; Tharme, 2003), and there is also opportunity for new approaches. Diver et al. (2019, p. 400, 403, 405) describe a "web of relations" between nature and people in which there is a multi-directional "flow of benefits and mutual responsibilities" and a need to maintain these connections by reframing governance around "reciprocal relations". Similarly, many Indigenous scholars, such as McGregor (2018, p.7), speak to the idea of "all our relations" asserted through Indigenous Water Laws and Declarations (Craft and King 2021). The concept of understanding water change through relationships is essentially about "hydrosocial multiplicity to acknowledge the need to re-affirm Indigenous laws, customs, epistemologies, and ontologies about water" (Wilson and Inkster 2018, p. 530). This is also about a means to define a baseline based on areas of potential concern for dependencies between different types of flow (groundwater low flows, recessional flows, overbank flows, within-bank flows), water quality, wildlife and people (Douglas et al. 2019).

Lastly, the final element is building water consensus through determining objectives for different water bodies ahead of development and assessment. Through this process, the sensitivity of different parts of the watershed can be determined in the pre-planning phase by communities and regional decision-making tables reflecting on the watershed's baseline, stressors, and deficiencies in information and data (WWF-Canada 2017, 2020). Historically,

watersheds have had information on hydrology (Ouellet Dallaire et al. 2020), but we call for effort to improve gaps in hydrological, ecological (Armanini et al. 2013; Trubilowicz et al. 2013), social, and rights-based information (Jackson et al. 2012; Linton and Budds 2014) that could inform consensus-building processes (Arsenault et al. 2018; Leonard et al. 2023). The World Wildlife Fund (2017) has helped Canada move in this direction by evaluating the stress of Canada's 167 sub-watersheds based on hydrologic, ecological, and climate rankings. They found that 53 of 167 sub-watersheds are highly stressed (WWF-Canada 2017). While this information is essential to build the capacity for regional readiness, there is no information about water justice and the marginalization of communities by hydrologic change and pollutants (McGregor 2018; Robison et al. 2018). This information could help determine if watersheds should have an ecological or Indigenous water reserve to establish environmental or cultural water as a prior right ahead of development (Horne et al., 2017).

4.6.3 Implementation and Practice of Environmental-Cultural Flows through Regional Readiness in Different Levels of Impact Assessment

Evaluating regional readiness could offer an easier way to include systems thinking in impact assessments through collaborative attention to environmental and cultural flows. Noble et al. (2019) mention that a strategic assessment will fail if it is "disconnected from larger formal systems of participatory and integrated policy, planning, and development decision-making" (p. 344). Similarly, Ehrlich (2021) says that project-level impact assessments need greater evidence of systems thinking through the assessment of cumulative impacts from other projects across regional and strategic scales (tiering: Arts et al. 2011). Environmental and cultural flows offer a water-centric lens to evaluate if a system has been characterized through diverse water sensibilities. To facilitate the process described in this paper, we recommend that the new Canadian Water Agency explore the idea of watershed or regional readiness as a potential mandate and directive and operate as an auditor between different levels of impact assessment.

4.7 Conclusion

In our study, we sought to develop a process to describe how to enable greater and more effective inclusion of regional communities and ecosystems in impact assessments within watersheds. To accomplish this, we examined the nexus of environmental-cultural flows, impact assessment, and collaboration in the Canadian context by speaking with practitioners, policy

advisors, regulators, researchers, and reviewers. What emerged was potential required elements (water councils, water change, and water consensus) for inclusive systems understanding before and/or in the design and implementation of assessment processes in watersheds. We defined this as regional readiness, which was inspired by contributors' reflections on collaborative attention to environmental and cultural flows. To protect environmental and cultural water in impact assessment requires collaboration and knowledge sharing about regional water goals, assertion of Indigenous water rights, determination of environmental and cultural water requirements based on agreed-upon baseline data and valued ecosystem components, and evaluation of the cumulative effects of on-going water withdrawal and climate change. Focusing on building regional readiness through collaborative processes that identify and protect environmental and cultural flows before development could help in making greater strides towards sustainability and democratic water governance.

4.8 Transition

This paper identified a need for greater collaborative oversight of environmental and cultural flows ahead of impact assessments through higher-level assessment. In particular, participants identified higher-level water advisory groups, determining roles and responsibilities of actors to maintain the regional water environment, and setting the sensitivity and importance of water bodies. The next chapter focuses on water regulation and assessment in the Canadian Prairies for case studies related to the protection of environmental and cultural flows (Fig. 4.3).

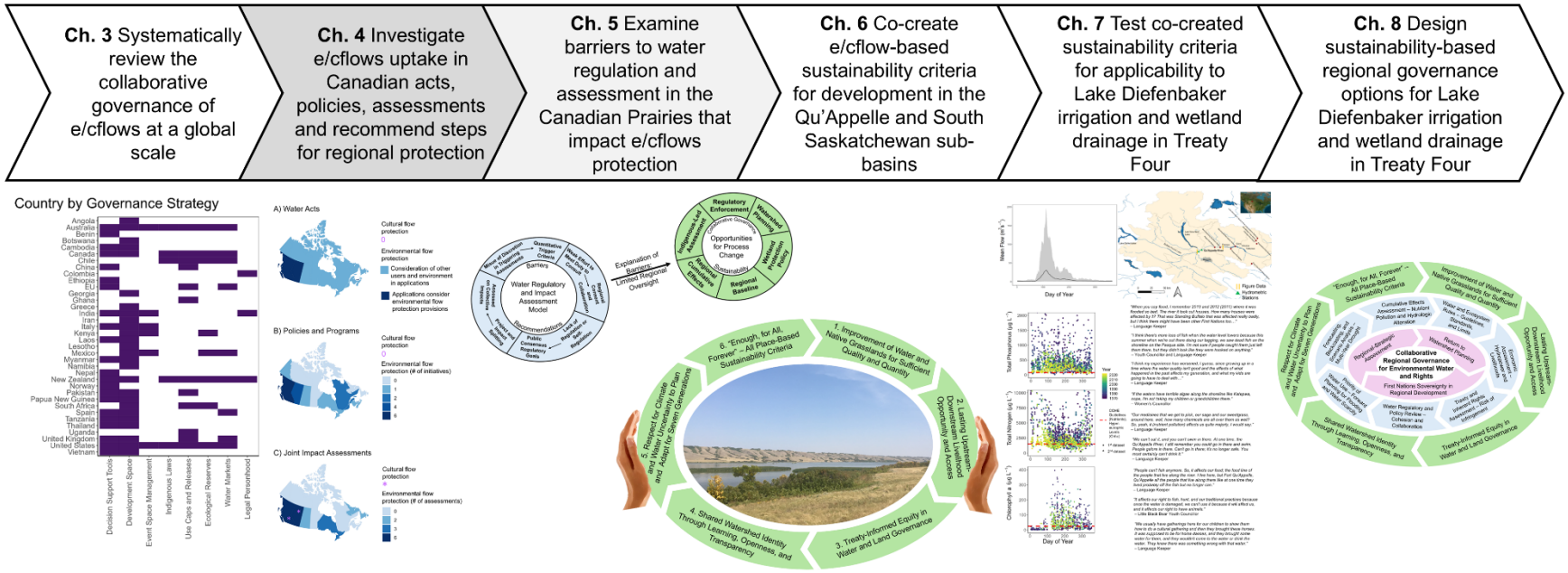


Figure 4.3. A roadmap diagram showing the transition from Ch. 4 to Ch. 5 objectives. E/cflows refers to environmental and cultural flows.

CHAPTER 5. BARRIERS TO OPPORTUNITIES: EVALUATION OF ENVIRONMENTAL ASSESSMENT AND WATER REGULATION IN THE CENTRAL CANADIAN PRAIRIES

5.1 Overview

Creating environmental impact assessments and water regulations that meaningfully protect water for the environment and Treaty and Inherent Rights is difficult. To explore barriers and opportunities for impact assessments, we focus on the regulatory environment of three water withdrawal and drainage projects in the central Canadian Prairies. The Canadian province of Saskatchewan is the home of the lead author, and this project was co-created with FHQTC-LRES. We synthesized news articles, reports, and assessment guidance documents and conducted interviews and workshops with government representatives, Rights holders, and stakeholders. Participants described their experiences with regulatory and assessment processes, offering examples from the Lake Diefenbaker Irrigation Expansion, Quill Lakes Drainage Project, and the Yancoal Potash Mine. Barriers to effective regulation included discretion in triggering assessments, project and impact splitting, limited or self regulation, and narrowly scoped duty to consult obligations. Contributors suggested that these barriers persist because of a lack of watershed planning, no environmental appeal board, no consensus determination of a baseline, and the absence of a structure and tradition to address cumulative effects. Study participants described opportunities for regional assessment, Indigenous-led assessment, and more regulatory enforcement to guide current water regulation towards more collaborative governance.

5.2 Introduction

There are barriers within environmental impact assessment and water regulation in Canada that may limit the protection of water for the environment and rights. Water of an adequate quantity and quality for downstream ecosystems (termed environmental water/flows) and Indigenous rights (termed cultural water/flows) is a recognized goal internationally and in Canada (Arthington et al. 2018; Government of Canada 2024d). However, while most environmental impacts assessments are meant to mitigate harms to these features, they may fall short in certain cases (Acreman et al. 2017; King and Brown 2018). Individual development projects, licences, and permits (including federal and provincial) for various water considerations are assessed one-by-one, without effective attention to their interactive and cumulative effects (Gunn and Noble 2009; Renzetti and Dupont 2017; Muldoon et al. 2020). Many practitioners and scholars report issues when water developments and licence applications are exempt from environmental impact assessments or are evaluated on an individual basis. They argue that cumulative effects are not appropriately addressed (Duinker and Greig 2006; Therivel and Ross 2007; Sinclair et al. 2017), meaningful partnerships and duty to consult obligations with Indigenous Nations are not adequately fulfilled (Udofia et al. 2017; Herse et al. 2020; Pfeffer 2022), social-ecological systems cannot be understood (Liu et al. 2007; Gibson et al. 2020; Ehrlich 2021), and future directions based on alternative regional scenarios cannot be determined (Duinker and Greig 2007; Jones 2016; Foley et al. 2017). Therefore, there is a need to identify and rectify barriers in environmental impact assessment and water regulatory processes for greater collaboration to protect water for the environment and rights.

Steps towards more inclusive and collaborative management may address barriers in project-level assessment and individual licencing requirements. Through watershed planning, higher-level assessment, and Indigenous leadership there may be opportunity for more regional consensus that links to development decisions (Clogg et al. 2017; FNMPC 2020; Gibson et al. 2020). This can happen through a process called tiering in which larger initiatives influence, and offer guidance, to lower level plans (Arts et al. 2011). However, enabling environmental laws and regulations and a tradition of regional management must be established for greater collaborative water protection (Dubé 2003; Sheelanere et al. 2013; Curran 2019; FNMPC 2020).

In the Canadian Prairies, barriers to effective regulation and assessment need to be investigated because governance is fragmented and watersheds are highly degraded (Morgan et

al. 2014; WWF-Canada 2017; Chilima et al. 2021). Governance of water in the Canadian Prairies is carried out provincially, but the federal government has a fiduciary responsibility to First Nations (Renzetti and Dupont 2017). There are difficulties with inter-jurisdictional collaboration through the Prairie Provinces Water Board, and project-level environmental assessments have challenges addressing cumulative effects (Prairie Water Directive 2009; Sheelanere et al. 2013; Morgan et al. 2014). However, the current governance model does support inter-provincial (Alberta, Saskatchewan, Manitoba) water quantity management through the *Master Agreement on Apportionment*, communication and education through watershed groups, and water- and land-use planning in Alberta (Swainson et al. 2011; Morgan et al. 2014). Despite these successes, the South Saskatchewan, Qu'Appelle, and Assiniboine River basins are some of the most degraded water bodies in Canada with risks to water for human purposes and the environment: poor water quality, variable water availability, water scarcity, and climate risk (Sauchyn et al. 2016; WWF-Canada 2017, 2020; Vogt et al. 2018). Downstream First Nations often bear the brunt of these adverse cumulative effects (Sardarli 2013; FHQTC 2021b; Jardine et al. 2023).

These risks threaten First Nations' Inherent and Treaty Rights and could potentially lead to a breach of those Rights if water regulatory and environmental assessments processes do not address cumulative effects that continue to increase and move downstream (e.g. Yahey v British Columbia, 2021). Treaty Rights are enshrined in Canada's *Constitution Act* and supported through commitments to implement UNDRIPA. Article 26 of UNDRIP (2007) articulates that "States shall give legal recognition and protection to these lands, territories and resources. Such recognition shall be conducted with due respect to the customs, traditions and land tenure systems of the indigenous peoples concerned." Treaty Four states that:

> Her Majesty agrees that Her said Indians shall have right to pursue their avocations of hunting, trapping and fishing throughout the tract surrendered, subject to such regulations as may from time to time be made by the Government of the country, acting under the authority of Her Majesty, and saving and excepting such tracts as may be required or taken up from time to time for settlement, mining or other purposes, under grant or other right given by Her Majesty's said Government. (Government of Canada 1874, p. 5)

To protect Treaty Rights (Treaties One, Two, Four, Six, and Seven) within the South Saskatchewan, Qu'Appelle, and Assiniboine River basins, there is a need to improve the effectiveness of water regulation and environmental impact assessments.

For this study, we draw on water abstraction and drainage case studies, including the Lake Diefenbaker Irrigation Expansion, Quill Lakes Drainage Project, and Yancoal Potash Mine. These examples emerged from discussions with 55 people (government representatives, stakeholders, and Rights holders) about impacts to water for the environment and Treaty and Inherent Rights. The aim of the study is to examine what barriers and opportunities exist for the environmental assessment and regulatory processes in the Canadian Prairies, reflecting on the Lake Diefenbaker Irrigation Expansion, Quill Lakes Drainage Project, and Yancoal Potash Mine.

5.3 Methodology

For this paper, we chose multiple case studies to examine the regulatory context of three examples of water withdrawal and drainage projects in the Qu'Appelle River Valley with reference to the South Saskatchewan River and Assiniboine River (Crowe et al. 2011; Priya 2021). We chose the Qu'Appelle sub-watershed for an in-depth exploration because there are existing relationships and a desire to build on these relationships and the South Saskatchewan, Qu'Appelle, and Assiniboine basins are some of the most stressed sub-watersheds in Canada (Sauchyn et al. 2016; WWF-Canada 2017, 2020; Vogt et al. 2018). The South Saskatchewan River originates from the glacial-fed Bow and Oldman rivers in Alberta and feeds into the Lake Diefenbaker Reservoir which splits into the South Saskatchewan River (Gardiner Dam) and Qu'Appelle River (Qu'Appelle Dam), both of which eventually feed into Lake Winnipeg in Manitoba (WWF-Canada 2017). The flow of the South Saskatchewan River, Qu'Appelle River, and Qu'Appelle Lakes (Buffalo Pound, Pasqua, Echo, Katepwa, Mission, Crooked, Round) is managed by the Saskatchewan Water Security Agency (Haig et al., 2021), which seeks to ensure adequate water availability downstream through the *Water Security Agency Act* (flow allocation for drinking water, services, riparian zone, fish), the *Water Power Act* (controls use of hydropower at Gardiner Dam), *Saskatchewan Watershed Authority Act* (surface and groundwater permits), *Master Agreement on Apportionment* (water allocation between Alberta, Saskatchewan, and Manitoba), and other acts and agreements (Chilima et al. 2021). Our partner, FHQTC, represents 11 Treaty Four Member Nations in the Qu'Appelle system, including Nekaneet, Wood Mountain Lakota, Muscowpetung Saulteaux, Pasqua, Standing Buffalo Dakota, Okanese, Star

Blanket Cree, Little Black Bear's Band of Cree & Assiniboine, Peepeekisis Cree, and Carry the Kettle Nakoda (FHQTC 2020). Our case study approach included multiple sources of information from the Qu'Appelle River with reference to the South Saskatchewan River and Assiniboine River sub-basins: individual interviews, dyadic interviews, workshops, and government documents and media. The three case studies (Yancoal Potash Mine, Quill Lakes Drainage Project, and Lake Diefenbaker Irrigation Expansion) were chosen because they are the examples about which contributors shared in-depth information. These examples are described in more detail in the background section.

The participatory action research component of this research included working over three years with FHQTC-LRES, as described in chapter 2. We built relationships, developed research partnerships and ideas, co-designed research questions with staff and councils (Youth, Life Speakers, Women), and undertook in-person orientations and online narrative workshops (Hall and Smith 2000; Vaughn and Jacquez 2020). Orientations and the workshop included FHQTC-LRES protocols and ceremony (Wilson 2008). The workshop was done to the best of our ability in an online talking circle format to help ensure all participants felt comfortable sharing their experiences, knowledge, and ideas (Hall and Smith 2000; Datta 2018). Language Keepers were supported during the workshop by Youth Council members provided through FHQTC-LRES.

The research received ethics approval, and a Data Sharing Agreement was created. The research project underwent approval and ethics processes through the University of Waterloo's Research Ethics Board (number 44463/44504 – initially designed as two projects) and FHQTC's Executive Council. A tri-partite Data Sharing Agreement was created by the University of Waterloo, University of Regina, and FHQTC to share information following Ownership, Control, Access, Possession (OCAP) Principles (Appendix D) (FNIGC 2024). The data manager (lead author) received OCAP training through the First Nations Information Governance Centre (FNIGC 2022) and cybersecurity training through the University of Waterloo.

Government representatives, academics, non-profit organizations, First Nations, industry, and agricultural producers or organizations with knowledge of development within the Qu'Appelle River and South Saskatchewan River broadly were recruited for this study between January and November 2023. Recruitment for interviews and the workshop was different. For interviews, recruitment was solicited over email and contributors received an invitation to

participate, an information letter and consent form, an interview questionnaire, and a background information document. Recruitment requests were sent to known key informants (through the lead author's social network) as seeds for the process and then contributors were asked to recommend other informants through snowball sampling (Goodman 1961; Parker et al. 2019). If potential contributors did not respond to an initial email, a second email was sent two to three weeks later. If contacted individuals wanted more information, short orientation discussions were held over the phone.

For workshops with FHQTC, their LRES Department recommended individuals from their Advisory Councils to take part in workshops. Before workshops occurred, we had two orientations in-person at the Treaty Four Governance and Lands, Resources, Environment and Stewardship office to ask for free, prior, and informed consent to participate in the workshops, share the research topic, and elicit interest. Honoraria were offered to orientation and workshop participants, as per the Tribal Council's policy.

Between January and November 2023, the lead author spoke with 55 informants about the current Saskatchewan water regulatory system, regional impacts of development projects on the Qu'Appelle River sub-basin (with additional information from the South Saskatchewan), strategic planning and assessment response options, and impressions of proposed water developments (Table 5.1, see questionnaire in Appendix B). Interviews were with government representatives, non-government organizations, industry professionals, and agricultural producers and organizations. Workshops were held with representatives of FHQTC's Advisory Councils (Language Speakers, Women, Youth). Non-Tribal-Council participants were recruited over email for individual or dyadic interviews (45 – 75 minutes), whereas Tribal Council workshop participants were selected by the Lands, Resources, Environment, and Stewardship Department for two three-hour workshops on the same day. Snowball sampling was done by asking participants who else we should speak to and interview. This process reached saturation when a target size (>50 participants) was achieved and few new people were recommended by interviewees (Parker et al. 2019). A sample size of greater than 50 people was reached and a saturation point was determined by reflecting on the social network(s) and determining that there were few new individuals or organizations or only peripherally-related groups being named by participants (Parker et al. 2019). To support this and add rigour to our process, we also considered when theoretical saturation was reached in that no new ideas were emerging from the

data; this generally occurs once ~30 interview participants are involved (Guest et al. 2006; Van Rijnsoever 2017). However, we acknowledge that we may have omitted some individuals, communities, or organizations because they did not demonstrate immediate interest and/or there was not enough time to build relationships. We note as well that there may have been a potential bias towards freshwater science and conservation-minded individuals that initially seeded our sampling process. However, we extended the research by several months to ensure industry, government, agricultural producer, and First Nations perspectives were included with similar numbers to more well-known individuals from academia and non-profits. We hoped to speak with 5-10 individuals from each category of contributors. A total of 55 people were recruited and contributed to this dialogue, including government and former government, academics, environmental non-governmental organizations, FHQTC-LRES Advisory Council members, independent consultants, industry professionals, and agricultural organizations and agricultural producers (Table 5.1). Note that there was some overlap because some contributors had multiple roles.

Table 5.1. Number of participants from government, stakeholder, and Rights holder backgrounds. Note that there were 55 participants, but there was some overlap in roles of those individuals.

Participant Category	Number of Participants
Government and Former Government	9
Academic	9
Environmental Non-Governmental Organizations	18
FHQTC-LRES Advisory Council Members	8
Independent Consultants	2
Industry Professionals	3
Agricultural Organizations and Producers	13

Data were collected through in-person or virtual recorded semi-structured individual interviews, dyadic interviews, and workshops. Interviews were conducted either in-person across the sub-watershed or online over Zoom for 45 minutes to 1 hour and 15 minutes, whereas the workshop was broken up into two groups and was three hours on Zoom. Conversations were structured to elicit information about experience with the Saskatchewan or federal environmental

assessment processes and regulatory framework, cumulative effects assessment and management, water values, regional assessment opportunities, and impressions of development and broader sustainability implications. Following interviews and the workshop, transcription was completed through Zoom and Otter.ai after which transcripts were iteratively verified by listening to recordings and then transcripts were sent back to participants and reiterated or amended if necessary.

Transcripts were coded through thematic analysis in NVivo (QSR International Pty Ltd. 2020). Thematic analysis involves going through text and separating ideas (individual lines of text or larger passages) into many codes, which are then iteratively organized into repeated themes, patterns, or units of analysis related to a topic of interest or research question (Braun and Clarke 2021; Finlay 2021). These candidate themes were then reviewed and reorganized based on the coherence of internal sub-themes and whether ideas/text fit together until no new substantial revisions were adding meaning (Braun and Clarke 2006). Analysis was generally inductive in that themes were not tied to any pre-conceived theory; rather, codes and generated themes were tied to the data and emerged from the dialogue (Charmaz 2006; Patton 2014). To iterate and validate themes, we examined which codes could be merged into higher-level or same-level themes (Braun and Clarke 2021). Writing was done throughout the process of thematic analysis. To support this analysis, we purposively sampled publicly available information by searching through Google and Factiva, such as government documents, industry updates, and news articles related to these cases (Bowen 2009; Morgan 2022). News articles retrieved from Google and Factiva are presented in Table S5.1 in Appendix A.

5.4 Results

5.4.1 Background on the Abstraction and Drainage Projects and Regulatory Framework in Saskatchewan

Based on information generated in interviews and workshops, we chose three examples that contributors spoke about to highlight the water impact assessment and regulatory context in Saskatchewan. These projects included the Yancoal Potash Mine, the Quill Lakes Drainage Project, and the Lake Diefenbaker Irrigation Expansion (Figure 5.1). All three projects have anticipated risks to water for the environment and Treaty and Inherent Rights.

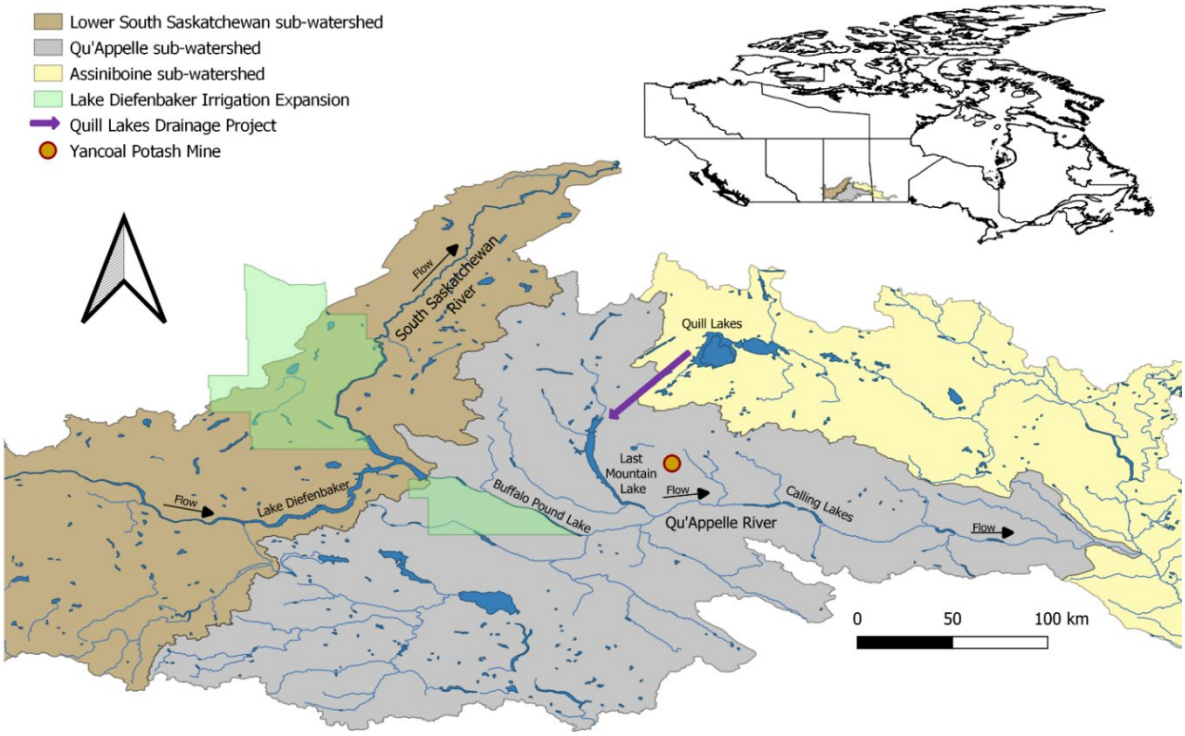


Figure 5.1. A map of the Lake Diefenbaker Irrigation Expansion, Yancoal Potash Mine, and the Quill Lakes Diversion Project within the Lower South Saskatchewan, Qu'Appelle, and Assiniboine sub-watersheds, respectively, in central Canada.

5.4.1.1 Lake Diefenbaker Irrigation Expansion

The Lake Diefenbaker Irrigation Expansion is a proposed $4 billion irrigation project in central and southern Saskatchewan. The Government of Saskatchewan, with the Water Security Agency as the proponent, has proposed to expand river canals at the outflows of Lake Diefenbaker's Gardiner Dam (South Saskatchewan River) and Qu'Appelle Dam (Qu'Appelle River) to increase irrigated farmland by 500,000 acres (Glover 2020; Postmedia 2021; Zinchuk 2021). This will expand their irrigation farming base and potentially supply other water-dependent industries (e.g., potash mining, wheat straw pulp mills, and canola seed-crushing plants) (Leavitt 2021). This expansion will occur in three phases over the next 10 years in the following order: the Westside South Saskatchewan Irrigation Rehabilitation (1) and Expansion (2) and the South Water Conveyance at Qu'Appelle (3)(Glover 2020). The Impact Assessment Agency of Canada has considered the irrigation expansion as three separate projects and has indicated that there is not enough information to designate phases one and two but that phase

three will likely be designated under the *Physical Activities Regulations* under the *Impact Assessment Act* (Impact Assessment Agency of Canada 2021; Olson 2021). Concern has been expressed about impacts to ecosystems and Indigenous Treaty and Inherent Rights by the Federation of Sovereign Indigenous Nations (FSIN 2021), File Hills Qu'Appelle Tribal Council (FHQTC 2021a), scientists (Kurz 2021; Leavitt 2021), and conservation groups (Globalanna 2020; Baldwin 2023). In 2023, Saskatchewan's Association of Rural Municipalities called for the Government of Saskatchewan to expedite development of the expansion (Peterson 2023). The first phase of the expansion began in 2024 (Ruttle 2024) and recent concern about a lack of meaningful consultation and no impact assessment has been expressed by the Federation of Sovereign Indigenous Nations (Quon 2024).

5.4.1.2 Quill Lakes Drainage Project

The Common Ground Drainage Diversion Project (Quill Lakes Drainage Project) was a proposed 25 km drainage diversion channel in 2017 and 2018 which would have redirected surface water from the flooded saline Quill Lakes (Big Quill Lake, Mud Lake, Little Quill Lake) through Kutawagan Lake and Pel Lake to Last Mountain Lake, the Qu'Appelle River system, and onward to Manitoba (Giacchetto 2019; Sebastian 2020). The project was proposed by the Quill Lakes Watershed Association and Quill Lakes Conservation and Development Authority to lower the Quill Lakes by 0.6 m and stop the flooding of farmland and economic losses therein. Flooding is reported to have occurred because of rainfall, decreased surface evaporation, drainage of wetlands, and no outlet (endorheic lake) (Petry 2018). As of September 8, 2017, the Saskatchewan Ministry of Environment chose to not designate the project for an environmental impact assessment (Petry 2018). Similarly, the project was broken into four phases and did not warrant a federal impact assessment (trigger of 10,000,000 m^3/year) (Petry 2018). Stakeholder and Rights holder groups petitioned for an environmental assessment of the Quill Lakes (Harder 2018a). The project proposal was ultimately rescinded by the Quill Lakes Watershed Association potentially because of a momentary pause in flooding, opposition, and a new drainage policy, but there is confusion and concern by Rights holders and stakeholders about what future flooding and drainage could mean for downstream watersheds (Harder 2018b; Regina Leader-Post 2018). In the aftermath, Pasqua First Nation reached a court settlement in which all future Quill Lakes projects will undergo provincial environmental assessments, including respect for the duty to consult, assessment of impacts to Treaty and Inherent Rights, and public notice of a project

proposal (Ackerman 2018). Others point to the need for a long-term conservation plan (Harbron 2018). The Quill Lakes continue to pose a flood risk (Steffenson 2022) and the Water Security Agency (WSA) has now created an Agricultural Water Stewardship Policy for potentially greater responsible drainage compliance in the Quill Lakes and Saskatchewan (WSA 2018a, b, 2024a). This policy has received opposition by Saskatchewan residents because of challenges defining an adequate outlet and loss of wetlands (Ritchie 2023; Walter 2023).

5.4.1.3 Yancoal Potash Mine

The Yancoal potash mine is a $2.8-million-tonnes-per-year solution potash mine in Southey, Saskatchewan north of Regina, Saskatchewan (MacPherson 2017). The project will withdraw water from Buffalo Pound Lake in the Qu'Appelle River system (Government of Saskatchewan 2016). The Saskatchewan Ministry of Environment approved the project's 3000-page environmental impact statement in 2016 contingent on several obligations around community involvement, monitoring, water licences, and reclamation (Government of Saskatchewan 2016; Kuna 2016; The Canadian Press 2016). The Saskatchewan Water Security Agency determined that the project's withdrawal of 13 million cubic metres per year is only a small fraction (0.2%) of inflow to Lake Diefenbaker which feeds Buffalo Pound Lake and that this project will not have a significant impact when considering other withdrawal projects in Buffalo Pound (Government of Saskatchewan 2016). Environmental organizations have expressed concern about water supply in Buffalo Pound Lake, water quality impacts to groundwater and the Qu'Appelle system, social impacts to communities, and conflicts of interest by government officials (Hunter 2016; Johnston 2016; Mandryk 2016a, b; Fraser 2017; MacPherson 2017).

5.4.2 Barriers to Water Regulation and Impact Assessment

5.4.2.1 The Current Governance Model – Water for the Economy

According to many contributors, the Government of Saskatchewan is following an economic growth model for water management with little regard for social or environmental issues. Participants spoke about how water quality, ecosystems, and First Nations rights are factors that are challenging to consider in the current governance model. A University of Saskatchewan researcher said:

> Water is managed to think about flood risk based on squeaky wheels and economic consequences, but not necessarily considering some of the other impacts and people who may not have as much of a voice at the table. Water is managed for water, specifically H_2O, not water quality.

A University of Regina contributor argues the current model is not positioned to improve social development in the long-term; rather, industrial development is prioritized. They said:

> The province has a model of economic growth based in the 1950s and not a model of social development in which resources remain available for future use without degradation so that the water quality will improve and will stay improved while also allowing industry and development by holding the polluting parties more accountable to their actions.

While government representatives describe water withdrawal and drainage projects as well-regulated, those with other perspectives spoke to the province's inability to regulate pollution and its commitment to expediting development. These participants spoke to difficulty triggering assessment, project and impact splitting, limited regulation or self-regulation, weak effort to meet duty to consult, and issues with public engagement (Table 5.2). A water for the economy priority was described as the evident foundation for these barriers. Taken together, there are multiple avenues through which environmental protection is potentially bypassed that represent barriers in the current regulatory framework.

Table 5.2. Barriers identified by study participants, and their definitions, that contribute to discretion in environmental assessment and water regulation in Saskatchewan.

Barrier	Definition
Discretional Misuse of the Assessment Triggers	***Assessment Triggers*** Criteria that result in development projects being designated or not being designated for impact assessments. – IAAC, 2019; Noble, 2021a Saskatchewan Environmental Assessment has six qualitative criteria: • "have an effect on any unique, rare or endangered feature of the environment; • substantially utilize any provincial resource, and in doing so, pre-empt the use, or potential use of that resource for any other purpose; • cause the emission of any pollutants or create by-products, residual or waste products which require handling and disposal in a manner that is not regulated by any other Act or regulation; • cause widespread public concern because of potential environmental changes; • involve a new technology that is concerned with resource utilization and that may induce significant environmental change; or • have a significant impact on the environment or necessitate a further development, which is likely to have a significant impact on the environment." - Government of Saskatchewan, 2014, p. 4
Project and Impact Splitting	***Project Splitting*** "Project splitting involves proponents seeking approvals for parts of a larger project separately, to avoid more rigorous EIA for the total project." - Ehrlich, 2021, p. 6 ***Impact Splitting*** "Impact splitting involves considering significance determinations of individual impacts separately, to avoid a finding of significant adverse impact for the total effects of a project. Both involve flying below the impact assessment radar." - Ehrlich, 2021, p. 6
Limited Regulation or Self-Regulation	***Limited Regulation*** A lack of regulatory enforcement because of no enabling legislation or discretion by regulatory bodies. – Sheelanere et al. 2013 ***Self-Regulation and Regulatory Capture*** When proponents or licence holders have the power to influence the regulatory process, and, in these cases, the regulator may represent the proponent or license holder rather than the public. – Edwards, 2021
Weak Efforts to Meet Duty to Consult	***Duty to Consult*** "The Government of Canada has a duty to consult and, where appropriate, accommodate Indigenous groups when it considers conduct that might adversely impact potential or established Aboriginal or treaty rights." – *Constitution Act*, 1982, section 35 informed by high court decisions ***Range of Duty to Consult*** The Crown (or proponents charged with part of the duty to consult) determines the degree of consultation necessary based on the level of Indigenous interest, seriousness of impairment, and the strength of the Indigenous land claim. – Wright, 2020 *Consultation* At one end of the spectrum, consultation means giving notice of conduct, sharing relevant information, and discussing issues brought up from the notice – Wright, 2020 *Deep Consultation and Engagement* "The opportunity to make submissions; formal participation in the decision-making process; and, the provision of written reasons to show that Indigenous concerns were considered and how those concerns were factored into the decision." – Wright, 2020, p. 14
Adequate Public Engagement	***Engagement*** Governments, proponents and practitioners must include stakeholder perspectives. - Government of Canada, 2019

5.4.2.2 Barrier One – Discretionary Misuse of Assessment Triggers

Contributors spoke about how environmental assessments are circumvented because of divergent interpretations of triggers for the process (Table 5.2). Unlike the Canadian assessment process which uses numeric triggers, the province has six criteria categories that trigger an assessment based on the likelihood of significant effects (Government of Saskatchewan 2020a). One of the criteria is "widespread public concern" which may be problematic, as articulated by a former government official. They said, "One of the conditions for a project to be rejected is widespread public concern, and it's too vague and it's quite often a loophole that allows pro-development." This is especially true for the Quill Lakes Drainage Project. A non-profit contributor described this:

> One of the things that would have triggered an environmental assessment would have been significant landowner or citizen concern, and I know there were numerous petitions sent to the provincial government; people posting stuff on social media and going to the legislature. You couldn't have asked for a bigger demonstration of public concern. Yet, the government said, "No, we're not going to do an environmental assessment."

Here, public concern was demonstrated, but this did not lead to an assessment designation. The Lake Diefenbaker Project appears to be subject to similar discretion in that no phase has triggered a provincial assessment, whereas one phase will likely trigger a federal assessment. In contrast, potash mines in Saskatchewan, as reported by contributors, seem to always trigger a provincial environmental assessment.

If projects trigger environmental assessments, contributors spoke to how the assessment process may omit certain impact or sustainability considerations because of treatment of assessment requirements as a checkbox exercise (Table 5.2). For example, speaking about the Yancoal Potash Mine as a stakeholder and concerned citizen during the process, a University of Regina researcher said,

> Even the assessment that has been written up for Yancoal, it was done by consultants, who, I think, routinely develop these reports, and the company in the end said, "Oh, yeah, that was inadequate. We just paid somebody to do this." So, it was almost like the company itself wasn't engaged, that there was almost a prototype being used.

In contrast, government representatives described how assessment processes are thorough and go through independent review panel audits to ensure processes are rigorous and complete. Discretion in the rigour of assessments and then approving those processes and follow-up measures may be challenges for the current regulatory framework. As suggested above, the substantive scope of the provincial assessments may be too narrow to permit attention to key issues of concern related to sustainability.

5.4.2.3 Barrier Two - Project and Impact Splitting

There is the potential to scope projects narrowly by reducing them into smaller initiatives that do not meet provincial or federal thresholds to designate projects (Table 5.2). Both the Quill Lakes Drainage Project and the Lake Diefenbaker Irrigation Project are examples of this. A researcher at the University of Regina suggested that this was happening for the Quill Lakes Drainage Project:

> The whole thing, even the water flow rates that they were looking at, they've broken it up into a multi-stage process precisely so it would be under the amount needed to trigger a federal assessment, and that was quite deliberate, and yet once they broke it down into those small amounts of water, it wouldn't actually have solved their problem…

A different researcher at the University of Regina spoke about how this is happening again with the proposed Lake Diefenbaker Irrigation Expansion:

> A good example is the Diefenbaker Project, where instead of treating it like the single largest infrastructure project in the history of the province, the province has immediately started to split it into three, claiming that each is relatively minor and, therefore, is not worthy of a separate analysis.

At least for water-related projects within Saskatchewan, there appears to be a precedent to scope and define projects narrowly potentially because of a desire by the province to avoid an investigation of cumulative effects.

Several contributors suggest that there is a narrow scoping of assessments to neglect socio-economic, health, cultural, rights and legacy effects and their interactions and the cumulative results. A member of the Assiniboine River Basin Initiative spoke to this:

> My observation of our current policy of Saskatchewan is to treat each one of these stressors or inputs into the Qu'Appelle or the Assiniboine, Pipestone, and Souris as separate, standalone entities, and by doing that, you're not looking at the entire picture and you can say, well, that one little thing that's not bad it only causes a small effect, whether it's a drainage project, new mine development, or a new community.

In contrast to inattention to cumulative effects because of project splitting for the Lake Diefenbaker Irrigation Expansion and the Quill Lake's Drainage Project, multiple contributors, government included, spoke about how assessments of potash developments, like the Yancoal Potash Mine, do consider cumulative effects to a greater extent. Additionally, government representatives mentioned that the legislated definition of environment includes social, economic, and cultural factors and impact assessments employ expertise in these areas from across all ministries who may be part of Saskatchewan Environmental Assessment Review Panels.

5.4.2.4 Barrier Three - Limited Regulation and Self-Regulation

Contributors describe limited regulation by the government or self-regulation by industry and licence holders (Table 5.2). When thinking about water movement in Saskatchewan, a member of the Assiniboine River Basin Initiative described discretion when designating an adequate outlet:

> If you're going to drain water, it has to go somewhere, but if you're not going to do an impact assessment of what you've called an adequate outlet other than water flows down it, then that's one of the biggest problems is there's some arbitrary judgment call type stuff, not actual science and rules that apply to everybody.

A member of the Last Mountain Lake Stewardship Group expressed concern about designating an adequate outlet when the Quill Lakes were flooding:

> We were worried that our lake would be considered an adequate outlet, which means that a lot of water could be poured into our lake with no consideration to nutrients or the content of that water. So, that was a really a very serious concern to us, and having said that, with the higher lake levels, then some of that water would travel downstream to the smaller lakes and lower Qu'Appelle which would be very serious for them because then it would certainly cause shoreline erosion and much higher water levels than ours.

The lack of regulation and the ability of water licence holders and project proponents to influence how they are regulated could result in unforeseen cumulative impacts to water bodies, the environment and other associated wellbeing parameters.

Organizations are currently at work to find solutions to regulatory issues, such as strategies to facilitate responsible drainage networks for temporary, not permanent, wetlands. A representative of the Saskatchewan Farmers Stewardship Association spoke to this:

> What we're working closely with Water Security on is developing kind of a point of adequate outlet network across Saskatchewan. So, you're identifying your water highways, if we'll call it that. So, your primary water highways, secondary, tertiary, and how those water channels actually need to be managed and maintained maybe a little bit more effectively.

These strategies could potentially alleviate some of the frustration experienced by agricultural producers related to the overreach or irrelevance of regulation. More information needs to be shared with stakeholders and Rights holders describing how to delineate an adequate outlet, how the cumulative impact of multiple outlets is addressed, and how the process unfolds.

5.4.2.5 Barrier Four – Weak Effort to Meet Duty to Consult

The fourth issue is the discretionary power to interpret duty to consult obligations during assessments (Table 5.2). Once an assessment is triggered, government representatives mentioned there are processes in place to undertake rigorous duty to consult processes for development, such as a clear characterization of issues that may jeopardize Inherent and Treaty Rights with the potential for the proponent or the provincial government to appropriately accommodate when there are residual impacts. However, if projects are narrowly scoped and not triggered (issues one and two), there could be challenges meeting duty to consult obligations and following through on recommendations made by Rights holders.

Rights holders described concern about not being consulted on their terms or at all. A Language Keeper with FHQTC-LRES remarked, "What we talked about yesterday about the environmental assessments that had been happening without our knowledge. I'm wondering when you go in there to ask about anything like that, you don't get a real answer." A University of Regina researcher echoed this, speaking about duty to consult and cumulative effects:

> There is the cultural component in which I think the role of Treaty Rights is particularly opaque in government. There's lip service to it, but they seem to think that talking to a few quote-unquote Indians constitutes consultation and there's a massive missing component that distinguishes environmental impacts from impact assessments as done in the federal mandate.

Even if Saskatchewan undertakes project-level assessments, duty to consult processes at higher levels of planning are needed to determine how cumulative impacts will affect the practice of Treaty and Inherent Rights. Overall, duty to consult processes are needed that cater to Rights holder perspectives in ways that facilitate meaningful participation.

5.4.2.6 Barrier Five – Meaningful Public Engagement

One additional barrier described by stakeholders in this study was concerns about not being taken seriously after public engagement for water-related impact assessments. For example, an agricultural producer spoke about the Yancoal Potash Mine:

> We all learned very clearly what the rules were and how we could bring our concerns forward and then just watch the province throw it all under the rug. It was quite sad…We actually hired our own consultant to review the same paper [impact assessment statement] that the province was going to review and came up with multiple issues and the province didn't address a single one of them.

Stakeholders came forward describing their involvement in assessment and issues with their concerns not being adequately addressed during determination of the significance of impacts and mitigation.

5.4.3 A Road Map Forward: Opportunities to Enhance Water Regulation and Assessment in Saskatchewan

Participants offered explanations for why the aforementioned barriers occur and described opportunities for regulatory and policy regime change. Opportunities included regulatory enforcement and enabling legislation, watershed planning, a wetland protection policy, baseline assessment, regional cumulative effects assessment, and Indigenous-led assessment (Table 5.3).

Table 5.3. Explanations of barriers, their definitions, and opportunities for regulatory change.

Themes and Opportunities	Definition
Regulatory Enforcement with Enabling Legislation	A lack of regulatory enforcement because of no enabling legislation or discretion by regulatory bodies. – Sheelanere et al. 2013
Watershed Planning/Management	"…a continuous and adaptive process of managing human activities in an ecosystem, within a defined watershed. Integrated watershed management involves the integration of environmental, social and economic decisions and activities through an inclusive decision making process to manage the protection, conservation, restoration and enhancement of aquatic and terrestrial ecosystem features, functions and linkages."- Canadian Council of Ministers of the Environment (CCME), 2016, p. 3
Wetland Protection Policy	"Saskatchewan requires policy to conserve, retain, and restore the province's wetlands, for the benefit of all Saskatchewan people, both current and future generations…" – Ritchie, 2023, p. 1
Baseline or Baseline Assessment	A regional reference condition to measure impacts against and determine the significance of those impacts. - Dubé, 2003; Jones, 2016
Regional Cumulative Effects Assessment	"An approach to assessment concerned with region-based environmental planning or development and assessing the impacts of area-specific plans and program initiatives." – Noble, 2021, p. 219
Indigenous-Led Assessment	"A process that is completed prior to any approvals or consent being provided for a proposed project, which is designed and conducted with meaningful input and an adequate degree of control by Indigenous parties — on their own terms and with their approval." – Gibson et al., 2018, p. 10

5.4.3.1 Regulatory Enforcement

Contributors provided examples of provincial government unwillingness to enforce environmental regulations or to facilitate citizen actions to seek enforcement (Table 5.3). When it comes to water drainage, Saskatchewan may not be enforcing its environmental legislation, as described by contributors, which leads to greater cumulative effects that are consequently more difficult to assess. A former government official said:

> The biggest challenge is that the government will not enforce laws that protect the environment and specifically drainage. We're the only province without a wetland policy and drainage occurs, and at this point in time, the government, against societal wishes, refuse to step in and halt drainage."

Contributors also described that there is no longer an appeal process to challenge development projects. A member of the Assiniboine River Basin Initiative spoke to this:

> It's pretty tough to get an environmental impact assessment done because, and just case in point, Saskatchewan does not have an Environmental Appeal Board. They had an Environmental Appeal Board, and they changed it to the Water Appeal Board and put it under the Water Security Agency and then they got rid of that. There's no formal process to call into question decisions made on environmental policies that impact people or communities.

Perspectives from these contributors suggest that Saskatchewan can circumvent environmental protection legislation and more regulatory enforcement with appropriate enabling legislation is likely needed.

5.4.3.2 Watershed and Land-Use Planning

The other reason contributors offered for why there is discretion without recourse is that there may be few accountability mechanisms for sub-watersheds (Table 5.3). Watershed and water source protection planning was abandoned by the Water Security Agency, as described by contributors, so there is no accounting to determine if new development projects fit within regional plans or warrant public concern. A representative of the Saskatchewan Wildlife Federation said, “It (development) seems to be rampant without anybody watching the gate if you like because there is not a watershed strategy or a plan.” A member of the Wascana Upper Qu’Appelle Watersheds Association added to this:

> The province hasn't developed management plans for Lake Diefenbaker or for the Qu’Appelle system. All the way down there is no management that's been developed and so it's hard to say they're doing it wrong, or they're not following the plan, or whatever when there isn't one.

Overall, there is a need for broader watershed planning that environmental impact assessments processes can look to for guidance.

5.4.3.3 Wetland Protection Policy

Alongside a lack of watershed planning, there is no wetland protection policy, though the province has identified the issue and may move at some point to address it (Table 5.3). A non-profit contributor spoke to this:

> We don't have a wetland conservation policy in this province. We're one of the few. So, currently, there is no requirement to conserve any wetlands as part of any kind of development unless it's voluntary. The government is currently working on a wetland drainage mitigation policy (same Agricultural Water Stewardship Policy noted earlier), but again, nobody knows what that is.

Other prairie provinces may be good exemplars for how to protect wetlands as suggested by an agricultural producer near the South Saskatchewan River: "Manitoba and Alberta, I think, both have better wetlands policies, in terms of protection of wetlands, than Saskatchewan does." A member of the Last Mountain Lake Stewardship Association added, "My vision would be for our governments to develop a wetland policy - top priority - and then tailor other industries like mining, like farming, like forestry underneath that wetland umbrella so that our resources are protected." Participants called for a wetland protection policy, modelled after the successes of Manitoba and Alberta, that protects wetlands and offers guidance for agriculture and industry.

5.4.3.4 Consensus in Defining a Baseline

While setting a reference condition ahead of development would inform the acceptability of new developments, defining an environmental baseline in the Qu'Appelle, South Saskatchewan, and Assiniboine watersheds has been challenging (Table 5.3). There are conflicting ideas about what constitutes a reference condition for hydrology, water quality, and nutrient pollution and for whom this baseline would be created. Participants remarked that there is no benchmark against which to measure change and development. For example, a University of Regina researcher said:

> The biggest problem is that there is no attempt by the province to establish baseline conditions against which change is to be monitored. Everything is sort of like this point forward rather than looking back and so cumulative damages or damages that have accumulated over the last century and a half are simply not being considered.

The task of establishing a baseline is not easy because the baseline could either be pre-settler, pre-damming, or post-damming (1930s). A Councillor of Pasqua First Nation said:

> My opinion is we need to go back as far as possible, the pre-settler times, and we need to know from as far back as possible what has happened to our lands and waters ever since then; how far decreased is the quality already at this point? At that time, then we can make those decisions.

A similar challenge with characterizing a baseline is what nutrient pollution is natural and what is a result of land use and nutrient loading. Ultimately, there is no defined and agreed-upon benchmark against which change is measured or whether objectives are being met through plans and policies to conserve the environment.

5.4.3.5 Lacks Regional Cumulative Effects Assessment

In Saskatchewan, t a structure and tradition of regional assessments, which could substitute for or link to watershed planning and provide higher-level guidance to project-level assessments is absent (Table 5.3). A government representative said that the Minister of Environment can choose to request that a regional study (not assessment) be conducted and mentioned there is no equivalent to a strategic assessment that would offer the opportunity for the assessment of proposed regional plans, policies, and programs. A former government official spoke about impediments to regional assessment thinking:

> I don't think those [regional assessment] conversations happen as regularly as I think they need to, and I don't think that it's the fault of officials. I really believe there are only so many resources, and if I were an environmental protection officer, and I had to permit 15 industries, I'm kind of wrapped up in that world. I don't have the time or the energy to contribute to looking at things from a regional approach or cumulative impacts, and I don't know where to create the room for that either because the resources for these ministries are finite.

Contributors spoke about how the Ministry of Environment had started a cumulative effects division; however, this division has since dissolved. Creating the regulatory environment for the assessment of regional cumulative effects could address barriers to Saskatchewan's environmental assessment process and water regulatory model.

5.4.3.6 First Nation-Led Assessment and Substitution

While the financial support for communities to conduct traditional land-use studies can be provided by the proponent, there are no provisions for co-led assessments with Indigenous authorities or no substitution for Indigenous-led assessment in Saskatchewan (Table 5.3). A Councillor of Pasqua First Nation said, “In an ideal world, I think there would be a First Nation Impact Assessment Board or an Indigenous Impact Assessment Board.” This person also adds that:

> All day we've been talking about protecting our rights and protecting our land, our water, our air, animals for our fishing, for our hunting, for our medicines, for our ceremonies, like everything. If you get down to the root of all of that, what we're doing is protecting our Treaty Rights and that's the basis of everything. We need to protect those Treaty Rights in any type of project and what do our Treaty Rights include? All of that - our right to our fishing, our medicines, our ceremony.

Taken together, FHQTC-LRES Advisory Council members expressed a desire to move from being sources of information to First Nations decision-makers, potentially through substitution of Crown environmental assessment for First Nations-led assessments or more inclusive regulatory boards.

5.5 Discussion

5.5.1 Summary

In our study, we spoke with 55 people (stakeholders, Rights holders, and government representatives) who offered their experience with environmental assessment and regulation in the central Canadian Prairies. Speaking to the Lake Diefenbaker Irrigation Expansion, Quill Lakes Drainage Project, and Yancoal Potash Mine, contributors described how a water security model for water quantity and economic investment is in place, which is supported by potential discretion in assessing developments and water licence permitting. In particular, barriers included difficulty triggering assessments, project or impact splitting, limited regulation and self-regulation, weak effort to meet duty to consult, and issues with adequate stakeholder engagement. Identified steps forward to add to the effectiveness of water and assessment regulatory model for the Canadian Prairies included greater regulatory enforcement for environmental protection, watershed planning, a wetland protection policy, consensus in defining

a regional baseline, regional assessment, and Indigenous-led assessment. Figure 5.2 brings together barriers, direct recommendations, and broader opportunities for process change. However, moving away from a water for the economy model will require more collaborative governance and application of sustainability assessment.

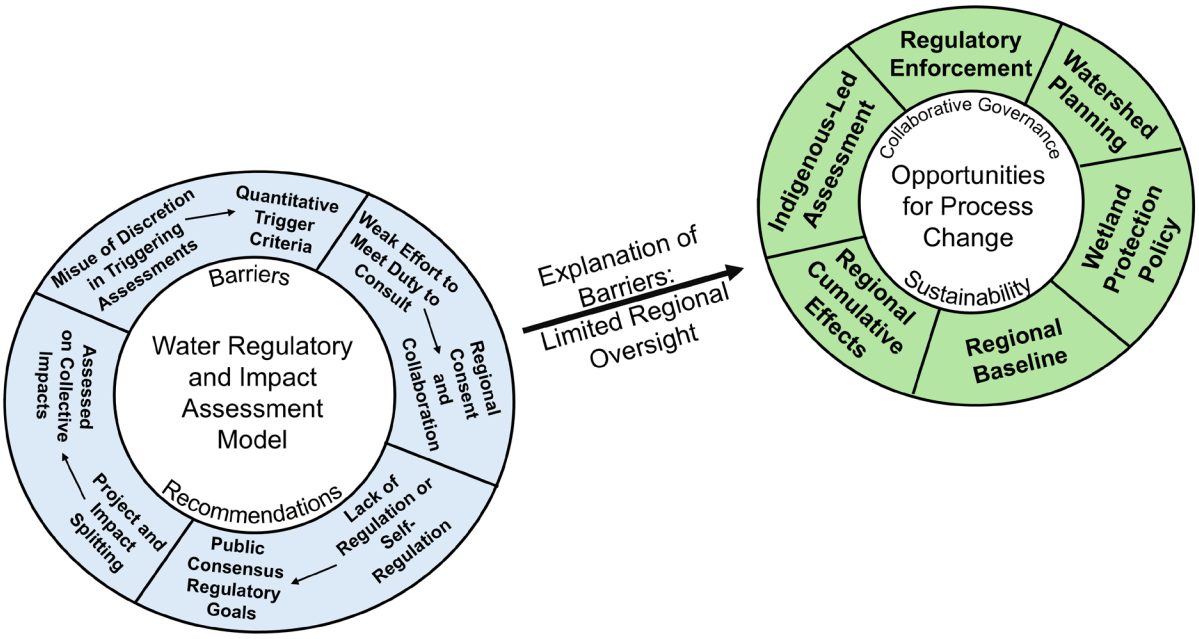


Figure 5.2. Barriers to effective water regulation and impact assessment and opportunities for broader process change to protect water for the environment and Treaty and Inherent Rights. In the left diagram, arrows represent direct recommendations for barriers, whereas the right diagram represents broader opportunities for change. A lack of these opportunities represents limited regional oversight that enables barriers, as described by study participants.

5.5.2. Barriers and Process Recommendations

While Canadian jurisdictions are set up to trigger impact assessments if there is a high likelihood of significant adverse effects to the environment, measuring public concern as a trigger has proven more difficult, as was noted by contributors in our study. The Saskatchewan *Environmental Assessment Act* designation triggers appear to be strictly qualitative and the Act identifies "widespread public concern" as a trigger for assessment (Government of Saskatchewan 2020a). For example, there was widespread public concern about the Quill Lakes Drainage and Lake Diefenbaker Irrigation Expansion project, yet assessments were not triggered. Haefele (2005) reports that there is often inconsistency in how proponents of development projects evaluate public concern during the screening phase of assessments and how decisions are made

regarding the significance of public concern. In the Saskatchewan process, proponents complete a self-assessment of all six trigger criteria to determine if their project will be designated (Ministry of Environment 2021). A process for gauging public concern is in place and recommended, but from our understanding, there are no measurable indicators for widespread public or Rights holder concern (Ministry of Environment 2021). In contrast, Haefele (2005) described indicators for the Mackenzie Gas Project related to, for example, frequency of concern, geographic distribution, source, and severity of concern. However, public concern is also different from concern by Rights holders. In Saskatchewan, concerns of Indigenous Peoples about water security, for example, may be different from the public's concerns because of "a more holistic framing of water security to include water as a life form, water and the spirit world, women as water-keepers, water and human ethics, and water in Indigenous culture" (Awume et al., 2020, p. 1). We recommend that both First Nation and settler guidelines for assessing widespread public concern and Rights holders concern should include standard measurable indicators to determine if an environmental impact assessment should be triggered.

Project splitting was a significant barrier to water regulatory processes in the Canadian Prairies and is a common challenge in impact assessment practice. Ehrlich (2021) used this term to describe how proponents scope down or divide projects into parts to avoid a comprehensive environmental impact assessment (project splitting) or consider individual primary impacts alone, rather than including secondary and interacting impacts, to avoid a significant adverse effect determination (impact splitting). Reductionism of projects and impacts in this way creates mistrust in the regulatory environment and limits opportunities to understand if there is a significant impact on a system and who should be consulted or partnered with based on those impacts (CIER 2009; Ehrlich and Ross 2015; Gibson et al. 2020). In the case of the Lake Diefenbaker Irrigation Expansion and the Quill Lakes Drainage Project, splitting refers to breaking a project into multiple phases to avoid triggering an assessment and splitting water flow impacts across time and space rather than considering total water allocation and the quality of those flows. The prairie provinces have been managed for water quantity and economic water needs (Prairie Water Directive 2009; Morgan et al. 2014); however, in a future of uncertainty, a multiplicity of uses and needs for water across different knowledge systems and experiences should be considered (Yates et al. 2017; Wilson and Inkster 2018; Anderson et al. 2019; Douglas et al. 2019). Breaking down projects into siloes and narrowly scoping relevant impacts does not

facilitate the broader planning processes to include those needs, uses, knowledge, and experiences in projects (Eckert et al. 2020; Ehrlich 2021; Goodchild 2021). To avoid splitting, we recommend projects should be designated for impact assessment based on their collective impact and impacts to valued components and the system should be mitigated (Ehrlich 2021).

Participants in this study identified a failure to regulate by government and self-regulation by water licence holders and project proponents as barriers to effective water regulatory processes. Unlike the other Canadian Prairie provinces of Alberta and Manitoba, Saskatchewan does not have an arms-length Clean Environment Commission like Manitoba (Manitoba Clean Environment Commission 2022), an environmental flows and water protection policy framework like Alberta (Government of Alberta 2023), or any no-net-loss wetland protection policies and regulations (Government of Alberta 2013; Government of Manitoba 2019). A lack of organizations, policies, and regulations (in contrast to Alberta and Manitoba) to protect water for the environment and wetlands may explain why participants described how unforeseen cumulative effects to waterbodies (quantity and quality) may emerge from a lack of regulation of water license holders and industrial proponents (Sheelanere et al. 2013; Chilima et al. 2021). For example, downstream agricultural producers were concerned about government not regulating drainage and ambiguity around defining an adequate outlet. However, agricultural organizations described initiatives with government to create coordinated drainage networks to facilitate more responsible drainage with many agricultural producers. Development of an Agricultural Water Stewardship Policy was underway in 2023 to 2024 and may effectively bring together producers to facilitate the creation of drainage networks that lead to an adequate outlet (WSA 2023a, 2024b).

Similar to a lack of regulation, participants described issues with self-regulation by licence holders or project proponents. This may be a form of regulatory capture, which refers to proponents or licence holders having the power to influence the regulatory process, and, in these cases, the regulator may represent the proponent or licence holder rather than the public (Edwards 2021). Regulatory capture is generally discussed in regard to the oil and gas industry and nuclear power (Maclean 2016), but this problem extends to water use, pollution, drainage, and impact mitigation. For example, the Water Security Agency is the proponent for the Lake Diefenbaker Irrigation Expansion and may also be a partial regulator alongside the Ministry of Environment; however, government mentioned that in this case there is a level of independence

through third-party review. We recommend more environmental regulatory oversight and continued third-party review to avoid self-regulation that may be regulatory capture.

Rights holders in this study discussed how there is some discretion in duty to consult obligations in project-level assessments in the Canadian Prairies, which may preclude formation of relationships and partnerships in assessment like those occurring in other Canadian jurisdictions. Issues in assessment to understand impacts that affect Indigenous communities and a lack of participation are well-documented (Usher 2000; Udofia et al. 2017; Arsenault et al. 2019). In particular, concern was expressed by Rights holders about not being notified that assessments are occurring, how cumulative effects will be part of consultation and discarding of issues that are reported on that may be relevant. Some of these issues may arise from the government delegating duty to consult obligations to proponents and the extent of impacts potentially being scoped down, like with the Yancoal Potash Mine, so that downstream Rights holders might not have an opportunity to contribute. Saskatchewan's new 2023 First Nation and Métis Consultation Policy Framework now states that duty to consult obligations will not be delegated to proponents and it provides three levels of consultation for small to large-sized projects and a stipulation that notice to identified communities will be sent within six (small to medium projects) or 14 (large projects) calendar days (Government of Saskatchewan 2023). This new Framework may enable broader consultation, but there is no mention of cumulative effects and there could be clearer guidelines on how communities are identified (Government of Saskatchewan 2023). At the level of individual developments, scholars report that establishing meaningful partnerships and meeting duty to consult obligations are difficult (Udofia et al. 2017; Herse et al. 2020; Pfeffer 2022).

Rather, participation and partnerships may be more effective at the regional level of assessment, where there is an opportunity for relationship building that supports reconciliation. These processes can and should focus on: responsibility, respect, reciprocity, and relevance (Gibson et al. 2020). The new First Nation and Métis Consultation Policy Framework describes similar values ("Integrity and Good Faith", "Respect", "Government's Duty", "Reciprocal Responsibility", "Transparency and Accountability", and "Communication") and could emerge as a step towards reconciliation if there are opportunities for consent and partnership beyond consultation (Government of Saskatchewan, 2023, pp. 5-6). However, at this point, the "Government retains final decision-making authority; First Nations and Métis do not have a veto

over decisions" (Government of Saskatchewan, 2023, p. 6). We recommend regional partnerships with First Nations ahead of project-level assessments to better assess cumulative impacts. Co-governance arrangements are common in Canada, especially in the territories and often demonstrate power sharing without veto debates.

5.5.3 Opportunities for Regulatory and Policy Regime Change

Many participants in this study explained that barriers persist because of limited regulatory enforcement, no watershed planning, no wetland protection policy, no consensus in defining a baseline, limited opportunity for regional assessment, and no substitution of provincial assessment for Indigenous-led assessment. These limitations point to opportunities for regulatory and policy regime change in which planning and coordination occur at more regional scales. True consent in environmental development that is collaborative occurs at multiple scales and is ongoing and formalized (Phare et al. 2017). A cumulative effects branch in the Ministry of Environment in the Saskatchewan may have supported coordination in this way, but this institution has been dissolved. Without greater coordination in projects and programs through planning and higher-level assessment, there are likely fewer avenues for government to offer forums in which Rights holders and stakeholders can express their regional visions and free, prior, and informed consent can be sought (Simms et al. 2018; Mascher 2019). The First Nation and Métis Consultation Policy Framework does include "Legislation, Regulation, Policy and Strategic Plans" and "Land Use Planning"; however, if there are no regional assessment, watershed planning, and Indigenous-led assessment opportunities, it is unclear how cumulative effects will be assessed and how partnerships will be built (Government of Saskatchewan, 2023, p. 7). Ultimately, institutional processes can become fair and equitable through shared regional decision-making that rectifies how environmental decisions are historically made by those who experience the benefits rather than the costs (Bell and Carrick 2017; Menton et al. 2020). Collaborative regional governance would be an opportunity to move beyond a water for the economy model (Harrington 2017).

5.6 Conclusion

In this paper, we investigated barriers and opportunities of the current water regulatory and impact assessment processes in the central Canadian Prairies that may limit protections to water for the environment and Treaty and Inherent Rights. We spoke with 55 representatives

(government, Rights holder, and stakeholder groups) and synthesized news articles and government documents to explore the regulatory environment of the Lake Diefenbaker Irrigation Expansion, Quill Lakes Drainage Project, and Yancoal Potash Mine of Saskatchewan. While some participants felt the decision-making process was robust, the majority of participants identified barriers to the integrity of the regulatory framework, such as triggering assessments, project splitting, limited regulation, and narrowly defined duty to consult obligations. To address these barriers, scholars and practitioners in other Canadian contexts recommend criteria to measure public concern; designating and evaluating projects based on their primary and secondary impacts and determining significance to individual valued components and the system; creating regulatory goals based on public consensus to avoid a lack of regulation; and opportunities for duty to consult at higher levels of planning and assessment. Saskatchewan's First Nation and Métis Consultation Policy Framework may address barriers to meeting duty to consult obligations, but a movement towards collaborative governance and procedural justice is needed to move beyond a water for the economy model and consider water for the environment and rights.

5.7 Transition

Chapter 5 laid the groundwork for gaps and opportunities of the water regulatory and impact assessment process in the Canadian Prairies. To respond to these gaps, this next chapter (Ch. 6) describes needed flow- and place-based sustainability criteria to guide water development assessment in the Qu'Appelle River and South Saskatchewan River sub-basins (Figure 5.3).

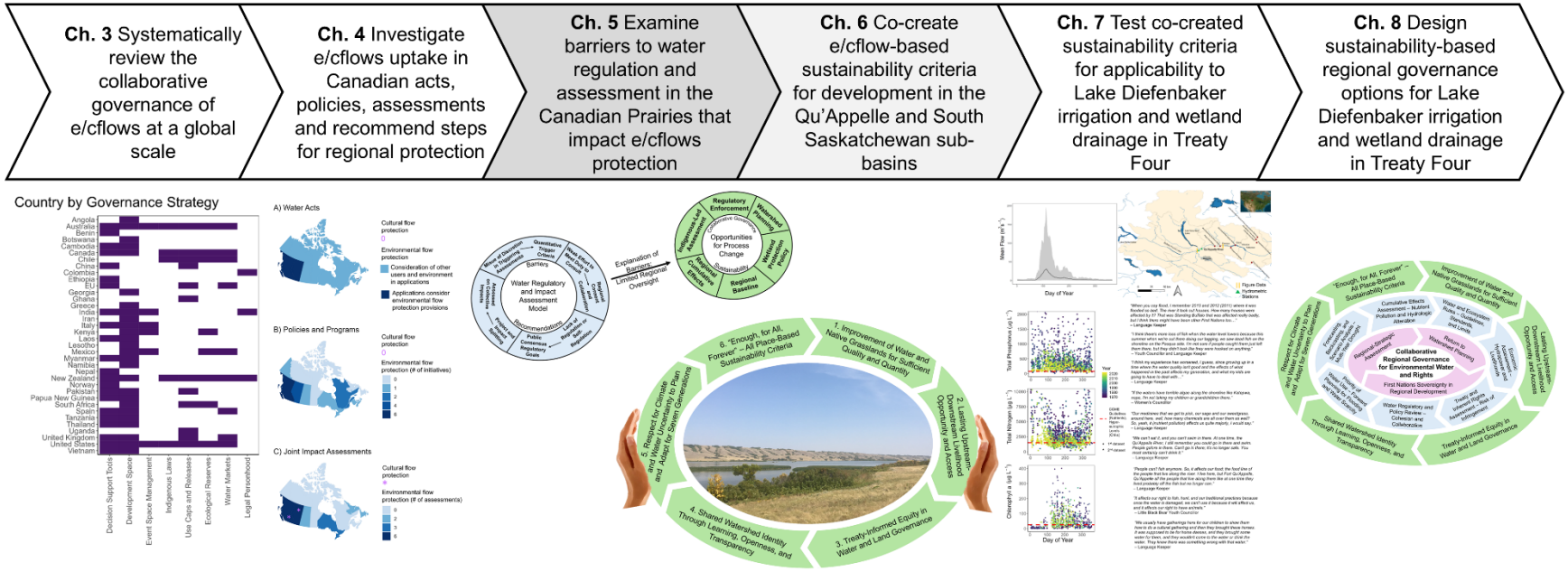


Figure 5.3. A roadmap diagram showing the transition from Ch. 5 to Ch. 6 objectives. E/cflows refers to environmental and cultural flows.

CHAPTER 6. "ENOUGH, FOR ALL, FOREVER": CO-CREATED REGIONAL SUSTAINABILITY CRITERIA FOR WATER DEVELOPMENT IN THE CANADIAN PRAIRIES

6.1 Overview

There are opportunities to define and apply sustainability assessment across Canada when evaluating proposed development to protect current and future generations and seek benefits to the economy, environment, and society. In particular, many watersheds in Canada are highly degraded because of water quality impairment, flow alteration, invasive species, and climate change; so careful attention to characterizing sustainability in a collaborative way is needed. In this study, we focus on the Qu'Appelle River Valley with information from the South Saskatchewan River to set sustainability criteria for water development. We define place-based and flow-based sustainability criteria starting with the core set of generic sustainability requirements and environmental and cultural flow definitions (sufficient water quantity and quality for ecosystems, livelihoods, and rights) and building in empirical information from case study and action research-based interviews and workshops. Interviews and workshops of 55 people were conducted with government, stakeholder, and Rights holder representatives with most information for criteria emerging from discussion about visions for water, how to relate to water, environmental and cultural flow considerations in watersheds, and what watersheds should offer in the future. The result is six sustainability criteria categories, each of which can be further specified to address particular concerns and opportunities: 1) improvement of water and grasslands for sufficient quality and quantity; 2) lasting upstream-downstream livelihood opportunity and access; 3) Treaty-based intragenerational equity in water and land use decision-making; 4) shared watershed identity through learning, openness, and transparency; 5) respect for climate and water uncertainty by preparing to mitigate and adapt for seven generations; and 6) "enough, for all, forever" – all five sustainability criteria together. The next step is to apply these criteria to evaluate options for water withdrawal and drainage in the Qu'Appelle and South Saskatchewan sub-watersheds.

6.2 Introduction

In southern Saskatchewan's Canadian Prairies, the existing "water for the economy" management model has limited regional oversight and provides inadequate guidance for sustainable development (Government of Saskatchewan 2024a). A more holistic sustainability-based water management model is needed to secure water and all it supports for future generations. This requires a movement towards the sustainability assessment of development initiatives. Given current and continuing trajectories in key local to global parameters (climate change, biodiversity loss, deepening inequities, etc.), sustainability assessment "must aim to reverse the prevailing (unsustainable) trends, integrate attention to all the key intertwined factors that affect sustainability, seek mutually reinforcing gains, minimize trade-offs, respect the context, and be open and broadly engaging" (Gibson, 2012, p. 167). Generic sustainability criteria that can be applied to evaluations of plans, proposals, and projects centre on "life support"; "livelihood sufficiency and opportunity"; "intragenerational equity"; "intergenerational equity"; "resource maintenance and efficiency"; "understanding, commitment and engagement"; "precaution and adaptation"; and "immediate and long-term integration" (Gibson et al. 2005, 2020, p. 27). While such generic criteria can be applied in the design and evaluation of plans, projects and developments, most, if not all, applications benefit from further specification to recognize the key characteristics of the case and the place (Gibson 2017). In this context, specifying case-relevant and place-based sustainability criteria ahead of development projects is needed to ensure long-term and mutual gains for the environment and society (Gibson et al. 2005b; Bond et al. 2012; Gunn and Noble 2015).

Sustainability assessment has been on a gradual rise in Canada and abroad, be it through *ad hoc* provincial or private evaluation of development projects, use of new (albeit challenged) federal legislation (the 2019 *Impact Assessment Act*), or application of regional and strategic assessments (Gibson 2017, 2020; Doelle and Sinclair 2019; Gibson et al. 2020). Notable and historic Canadian development projects have defined and embraced sustainability assessment using diverse mechanisms. For example, Voisey's Bay Mine (Labrador), White Point Quarry (Nova Scotia), the Kemess North Mine (British Columbia), the Mackenzie Valley Pipeline (Alberta), and the Lower Churchill Hydroelectric Generation Project (Labrador) all used joint review panels to conduct sustainability assessment. Voisey's Bay Mine review panel evaluated the sustainability-related effects of the proposed project based on sustainability criteria including

ecosystem integrity, rights of future generations to sustainable use, and lasting equitable and social and economic benefits (VBEAP 1999). The Mackenzie Gas Project panel used five context-specific sustainability criteria categories: cumulative impacts on the biophysical environment; cumulative impacts on the human environment; equity impacts; legacy and bridging, and; cumulative impacts management and preparedness (Gibson 2006, 2011; MGPJRP 2009, p. 6). Similarly, the Kemess North Mine, White Point Quarry, and Churchill Hydroelectric project reviews adopted sustainability tests and frameworks (WPJRP 2005; KMJRP 2007; LCJRP 2011; Doelle 2012, 2017). Other Canadian examples of sustainability evaluation include regional planning and assessment processes based on modern land claim agreements (e.g., North Yukon Regional Land Use Plan, Keewatin Regional Land Use Plan and North Baffin Regional Land Use Plan), strategic assessments to integrate sector planning with impact assessments (e.g., Ontario Power Authority's Integrated Power System Plan; Manitoba Hydro's Electric Power System Plan), and scoping of regional and urban plan development (e.g., Bay of Fundy tidal Energy projects, British Columbia's Capital Regional District growth plan) (reviewed in Gibson et al. 2020). In most cases, development project evaluations have included both broad regional and strategic perspectives as well as collaboratively defined and context-specific sustainability criteria.

To our knowledge, sustainability assessment criteria for watersheds and water development projects have never been explicitly integrated with principles of environmental and cultural flows that ensure sufficient water quantity and quality for downstream people and rights (Arthington et al. 2018; Anderson et al. 2019) (Table 6.2). Further, environmental and cultural flows are rarely considered ahead of development and project-level impact assessments to set goals and co-create visions for watershed futures (King and Brown 2018). Some Canadian resource development projects (mines, dams, oil, gas) consider environmental and cultural flows through consent-based water quality guidelines and Aboriginal flow thresholds as part of impact assessments (Candler et al. 2015; Yinka Dene 'Uza'hné 2016b). However, the prevailing approach is to emphasize valued ecosystem components related to water quality, quantity, livelihoods, and rights, and to mitigating significant damages, rather than defining sustainability criteria and applying them to maximize overall net benefits to both upstream and downstream water users and ecosystems.

The purpose of this paper is to describe sustainability criteria for water development projects based on key informant perspectives that merge standard sustainability assessment criteria with an environmental and cultural flow perspective in two of Canada's most highly stressed sub-watersheds: the Qu'Appelle River Valley (Calling Lakes – Pasqua, Echo, Mission, Katepwa) and South Saskatchewan River. These sub-watersheds experience profound effects of urbanization, intensive land use, and climate change (Sauchyn et al. 2016; Vogt et al. 2018), yet are being considered as venues for diverse future developments, including irrigation expansion, solution potash mining, grain crushing plants, urban growth, and agricultural wetland drainage (Leavitt 2021; Ritchie 2023). Within this context, the lead author interviewed and completed workshops with government representatives, stakeholders, and Rights holders about perspectives on development, regional impacts and management, and visions for the future of water to define regional place- and flow-based sustainability criteria for water development in southern Saskatchewan.

6.3 Methodology

This study was co-created with FHQTC-LRES and the lead author (Nathanael Bergbusch) spoke with 55 people through interviews and workshops, as described in chapters 2 and 5. The majority of the information for developing criteria in this chapter came from questions related to respondents' visions for water ahead of development, how they would like people and developers to relate to the watersheds, what environmental and cultural flow needs must be considered, and what they would like these watersheds to offer them in the future. Most individuals spoke about the Qu'Appelle River sub-watershed, which is an offshoot of the South Saskatchewan River due to a water transfer from Lake Diefenbaker, but additional information was shared about the broader South Saskatchewan River sub-watershed (Figure 6.1). Using NVivo (QSR International Pty Ltd. 2020), the lead author qualitatively analyzed interview and workshop information (Crowe et al. 2011; Saunders et al. 2019; Vaughn and Jacquez 2020). Text was coded into a set of generic criteria for sustainability and then iterated (merged and refined)

based on environmental and cultural flow considerations and, most importantly, empirical, context-specific requirements for the Qu'Appelle and South Saskatchewan sub-watersheds.

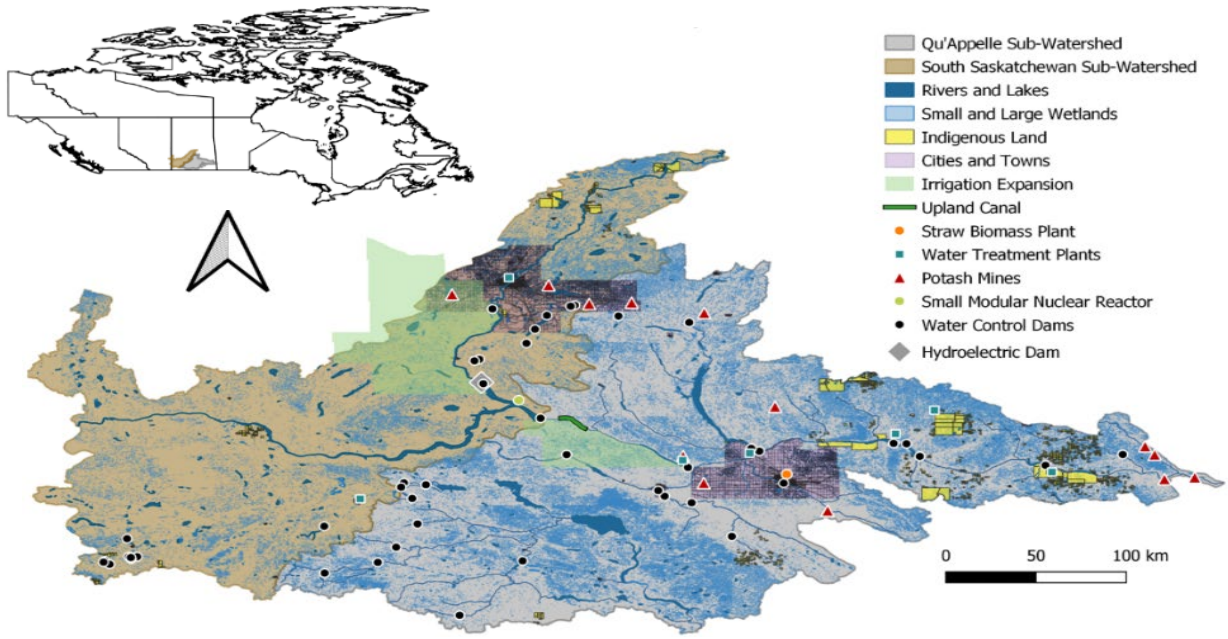


Figure 6.1. A map of the Qu'Appelle and South Saskatchewan sub-watersheds illustrating numerous and diverse water development projects.

Generic sustainability criteria (Table 6.1), rather than Sustainable Development Goals or pillars, were chosen because of their existing application in impact assessment, interest by the Impact Assessment Agency of Canada, ability to encompass social-ecological system dynamics, and incorporation as a starting place for sustainability in Canadian assessment contexts (Gibson et al. 2020). Environmental and cultural flow/water considerations were included because of their emphasis on adequate water quantity and quality for Rights holders (Table 6.2), which are key issues within these sub-watersheds and of particular importance to the 11 Member Nations of FHQTC. Finally, criteria are in ongoing discussions with collaborators at FHQTC-LRES and the University of Regina to be more specific to local conditions.

Table 6.1. A set of generic sustainability criteria from Gibson et al. (2020, p. 27).

Sustainability Criteria	Definition
Life support	"Build human-ecological relations that establish and maintain the long-term integrity of socio-biophysical systems and protect the irreplaceable life support functions upon which human as well as ecological well-being depends."
Livelihood sufficiency and opportunity	"Ensure that everyone and every community has enough for a decent life and opportunities to seek improvements in ways that do not compromise future generations' possibilities for sufficiency and opportunity."
Intragenerational equity	"Ensure that sufficiency and effective choices for all are pursued in ways that reduce dangerous gaps in sufficiency and opportunity (and health, security, social recognition, political influence, etc.) between the rich and the poor."
Intergenerational Equity	"Favour present options and actions that are most likely to preserve or enhance the opportunities and capabilities of future generations to live sustainably."
Resource Maintenance and Efficiency	"Provide a larger base for ensuring sustainable livelihoods for all while reducing threats to the long-term integrity of socio-ecological systems by reducing extractive damage, avoiding waste and cutting overall material and energy use per unit of benefit."
Understanding, Commitment and Engagement	"Build the capacity, motivation and habitual inclination of individuals, communities and other collective decision-making bodies to apply sustainability principles through more open and better-informed deliberations, greater attention to fostering reciprocal awareness and collective responsibility, and more integrated use of administrative, market, customary, collective and personal decision-making practices."
Precaution and Adaptation	"Respect uncertainty, avoid even poorly understood risks of serious or irreversible damage to the foundations for sustainability, plan to learn, design for surprise and manage for adaptation."
Immediate and Long-Term Integration	"Attempt to meet all requirements for sustainability together as a set of interdependent parts, seeking mutually supportive benefits."

Table 6.2. Definitions of environmental, environmental-social, and cultural flow and water terms from various sources.

Flow/Water Term	Definition
Environmental Flows/Water	"The quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems" – Brisbane Declaration and Global Action Agenda (2007), Updated Brisbane Declaration and Global Action Agenda (2018, p. 2)
Environmental-Social Flows/Water	"The quantity, timing, and quality of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods, and well-being." Updated Brisbane Declaration and Global Action Agenda (2018, p. 4)
Cultural Flows/Water	"….water entitlements that are legally and beneficially owned by the Indigenous Nations of a sufficient and adequate quantity and quality to improve the spiritual, cultural, environmental, social and economic conditions of those Indigenous Nations." Echuca Declaration (2007, p. 2)

Three limitations of this study need to be acknowledged. First, the focus of this study was the Qu'Appelle River sub-watershed with additional information from the South Saskatchewan River. More input is needed to tailor the criteria to the South Saskatchewan River. Second, this study was bounded by time (2022-2025) and reflects a discussion of these sub-watersheds and publicly available information about development at the time. Third, the sustainability criteria identified by Rights holders and stakeholders are in the English language and omit key insights only possible by using the relevant First Nations languages. File Hills Qu'Appelle Tribal Council represents 11 First Nations with five distinct official languages and cultures (Nakoda, Saulteaux, Cree, Dakota, and Lakota). For further application of sustainability criteria beyond this academic paper, discussion will need to be in these five languages and those of Nations in the South Saskatchewan. In this way, sustainability criteria can evolve, like Treaty Nine First Nations guiding principles adopted in the Ring of Fire Regional Assessment terms of reference (Regional Assessment Working Group 2024).

6.4 Results - Sustainability Criteria: Essential Elements for Assessment and Strategic Planning in the Canadian Prairies

Sustainability criteria for water development in the Qu'Appelle and South Saskatchewan sub-watersheds, informed by government representatives, stakeholders, and Rights holder visions, are summarized in Figure 6.2 and described in detail in text below. These criteria and their associated objectives and implications overlap and interact, and the sixth criterion is summative.



Figure 6.2. Regional sustainability criteria for water development in the Qu'Appelle and South Saskatchewan sub-watersheds informed by government representatives, stakeholders, and Rights holder visions. These criteria are based on participants' visions for the water, how people should relate to the water, and what these watersheds should offer in the future. The photo in the centre was taken by the lead author and depicts the Pasqua Lake Marshland, where the Qu'Appelle River joins Pasqua Lake.

6.4.1 Specified Sustainability Assessment Criterion #1: Improvement of Water and Native Grasslands for Sufficient Quality and Quantity (Figure 6.2)

Full statement of the criterion: Improve the long-term integrity of freshwater quality and quantity, wetlands, grasslands and native pastures, and dependent people and rights by avoiding pollution, unnecessary drainage, and protecting against drought and flood extremes.

The majority of participants spoke of improvement of water and native grasslands for sufficient quality and quantity. A councillor of Pasqua First Nation said, "I want our waters to be clean, I want them to be clear, and I pray for our water because of how sick it is right now." Similarly, a researcher at the University of Regina said, "Water should have the right to exist in a state that is naturally plentiful and undiminished in terms of its capabilities of supplying ecosystem services because ultimately the health of the water sets the health of all other species." One participant's vision for water managed in this way was:

> Understanding capacities (e.g., water extraction and assimilatory thresholds) and water quality and ecological conditions to balance development needs with environmental condition, stakeholder interests, and existing commitments. It includes increased communication about environmental state of the system and further engagement to increase understanding and knowledge of the management activities within the basin.

A former government ministry official spoke about the resources that need to be maintained and managed for the Qu'Appelle Valley system:

> The water quality in the Qu'Appelle lakes has deteriorated significantly, not only due to farmland drainage, but I think human sewage and problems caused from discharge, and Regina. So, we need to improve the water quality so that the fish can continue to survive. Some people won't eat fish out of the lakes. Yeah, so it's a treasure that we have, and everybody – rural, urban municipal provincials, governments – we need to ensure that we preserve this treasure that we have.

To build the understanding and values needed to meet this criterion, participants suggested education about the importance of water and grassland availability and quality and communication and community building for greater consensus and understanding. Of particular interest and concern was understanding ongoing and historical trends through attention to rights for nature, farming practices, restoring wetlands, and more knowledge about surface water and groundwater availability. Potential indicators derived from interviews and workshops include water quality improvement (reductions in fish kills, toxic algae, and nutrients), grassland and wetland retention and rehabilitation, and stable water levels and baseflows. Participants described strategic planning and assessment initiatives to support water and grassland resource maintenance included defining rules for water and grassland quality and quantity, collaboratively determining priority of water use, and monitoring and management of resources based on innovative farming practices and overarching water and wetland policies for development.

6.4.2 Specified Sustainability Assessment Criterion #2: Lasting Upstream-Downstream Livelihood Opportunity and Access (Figure 6.2)

Full statement of the criterion: Ensure equal and lasting livelihood opportunities (market and rights-based) of upstream and downstream people and communities are supported in development trajectories and not limited in any way by impacts affecting the land and water.

Almost half of participants spoke to lasting upstream-downstream livelihood opportunity and access. Speaking about the upstream-downstream component, one participant said, “I think that's really what has to change in our culture is instead of just worrying about yourself; all of us, government included, need to worry about people downstream.” Speaking about public access, an agricultural producer near the South Saskatchewan River said, “There's a reckoning that has to come here because [of], I think, the tension between protecting private property and allowing private exclusive use for a very limited few people.” Speaking about livelihoods, a Language Keeper of FHQTC-LRES said:

> At one time in the area, it was something to be really proud of, something that you believe in, and then these things come along and destroy our livelihood. It is a livelihood, even though we don't use it to make money with, but it's still a livelihood. When we continue to use clean water for our own use, or the use of our animals and everything else that lives, I think it's very disrespectful of whoever comes along and dumps all their junk in there to destroy our life-giving water.

A representative of the Prairie Adaptation Research Collaborative spoke of supporting agricultural producer livelihoods so that people can make conservation-minded decisions:

> I'm always amazed by how some farmers actually, for whatever reason, take it upon themselves and bear the cost of doing the right thing – maintaining the wetlands or maintaining the shelter belts and because if they were to drain the wetlands and cut all the shelter belts, they'd have more productive land. There's got to be a way of compensating farmers for managing the landscape.

For upstream-downstream livelihood opportunity, participants spoke about greater attention to small farmer livelihoods and non-market Indigenous livelihoods (e.g., berry and plant harvesting, fishing), cleaning up the water and algae to improve downstream livelihoods while supporting upstream agriculture producer livelihoods and rural revitalization, and moving away from private property and exclusive use access. Potential indicators derived from interviews and workshops include plant harvesting and fishing, public access, small farmer production and revenue, and downstream recreation and tourism. Strategic planning and assessment initiatives, described by participants, to support livelihood opportunities and access included livelihood and market analyses and Treaty and Inherent Rights assessments.

6.4.3 Specified Sustainability Assessment Criterion #3: Treaty-Informed Equity in Water and Land Governance (Figure 6.2)

Full statement of the criterion: Support Treaty- and Inherent Rights-informed democratic water governance that aims to reduce gaps (water quality, health, well-being, decision-making authority, and culture and rights practices) between upstream and downstream water and riparian users.

Around one third of participants spoke to treaty-informed equity in water and land governance. A University of Regina researcher said, "water gets disproportionately exploited depending on possession, land ownerships, policies that dictate so much more of it can go to agriculture and it's just people downstream get what trickles…so there's this real uneven distribution." Speaking to decision-making, a University of Saskatchewan researcher said, "even just having a water round table of different key Rights holders and stakeholders in the watershed to discuss where things are at would be incredibly valuable." A Saskatchewan writer said:

> I'd like to see the land and water in the Qu'Appelle basin managed in the spirit of the Treaties that our settler representatives signed in the 1870s with Treaty Four. That would mean really respecting and working with the best of traditional ecological knowledge from Indigenous people and coming up with land-use systems and agricultural systems that obviously have to be adapted for a modern world…"

A Councillor of Pasqua First Nations said:

> I think we need to be at that table, like I said before, as the decision makers for any and all projects, because they all affect our land, water, and air. So, not only just being as tokens at the table for information, I think we need to be at that table for the decision making.

Participants described how intragenerational equity in the spirit of Treaties (Four and Six) can be supported by striving towards a right to clean water quality and quantity, more public land with biodiversity protection, functioning agricultural land that is well taken care of, agricultural producer and Indigenous livelihoods, and learning and consensus developed through regional water advisory councils. Potential indicators derived from interviews and workshops include roles and responsibilities of communities in decision-making, adaptive policy review, and involvement of communities in regulatory frameworks and policy creation. Strategic planning and assessment initiatives, described by participants, to support treaty-based intragenerational

equity included an analysis of Treaty and Inherent Rights and revisiting roles and responsibilities in water and land regulation and decision-making ahead of development.

6.4.4 Specified Sustainability Assessment Criterion #4: Shared Watershed Identity Through Learning, Openness, and Transparency (Figure 6.2)

Full statement of the criterion: Build the shared identity (understanding and commitment) of individuals, communities, agricultural producers, and Indigenous and provincial governments to apply sustainability principles to watersheds and grasslands through ongoing learning, openness, and transparency.

More than half of participants spoke to shared watershed identity (understanding and commitment) through learning, openness, and transparency. A representative of the Calling Lakes Ecomuseum said, “We have no chance of ensuring water quality and water quantity if there isn't transparency and openness about what's happening upstream.” Another activist and resident of the Calling Lakes spoke of building shared values by recognizing our common and different identities: “The identity really does matter, but how would you get there? Well, the first thing you would want is something that actually brought all those people together with seemingly common interests.” An agricultural producer near Last Mountain Lake spoke about improving transparency in water management by catering to different and shared identities:

> We would have transparent clear policy of what the area needs. Not set in stone, maybe have the ability to change as it goes, but also, one that would understand that living right beside the lake is not the same as living 15 miles from the lake or from the river or whatever. Realizing that there are different realities at play. So that we're not saying that, as far as the regulations go, I understand about not spreading manure on the 100 feet from the creek where it's different than spreading manure out here that's never going to leave my land and my borders and my fence line. I think we need policies that understand the realities of what's going on.

A representative of Western Potash talked about fitting seamlessly in the middle of a regulatory model while respecting the watershed:

> Just the ability to, I think, to seamlessly fit in the middle of it, so having the information and guidance that we can fit our processes within that watershed; however, maybe we continue with our current water sources, but, yeah, the guidance where we can make

> good decisions to effortlessly fit in the middle of that and minimize upstream and downstream impacts to the best of current knowledge.

To move towards shared watershed identity, participants said we need to build up the capacity for greater dialogue and education on an ongoing basis, consensus and trust, respect, understanding of what development means for ecosystems and people, and transparent and clear policies and regulations. Potential indicators derived from interviews and workshops include communication, collective responsibility, political will, and transparency. Strategic planning and assessment initiatives, described by participants, to support shared watershed identity included a review of roles and responsibilities in the water regulatory framework and investigation of the capacity of watershed advisory groups to build relationships.

6.4.5 Specified Sustainability Assessment Criterion #5: Respect for Climate and Water Uncertainty to Plan and Adapt for Seven Generations (Figure 6.2)

Full statement of the criterion: Prepare to mitigate and adapt to uncertainties for seven generations by favouring efficient prairie adaptation and water development trajectories for sufficient agricultural resilience and land and water quality and quantity that supports Saskatchewan residents and improves the spiritual, cultural, environmental, social and economic conditions of Indigenous Nations.

More than one third of participants spoke about respect for regional climate and water uncertainty to plan and adapt for seven generations. Seven generations, a Great Law of the Haudenosaunee (with equivalents in the traditions of many other First Nations), suggests that "[i]n each deliberation, we must consider the impact of our decision on the next seven generations" (reviewed in Graham 2008, p. 47). Stakeholders, agricultural producers, Rights holders, and researchers spoke about this outlook. A Saskatchewan writer said, "We really need agricultural systems that are somehow more prairie adaptive and also climate change resilient and adaptive." An agricultural producer near the South Saskatchewan River said, "I'm really influenced, I guess, by the Indigenous concept of seven generations; if we can think about things in that kind of timeframe, rather than annual reports…" Another agricultural producer near the Qu'Appelle River spoke about water and agricultural efficiency to steward, conserve, and protect agricultural land and water:

> …making our field efficiency higher, being able to control the water that moves off of our land in an orderly fashion is a priority to me as it moves down the watershed. That water is valuable. There's more water being consumed and used all the time. So, if we can

> provide more water, and we can organize and coordinate with unusual events to be able to make it all work within the watershed, that's the future that I see for it.

Advisory Council members at FHQTC-LRES discussed an intergenerational respect for water, a need for reciprocity, and a living connection to water in the Qu'Appelle. A Language Keeper of FHQTC-LRES said:

> When we're talking to the water, we're hoping that water is listening to us [and] that it will continue to sustain us for as long as we all shall live and as long as we respect it, and our animals get sustained by it.

Indigenous, agricultural, and stakeholder perspectives about the future point to a need for planning and adaptation. For this to occur, land-use and agricultural systems need to adapt to climate change, but water uncertainties also need to be respected, as described by a representative of the Prairie Adaptation Research Collaborative:

> It (water) will be supplied in a different fashion, and it will occur at a different rate, different times of the year and so on, and in response to that, the river flows will differ in terms of their magnitude and timing and the frequency of floods and the frequency of low flows, so you really have to account for that if you're going to implement any kind of strategy for sustaining the health of the watershed and the communities. (Representative of the Prairie Adaptation Research Collaborative)

Participants said that gains in intergenerational equity can be achieved through greater precaution and adaptation and can be supported by relying less on the immediate past for planning, preparing for multi-year drought conditions greater than anything experienced before the 1900s, and organizing prairie adaptation for efficient water use and to respect unusual water and climate events. Potential indicators derived from interviews and workshops include climate extremes, frequency and intensity of flood and drought, adaptability, and the precautionary principle. Strategic planning and assessment initiatives, described by participants, to support this criterion included collaborative water forecasting and modelling based on flood and drought extremes, setting priority of water use, and ensuring efficient water use.

6.4.6 Specified Sustainability Assessment Criterion #6: "Enough, for All, Forever" – All Place-Based Sustainability Criteria (Figure 6.2)

Full statement of the criterion: Work to meet all the context-specific, interdependent sustainability requirements in the short and long term by respecting water and land and seeking mutual well-being and enjoyment forever.

Participants advocated for all sustainability criteria together. A representative of the Calling Lakes Ecomuseum said that their vision for water management is "enough, for all, forever". A Language Keeper of FHQTC-LRES said, "Without water, we don't live. Nothing lives. That's supposed to be our main life-giving source. When we don't respect something, it knows, and I think it has a life of its own…" A representative of the Qu'Appelle South Irrigation Project said, "I think you need to take into consideration all the different users…and how they interrelate between them. Like I said, we need economic development in order to be able to sustain the environment." A representative of Western Potash added:

> I think just generally some generational foresight that can put current usage into perspective because whether it be climate impacts or environmental impacts on a regional scale or really anything, I think people have a very difficult time in using foresight.

Lastly, a researcher at First Nations University said, "Indigenous people have a special view and special relationship with nature, with environment, and they consider themselves as a part of nature." Overall, sustainability criteria need to be proactively applied to water development so that safeguards are in place to protect water and land for current and future use and practice of Treaty and Inherent Rights. The value of these criteria steps rely on commitment to ensure lasting (multi-generational) integrity and viability of water systems and their environmental and cultural flows.

6.5 Discussion

The following section goes through the criteria one by one and offers context, background implications, and opportunities for implementation.

6.5.1 Improvement of Water and Native Grasslands for Sufficient Quality and Quantity

The Qu'Appelle River and South Saskatchewan River sub-watersheds are two of the most highly degraded basins in Canada (WWF-Canada 2017, 2020), so ensuring and improving water and grassland quality and quantity ahead of consideration of further water abstraction and drainage project development is imperative to preserve ecosystems, connectivity, and people

(Horne et al. 2017f). The 25-year Government of Saskatchewan water security strategy has been to maintain adequate water and grasslands, not attempt to improve quantity and quality. The result has been continued degradation rather than maintenance (Government of Saskatchewan 2020b). The Qu'Appelle River Valley is stressed from global warming, nutrient pollution from diffuse and point sources, agricultural intensification, loss of wetlands and grasslands, invasive species, toxic compounds, erosion and elevated turbidity, and current and future hydrologic variation and supply (Hall et al. 1999, 2020; Phillips et al. 2016; Hosseini et al. 2017; Vogt et al. 2018; Nanayakkara et al. 2018, 2021; Hayes et al. 2020; Bergbusch et al. 2021; Haig et al. 2021; Swarbrick et al. 2022). Similarly, the South Saskatchewan River is stressed because of nutrient pollution from farms and cities, floods and droughts, hydropower and hydrologic alteration, native grassland removal, reduced glacial water inputs, upstream irrigation, erosion, and disruptions to Indigenous uses and rights, especially in the downstream Saskatchewan River Delta (Cumberland Marshes) (Hassanzadeh et al. 2014; Pomeroy et al. 2016; Sauchyn et al. 2016; Andrews et al. 2018; Jardine et al. 2023). In both cases, Indigenous uses and Treaty and Inherent Rights are threatened because of cumulative adverse impacts to water and grasslands (Sardarli 2013; Andrews et al. 2018; Jardine et al. 2023). To mitigate these threats and adapt through improved water and soil management, there is opportunity to restore wetlands and grasslands in the Canadian Prairies (Baulch et al. 2019).

6.5.2 Lasting Upstream-Downstream Livelihood Opportunity and Access

Sustainability initiatives must address conservation goals and human development goals (Wood and Declerck 2015). This criterion includes the need to respect and offer opportunity for human development of, and revenue flows to, market and non-market ventures, and small and corporate livelihoods upstream and downstream (Richardson and Sato 2015; Arthington et al. 2018). Livelihoods include Indigenous non-market, subsistence activities that relate to stewardship and custodia that uphold all land and water relations inter-generationally(Yates et al. 2017; Diver et al. 2019; Goodchild 2021). Decreasing water availability globally and increased water extraction are expected to negatively impact sustainable development and livelihoods (Baggio et al. 2021). In southern Saskatchewan, water development proposals (water abstraction, drainage) need to support small and larger farmer livelihoods, revitalize rural communities, and strengthen Indigenous livelihoods through improved riparian health, water quality, and allocation

(Saskatchewan Irrigation Projects Association 2009; Pomeroy et al. 2016; Martin et al. 2017a; Andrews et al. 2018; Jardine et al. 2023).

6.5.3 Treaty-Informed Equity in Water and Land-Use Management

Procedural justice is needed for shared decision-making authority over land-use and water allocation and quality (Gibson et al. 2013; Bell and Carrick 2017; Sultana 2018). Treaty Four and Six are agreements that have established Indigenous rights and water laws and offered opportunity for greater Indigenous self-determination and representation in water governance (O'Donnell 2023a). To respect Treaty and Inherent Rights in light of Canada's commitment to implement UNDRIP, there need to be processes to respect and act upon these rights by building new institutional arrangements, expanding opportunities for knowledge pluralism, and mobilizing resources to Indigenous governments (Arsenault et al. 2018). Leonard et al. (2023) suggest that there is no land back without water back – for Indigenous land and water stewardship, Indigenous Water relations, and self-determination, water decision-making must be returned to Indigenous Nations. The water governance landscape in Canada is beginning to shift with devolution of land and resource decision-making in the territories, co-management agreements in British Columbia and the territories, and Water Declarations in Manitoba and Ontario (Wilson and Inkster 2018; Curran 2019; Craft and King 2021). Canada can also learn from New Zealand, where co-management agreements are forming with Indigenous Nations and regional water councils that match catchment boundaries and that have authority over water resources (Harmsworth et al. 2016). In southern Saskatchewan, there is a need for greater intragenerational and intergenerational equity through co-management between regional watershed groups and Indigenous Nations, context-specific research and governance frameworks that respect Indigenous knowledge (Kovach 2009; Martin et al. 2017b; Mora et al. 2022).

6.5.4 Shared Watershed Identity Through Learning, Openness, and Transparency

Learning, openness, and transparency were identified by participants as pre-requisites for moving away from myopic and not-in-my-backyard thinking to informed collective action for shared watershed identity. Iterative social learning about water and land use management and opportunities to get involved can support trust-building, sense-making, and critical reflection about the limitations of existing governance institutions and ways to experiment with collaborative forms of governance (Medema et al. 2014). What is particularly crucial for

effective, reconciliation-based learning is open and reflexive spaces for humility and respect in sharing across knowledge systems (Levac et al. 2018). In community-based natural resource management, effective communication strategies about proposals and projects from government organizations are also required to build openness and transparency and this is a first step to more collaborative governance (Gruber 2010). Canada and southern Saskatchewan have challenges with governance fragmentation (Gober and Wheater 2014; Morgan et al. 2014; Renzetti and Dupont 2017) and there are multiple, opposing uses of water within the Lake Diefenbaker Reservoir that supplies both the Qu'Appelle and South Saskatchewan sub-watersheds (Chilima et al. 2021). Chilima et al. (2021) report that there is no comprehensive master water allocation plan for the lake; project developments at the lake are assessed separately; there is no overarching licencing procedure for industry (such as exists for potash mines); and there is competition among irrigation, hydropower, fish farms, and recreational water use. To address this tension between Lake Diefenbaker development plans and potential effects on receiving watersheds, there is a need for learning, openness, and transparency in engagement, planning, and policy making to create a shared watershed or regional identity.

6.5.5 Respect Climate and Water Uncertainty to Plan and Adapt for Seven Generations

This sustainability criterion combines "inter-generational equity" with "precaution and adaptation" (Gibson et al. 2005b, 2020). In particular, this criterion reflects a need for foresight and projections that respect the precautionary principle by including the uncertainty of water availability as well as the limitations of further water developments as means to deliver lasting benefits. Climate change is likely to lead to less rainfall and headwater flows in prairie watersheds and reinforce existing inequalities in water resources and pollution. Consequently, there is a need to move towards efficient water use and water justice in which new developments (water abstraction and wetland drainage) support a redistribution of costs and benefits (Sultana 2018; Mills-Novoa et al. 2022). Many monitoring and management approaches for rivers assume hydrologic stationarity (hydrologic processes [river flow, precipitation, runoff and discharge] and variability will be constant over time), but there is a need to anticipate future water climate scenarios to proactively plan and monitor for climate indicators that trigger adaptive action (IPCC 2014; Capon et al. 2018; St-Hilaire et al. 2021). In southern Saskatchewan, hydrology is dynamic and variance in both floods and low flows is expected to increase with climate change (Sauchyn et al. 2010; Vogt et al. 2018). Any foresight and scenario approaches must consider

diverse perspectives on water security while supporting efficiency and exercising precaution during the evaluation of water development proposals and projects by establishing a space between estimated capacity and capacity assumed for project evaluation (Awume et al. 2020; FHQTC 2021a; FSIN 2021). Lastly, changes to future upstream uses need to be considered within the context of the prairie provinces' *Master Agreement on Apportionment* so that water conveyance entitlements are protected and enforced if there is not enough water (Prairie Water Directive 2009; Renzetti and Dupont 2017).

6.5.6 "Enough, for All, Forever"

Sustainability criteria categories in this paper need to be applied as a package. Criteria described here are mutually reinforcing because *Criterion #1* that supports improved water and grasslands is the foundation for most criteria but especially upstream-downstream equity (*Criterion #2*) and respect for climate and water uncertainty (*Criterion #5*). Environmental restoration supports equity and climate resilience (Sultana 2018; United Nations Water 2020). Similarly, *Criterion #3* about treaty-informed management and *Criterion #4* about watershed identity are mutually reinforcing as people in the Canadian Prairies are all treaty peoples and roles of individual actors in water management should reflect that. Applying criteria as a package would enable improved water governance, including co-governance with Government of Saskatchewan water managers and Indigenous authorities.

6.6 Conclusion

Saskatchewan's Growth Plan strives towards sustainability through targets for reliable water resources for a thriving economy (WSA 2019, 2024c; Government of Saskatchewan 2020b, 2024a). In this paper, we proposed a broader set of sustainability criteria categories for water development (water abstraction and drainage) in southern Saskatchewan watersheds that supports the idea of "enough, for all, forever" based on generic sustainability assessment and environmental and cultural flow principles. Criteria were developed by a synthesis of government representative, stakeholder, and Rights holder perspectives on their visions for the future of water. These regional sustainability criteria guide initiatives responding to established needs for 1) restoration of water and land, 2) lasting upstream-downstream equity, 3) respect for treaties and rights, 4) transparency and openness, 5) an understanding of climate uncertainty and efficient water use, 6) and procedural justice. There is opportunity to apply these requirements to

water withdrawal and wetland drainage proposals in the Qu'Appelle and South Saskatchewan sub-watersheds. Practical application should involve continuing to iterate and specify criteria, identifying a set of mutually reinforcing recommendations as part of an action plan, and seeking opportunities for collaborative testing and re-evaluating these criteria in regional governance.

6.7 Transition

Chapter 6 proposed sustainability criteria for water development in the Qu'Appelle and South Saskatchewan River sub-basins. In Chapter 7, I test these criteria based on perceived regional vulnerabilities, trade-offs, and some alternatives of and alternative approaches to interpreting and implementing the Lake Diefenbaker Irrigation Expansion and Agricultural Water Stewardship Policy (drainage) (Figure 6.3).

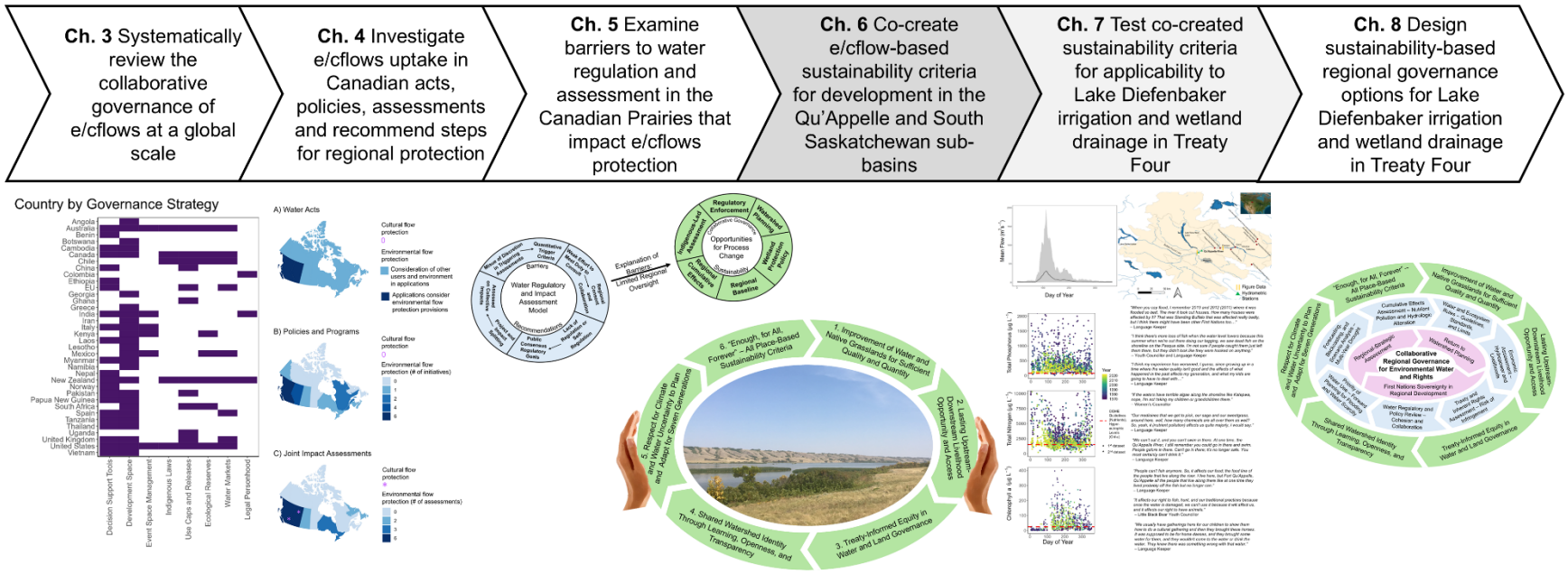


Figure 6.3. A roadmap diagram showing the transition from Ch. 6 to Ch. 7 objectives. E/cflows refers to environmental and cultural flows.

CHAPTER 7. SUSTAINABILITY OF IRRIGATION AND DRAINAGE IN THE CENTRAL CANADIAN PRAIRIES: APPLYING SUSTAINABILITY CRITERIA USING A CO-CREATION MODEL

7.1 Overview

Globally, arid regions frequently experience marked water insecurity. Yet, they are subject to regular project developments to extract or manage surface waters without necessarily evaluating project effects on sustainability. Here, we tested the applicability of co-created, context-specific sustainability criteria to a planned surface water irrigation expansion and projected agricultural wetland drainage in the semi-arid and sub-humid Canadian Prairies. Through a process developed with the Lands, Resources, Environment, and Stewardship Department of File Hills Qu'Appelle Tribal Council, we used a combination of interviews and workshops (55 people; government, stakeholders, and rights holders), hydro-ecological analyses, news reports, and government publications that addressed regional vulnerabilities, trade-offs, and alternatives of the current development trajectory. We found that contributors expected benefits from irrigation and drainage, such as economic growth, water control, and farm stewardship, but there was concern about how irrigation and drainage together could cause losses to downstream water quality and quantity, Treaty and Inherent Rights, and livelihoods. When testing sustainability criteria through application to irrigation and drainage initiatives, we found multiple grounds for questioning the proposed projects, including loss of water and grasslands habitats; failure to apply the precautionary principle; lack of consideration of uncertainty in climate and environmental variability; and needs for relationship-building with Rights holders and stakeholders and for communication strategies that improve openness and transparency in water regulation. The initial sustainability criteria could be further refined, for example, to consider the unique characteristics of the downstream Saskatchewan River Delta and native grasslands, a suite of lake and river restoration strategies, relationship building and conflict mitigation, and means of encouraging greater efficiency in water uses. Taken together, this synthesis highlights the need to apply co-created, context-specific sustainability criteria to watershed developments in Canada and abroad to identify the perceived and often hidden trade-offs of proposed projects.

7.2 Introduction

There are gaps in impact assessment that limit the consideration of broader regional sustainability. Environmental impact assessment is the evaluation of one development project on one site, and the project's lifecycle impacts and their mitigation (Gunn and Noble 2009). The Canadian Institute of Resources Law summarizes how to respond to the central gap in impact assessment (Kennett, 2006, p. 10): "The solution lies in a fundamental shift from blind incrementalism and fragmented decision-making to an integrated system for managing land and resource use." Impact assessment that evaluates single developments is often not sufficient to determine cumulative and legacy impacts, guide or align with regional development plans and goals, collaborate effectively with multiple authorities, and facilitate future thinking and comparison of alternative future scenarios (Liu et al. 2007; Pope et al. 2013; Jones 2016; Foley et al. 2017). Rather, impact assessments typically require 1) an expansion from project-based to regional thinking (Gunn and Noble 2009; Gibson et al. 2020); 2) links between assessment levels so that strategic decision-making is harmonized with on-the-ground assessment and vice versa (Arts et al. 2011; White and Noble 2013); 3) a shift from considering only biophysical impacts to greater inclusion of social-ecological system impacts, including perceived risks (Morgan 2012b; Dendena and Corsi 2015); 4) opportunities for collaboration through co-governance agreements, especially with Indigenous Nations (Clogg et al. 2017; FNMPC 2020); and 5) explicit and context-specific sustainability criteria (Pope et al. 2004; Gibson 2017). In this paper, we apply and test co-created and context-specific sustainability criteria for regional water development, created in Chapter 6, to make recommendations for more effective impact assessment processes.

Sustainability should be applied and tested for individual projects, regional frameworks, and strategic assessments as a basis for collaborative decision-making to improve resource management and policy development (Pope et al. 2004; Clogg et al. 2017; Gibson et al. 2020). Within Canada, application of collaboratively-defined and context-specific criteria has resulted in diverse outcomes, including extensions to project lifespans that support local economies and co-management agreements (Voisey's Bay Mine, Labrador) (VBEAP 1999); projects not being approved because of damaging environmental outcomes and Indigenous rights (Kemess North Mine, British Columbia) (Environmental Assessment Office 2017); and broadening of regional and strategic issues to support communities and seek maximal net gains (White Point Mine, Churchill Hydroelectric, Mackenzie Valley Pipeline) (WPJRP 2005; MGPJRP 2009; Doelle

2012; Manitoba Hydro 2015). Despite these successes, use of context-specific sustainability criteria is still comparatively uncommon (Gibson et al. 2020). In particular, there is a need to apply sustainability criteria to water development projects in Canada because of increased incidence of water degradation and scarcity, the potential for Indigenous Rights infringements, and a desire to contribute to reaching the full range of sustainability goals while attaining economic and social benefits and enabling ecological recovery and resilience (WWF-Canada 2017, 2020).

At the core of sustainability is the evaluation of new developments in light of vulnerabilities, trade-offs, and alternatives (Gibson et al. 2005b). Regional vulnerabilities are all of the potential risks and complexities that may further compromise the regional social-ecological system, resulting in system collapses, reorganization, and surprises with negative consequences for people and other life (Holling 2001). To define these vulnerabilities, research suggests that braided or co-applied information from both Western and Indigenous science is essential to inform baseline conditions for watersheds and landscapes (Kimmerer 2013; Jimmy et al. 2019; Gibson et al. 2020). At the same time, projects may be evaluated on their trade-offs: benefits and adverse effects, including perceived risks and foreclosed opportunities (Morrison-Saunders and Pope 2013). Perceived risks are hazards that may or may not occur but cause impacts to people's well-being because of an expectation of future adverse impacts (Slovic 2016). Foreclosed opportunities refer to potentially valuable pathways and alternatives that will become unavailable or impractical if specified development trajectories are pursued (Gibson et al. 2005b). To date, perceived risks and foreclosed opportunities have rarely been considered in assessments, policy development, or application of project regulations (Leung et al. 2016; Slovic 2016), particularly in the case of watershed developments, in part because foreclosed opportunities may manifest as losses to downstream cultures and ecosystems distant from the project site (Finn and Jackson 2011; Anderson et al. 2019; Douglas et al. 2019). Lastly, development alternatives need to be assessed (no development, different development components or pace and scale, and other approaches to development) to determine the most beneficial trajectory (Gibson et al. 2005b). In principle, the combined evaluation of regional vulnerabilities, trade-offs, and alternatives based on the application of context-dependent sustainability criteria provides a novel means of assessing water developments that have broad regional and strategic implications.

Cumulative developments in watersheds in Canada require an assessment explicitly applying sustainability criteria because 53 of Canada's 167 major watersheds are now at a high risk of environmental degradation because of water scarcity and flow alteration, poor water quality, climate change, and invasive species (WWF-Canada 2017, 2020). Cumulative effects of multiple parallel and sequential developments stress watersheds and can breach Treaty and Inherent Rights of Indigenous Nations (Arsenault et al. 2018), as demonstrated in the recent case of Blueberry River First Nations (Simmons 2021). Blueberry River First Nations put forward a cumulative effects atlas of their traditional territory showing disturbance from oil and gas wells, development roads, pipelines, seismic lines and forestry development (Macdonald and Ecotrust Canada 2016). This led to a British Columbia Supreme Court ruling for the first time in Canadian history identifying a breach of Treaty and Inherent Rights because of cumulative effects (Simmons 2021). Similar breaches can be avoided in other parts of Canada with the application of collaborative sustainability criteria ahead of regional developments (Gibson et al. 2020). We offer an example from southern Saskatchewan watersheds, that are subject to multiple impacts from on-going anthropogenic and natural phenomena, to exemplify application of sustainability criteria to address stakeholder and Rights holder concerns.

The Qu'Appelle River and South Saskatchewan River basins are two of the most highly stressed watersheds in Canada due to inherently low water availability, degraded water quality, and high vulnerability to climate change (Sauchyn et al. 2016; WWF-Canada 2017, 2020; Vogt et al. 2018). Environmental scientists, economists, and Indigenous Nations anticipate a complex mix of costs and benefits to the Qu'Appelle River and adjacent watersheds arising from a proposed irrigation expansion, potash mines, canola and straw biomass plants, wetland drainage, city and shoreline development, and climate change (FHQTC 2021a; FSIN 2021; Leavitt 2021). However, the current regulatory framework has challenges that limit the utility and validity of impact assessments and regional strategic oversight. The problems include project splitting to avoid provincial or federal assessment designation and watershed planning that stopped after development in the 2010s (Chapter 5). This paper focuses on water abstraction by the Lake Diefenbaker Irrigation Expansion and wetland drainage projects supported by the Saskatchewan Government's Agricultural Water Stewardship Policy, both of which have the potential to alter water quantity and pose risks of water contamination (Leavitt 2021; Ritchie 2023).

The Lake Diefenbaker Irrigation Expansion is a $4 billion project to expand outflows and canals for irrigated farming at Lake Diefenbaker on both the South Saskatchewan and Qu'Appelle River outlets (Glover 2020). In the instance of the Qu'Appelle River (phase three), transfers of water from the upstream Lake Diefenbaker reservoir may be designated for a federal impact assessment under the *Physical Activities Regulations* (Impact Assessment Agency of Canada 2021), but what's not being assessed or designated for assessment are regional cumulative effects of irrigation and drainage (Impact Assessment Agency of Canada 2019a, 2021). This designated sub-project of the much bigger Lake Diefenbaker Irrigation Expansion includes creation of upland canal infrastructure that will facilitate increased water withdrawal for irrigation, other industries, and the environment (Saskatchewan Irrigation Projects Association 2009; Clifton Associates 2012; Lindenschmidt et al. 2020). Co-occurring with irrigation development is the drainage of agricultural wetlands adjacent to the Qu'Appelle River and lakes, facilitated through an upcoming Agricultural Water Stewardship Policy (WSA 2023a). The Qu'Appelle River system is the traditional territory (Treaty Four) and location of several Reserves of the 11 First Nations of the File Hills Qu'Appelle Tribal Council (FHQTC) and the interests of these Rights holders could be affected adversely as well as positively. In this context, provincial decision making about water should be informed by analysis that applies sustainability criteria to determine whether the proposed development(s) and water licence applications would be the best option to deliver fairly distributed long-term gains and avoid negative consequences to diverse regional water values (Gibson et al. 2020). However, sustainability criteria cannot be merely generic and must be specified for each development and watershed context to represent local values and needs.

We initiated a collaborative discussion of the key considerations for a regional sustainability-based evaluation of the proposed water developments in the Qu'Appelle River to guide the development of context-specific sustainability criteria. We interviewed government representatives and stakeholders, held workshops with Rights holders, and synthesized perspectives of supporters and critics of the proposed development from news outlets, government documents, and technical reports. Long-term hydrology, water quality, and system mapping analyses supported this research. The objectives were to 1) identify key sustainability considerations – existing natural and social vulnerabilities and trade-offs and alternatives of irrigation and drainage and 2) test the appropriateness of sustainability criteria categories

identified in Chapter 6 to evaluate regional irrigation and drainage projects. This case study is meant to illustrate a model approach to testing and applying sustainability criteria for sustainability-based evaluations of proposed developments in Canadian contexts, where cumulative effects could cause infringements to watershed values, services, and to Treaty and Inherent Rights.

7.3 Methods

This research focused on water withdrawal (for irrigation expansion, potash and grain crushing plants) and wetland drainage in the Qu'Appelle River sub-watershed, plus consequences for the South Saskatchewan River sub-watershed. Interview and workshop questions were designed with FHQTC-LRES, as described in chapters 2 and 5. A map of the drainage basins, development, and land use in southern Saskatchewan is presented in Figure 7.1. Information for this paper came from interviews, workshops, long-term hydro-ecological data, and available government development documents and critic responses (Bowen 2009; Crowe et al. 2011; Vaughn and Jacquez 2020; Finlay 2021).

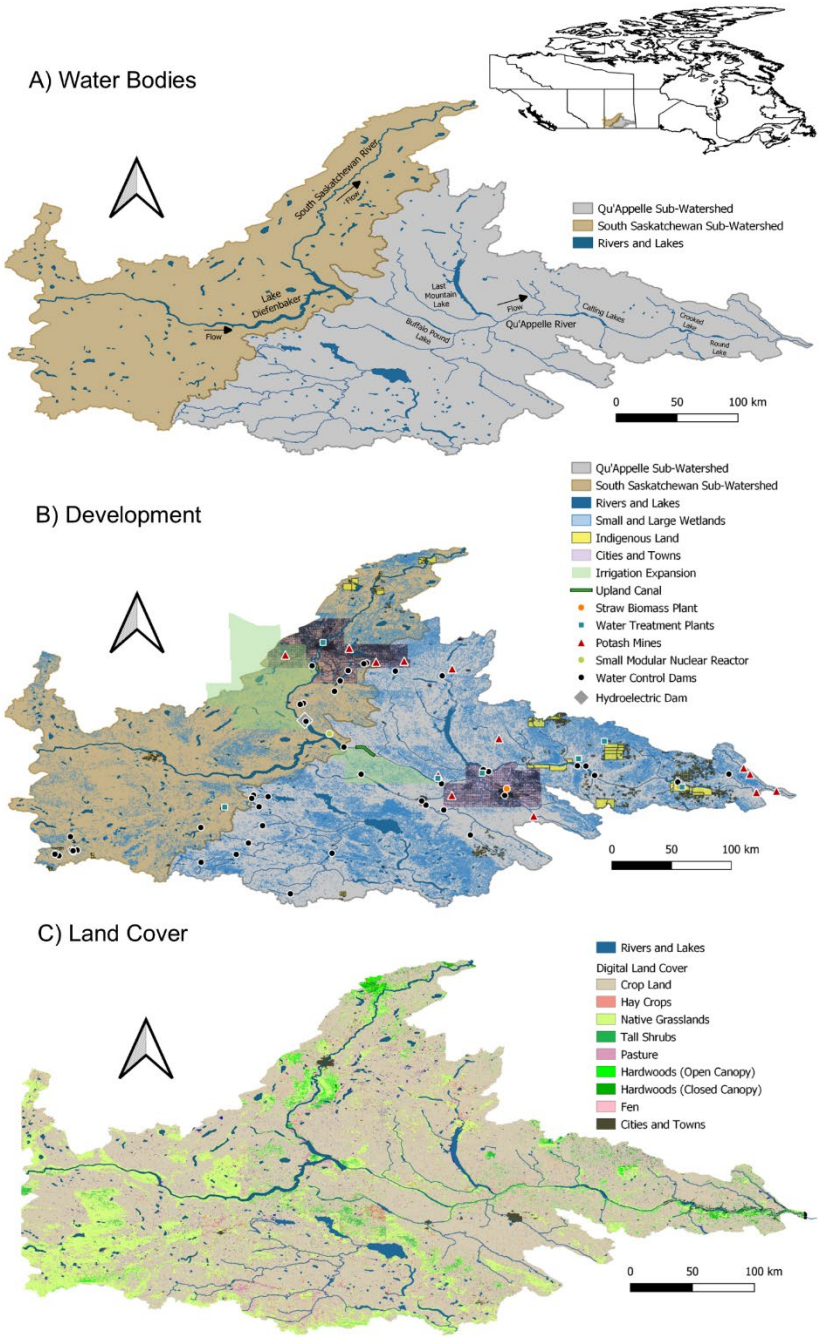


Figure 7.1. A map of the Qu'Appelle and South Saskatchewan sub-watersheds in Saskatchewan, Canada with rivers and lakes (A), development (B), and land cover (C). Land cover is from the Government of Saskatchewan GIS hub and is updated to November 21, 2023. All mapped developments in B) exist, except for the Lake Diefenbaker Irrigation Expansion, which is in development. Possible new potash and grain crushing plants are not displayed here, as their locations are not yet publicly available or determined. This figure is the same as Figure 1.1.

A workshop with representatives from Language Speakers, Women, and Youth Advisory Councils sought reflections on long-term hydrology and water quality data. The agenda of the workshop included questions about experiences with the current water regulatory and assessment process, water project impacts on culture and rights, visions for the Qu'Appelle River watershed, strategies for planning and regional assessment, impressions of water development proposals, and opportunities for Indigenous-led assessment. For the purposes of this study, the workshop delivered Indigenous knowledge about regional baseline information and impacts on Treaty and Inherent Rights impacts related to hydrologic and water-quality change, as well as perceptions about proposed water development. Quantitative data were provided by Peter Leavitt's research program at the University of Regina (Haig and Leavitt 2019), the Saskatchewan Water Security Agency, and Environment and Climate Change Canada's website (Government of Canada 2024e). Methods for the determination of river Chl *a*, algal group pigments (diatoms [Fucoxanthin], cyanobacteria [Echinenone], blue-green algae [Lutein-Zeaxanthin], and green algae [Chl *b*]), and nutrients for Peter Leavitt's research program can be found in Bergbusch et al. (2021).

Data on river and lake nutrients (total phosphorus and nitrogen) and algal biomass (as chlorophyll *a*), river hydrology, and lake levels were presented from Lake Diefenbaker to Crooked Lake (Figure 7.2 and Appendix A Figures S7.1, S7.2, S7.3) to complement qualitative information and serve as an opportunity for respectful braiding of past and present regional impacts (Kimmerer 2013; Martin et al. 2017a; Jimmy et al. 2019; Wright et al. 2019). Figures were created in R (version 2023.12.0+369) with ggplot2 (Wickham 2016). River hydrology, chemical variables, and suspended algae and cyanobacteria were evaluated through univariate and multivariate analyses. Generalized additive models were used in R to evaluate the non-linear and linear relationships of river discharge against Chl *a*, total phosphorus, and total nitrogen (Pedersen et al. 2019). Variables were normalized through logarithmic (non-zero values) or square-root transformations (inclusive of zero values; e.g., discharge). Gamma distributions with log-link functions were chosen for all univariate models because variables were characterized by non-zero, low-value-inflated distributions (Pedersen et al. 2019). Basis size (the number of functions used to build the smooth curve that represents the linear and non-linear relationships) and model assumptions were verified to ensure model effectiveness (Pedersen et al. 2019). A principal component analysis was completed to evaluate correlations between all hydrologic,

algal, and nutrient variables and spread of variance (Greenacre et al. 2022). Models were created using mgcv, gratia, and vegan R packages (Wood 2011; Oksanen et al. 2022; Simpson 2022).

Map information was retrieved from various government sources. This included Natural Resources Canada (Government of Canada 2024f), the Saskatchewan Water Security Agency's geoportal (WSA 2024d), the Government of Saskatchewan's digital landcover repository (Government of Saskatchewan 2024b), the Government of Canada's Aboriginal lands of Canada legislative boundaries (Government of Canada 2024g), and by extracting coordinates from Google Maps. Geospatial experts at the University of Waterloo and FHQTC-LRES helped develop maps. Maps were created in QGIS (QGIS Development Team 2023).

Using NVivo (QSR International Pty Ltd. 2020), the lead author qualitatively analyzed interview and workshop information deductively based on existing frameworks (Crowe et al. 2011; Saunders et al. 2019; Vaughn and Jacquez 2020). First, to examine perspectives on regional impacts, we coded themes into categories from sustainability assessment. Gibson (2012, p. 167) notes that the core of sustainability assessment effectiveness lies in six imperatives: reversal of prevailing detrimental (unsustainable) trends; integration of all key factors that affect sustainability; reinforcing mutual gains; minimization of trade-offs; respect of regional context; and openness and broad engagement. We defined impacts to include analysis of vulnerabilities, benefits, perceived risks/foreclosed opportunities (near term losses and those that lead to adverse legacy impacts), and alternatives (Gibson et al. 2005b). Vulnerabilities, benefits, and foreclosed opportunities were visualized through a cause-effect analysis that involved going through participant quotes to determine causal relationships between variables, such as that between water quality and the practice of Treaty and Inherent Rights. This approach included commitment to maintain environmental and cultural flows, as well as concepts about how water quantity and quality relate to broader ecological, social, and rights components (Douglas et al. 2019). We used and applied flow-based and context-specific sustainability criteria from Chapter 6 to evaluate net contributions to sustainability (Table 7.1). Causal diagrams were created in Kumu (Kumu 2025).

Table 7.1. Definitions of sustainability criteria categories for water development in the Qu'Appelle and South Saskatchewan sub-basins informed by government representative, stakeholders, and Rights holder visions. Criteria were derived in Chapter 6.

Sustainability Criteria Categories	Definition	Possible Indicators
Improvement of Water and Native Grasslands for Sufficient Quality and Quantity	Improve the long-term integrity of freshwater quality and quantity, wetlands, grasslands and native pastures, and dependent people and rights by avoiding pollution, unnecessary drainage, and protecting against drought and flood extremes.	- Water quality improvement (fish kills, toxic algae, nutrients) - Grassland and wetland retention and rehabilitation - Water level and low flows
Lasting Upstream-Downstream Livelihood Opportunities and Access	Ensure equal livelihood opportunities (market and rights-based) of upstream and downstream people and communities are supported in development trajectories and not limited in any way by impacts affecting the land and water.	- Rights-based plant harvesting and fishing - Public access - Small farmer revenue - Downstream recreation and tourism
Treaty-Informed Equity in Water and Land Governance	Support Treaty- and Inherent Rights-informed democratic water governance through a regional advisory council(s) that aims to reduce gaps (water quality, health, well-being, decision-making authority, and culture and rights practices) between upstream and downstream water and riparian users.	- Roles and responsibilities of managers and communities - Adaptive policy review - Relationship building - Involvement in regulatory frameworks and policy creation
Shared Watershed Identity Through Learning, Openness, and Transparency	Build the shared identity (understanding and commitment) of individuals, communities and Indigenous and provincial governments to apply sustainability principles to watersheds and grasslands through ongoing learning, openness, and transparency.	- Communication - Collective action/responsibility - Political will - Transparency
Respect Regional Climate and Water Uncertainty by Preparing to Mitigate and Adapt for Seven Generations	Prepare to mitigate and adapt for seven generations by favouring efficient prairie adaptation and water development trajectories for sufficient agricultural resilience and land and water quality and quantity that supports Saskatchewan residents and improves the spiritual, cultural, environmental, social and economic conditions of Indigenous Nations	- Climate extremes - Frequency and intensity of floods and droughts - Adaptation strategies - Precautionary principle
"Enough, For All, Forever" – All Place-Based Sustainability Criteria	Work to meet all the context-specific, interdependent sustainability requirements in the short and long term by respecting water and land and seeking mutual well-being and enjoyment forever.	- All

7.4 Findings

The results section begins with a synthesis of key sustainability considerations in the Qu'Appelle River sub-basin, with supporting information from the South Saskatchewan River sub-basin, described by research participants. This includes regional vulnerabilities, trade-offs of irrigation and drainage, and alternatives to the current trajectory. This section sets the key variables and perspectives to test the applicability of sustainability criteria in the second section.

7.4.1 Key Regional Sustainability Considerations

7.4.1.1 Regional Vulnerabilities

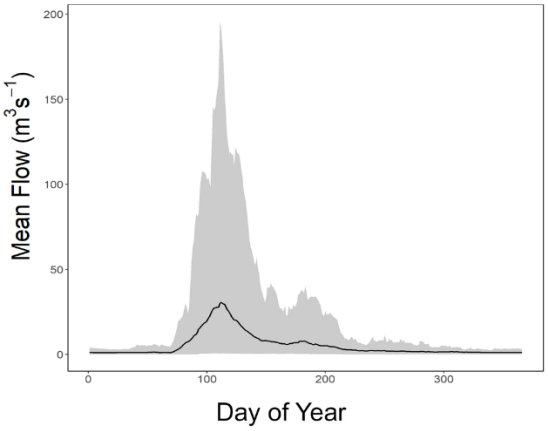
Land use, variable hydrology, nutrient pollution, and degraded water quality in the Qu'Appelle River Valley have impacted the environment, people, and the exercise of Treaty and Inherent Rights throughout the 52,000 km^2 drainage basin. Participants described how future climate warming and increased variability, especially in rainfall and snowmelt, will substantially exacerbate effects of hydrology modification and water quality degradation in both lakes and rivers. Regional interactions between floods, droughts, nutrients, and degraded water quality are described by study participants in the following section.

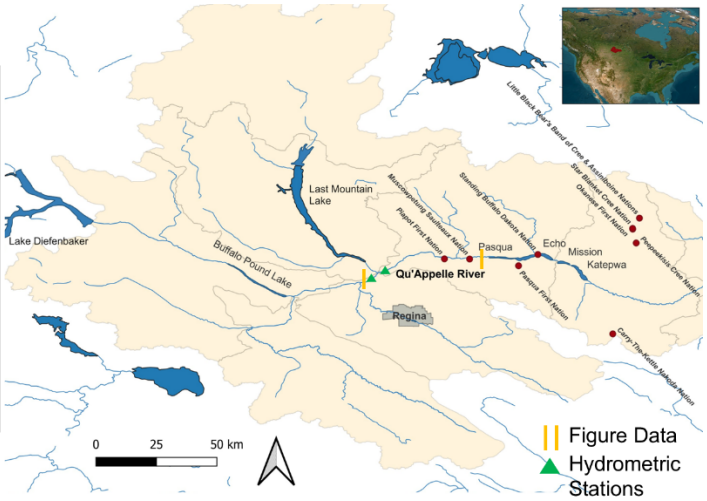
The majority of land cover in these sub-watersheds is grain cropland (e.g., wheat, canola, flax), followed by native grassland and hardwoods in riparian areas (Figure 7.1C, Table 7.2). Cropland in the Qu'Appelle River and South Saskatchewan River sub-watersheds make up 74% and 61%, respectively. More native grassland is intact in the South Saskatchewan River sub-watershed (27%) compared to the Qu'Appelle River sub-basin (15%) reflecting differential distribution of cultivation (Figure 7.1C). Interest groups spoke about cultivation diminishing small wetlands and native grasslands. Interviewed agricultural producers, academics, and non-profit organization members also expect future constraints on grasslands, land use, agriculture, and markets from climate pressures.

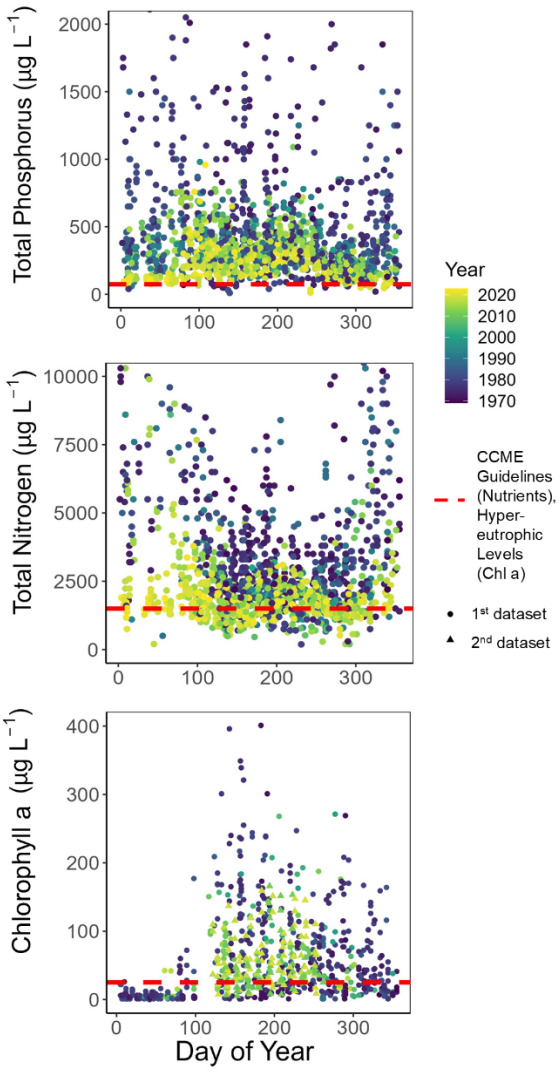
Table 7.2. The area and percent cover of land types in the Qu'Appelle and South Saskatchewan River sub-watersheds. Data were collected from the Government of Saskatchewan GIS hub (updated November 21, 2023) and calculated in QGIS.

Sub-Watershed	Land Cover	Area (km^2)	Percent Cover (%)
Qu'Appelle River	Crop Land	54699.1	73.6
	Hay Crops	1095.1	1.5
	Native Grasslands	11396.6	15.3
	Tall Shrubs	1537.5	2.1
	Pasture	698.6	0.9
	Hardwoods (Open Canopy)	765.3	1.0
	Hardwoods (Closed Canopy)	186.6	0.3
	Fen	92.6	0.1
	Cities and Towns	706.1	1.0
South Saskatchewan River	Crop Land	33443.8	61.4
	Hay Crops	679.9	1.3
	Native Grasslands	14863.8	27.3
	Tall Shrubs	1117.8	2.1
	Pasture	474.2	0.9
	Hardwoods (Open Canopy)	859.2	1.6
	Hardwoods (Closed Canopy)	134.7	0.3
	Fen	41.7	0.1
	Cities and Towns	402.4	0.7

The effects of floods are well known by First Nations in the Qu'Appelle River Valley (Figure 7.2). While flow is regulated at several locations in the Qu'Appelle River sub-basin, hydrologic variability is marked with river flow during floods as high as 436 m^3/s (1974; 300 m^3/s in 2011) and as little as 0 m^3/s during droughts at the Qu'Appelle River before Last Mountain Lake, with a mean annual flow of 6.58 ± 0.62 m^3/s between 1950-2020. However, extreme floods are partially mitigated by a control structure at Last Mountain Lake that lessened flooding in 2011 from a maximum of 300 m^3/s to 163 m^3/s before Pasqua Lake. In contrast, most lake levels remain relatively constant due to operation of water outflow control structures (Figure 7.2, Figure S7.1). Agricultural producers reported that the worst floods (e.g., 2011) occurred early in the cultivation season when there was high precipitation but little crop cover, leading to greater cumulative drainage run-off downstream. Agricultural producers also spoke about how flooding impacted their livelihoods through crop damage. Interest groups spoke to flooding affecting stream buffering capacity and roads. Advisory Council members of FHQTC-LRES spoke about how flooding destroyed First Nations' homes and how floods and droughts caused fish kills, leading to losses to Treaty and Inherent Rights.







"When you say flood, I remember 2013 and 2012 (2011) where it was flooded so bad. The river it took out houses. How many houses were affected by it? That was Standing Buffalo that was affected really badly, but I think there might have been other First Nations too…"
– Language Keeper

"*I think there's more loss of fish when the water level lowers because this summer when we're out there doing our tagging, we saw dead fish on the shoreline on the Pasqua side. I'm not sure if people caught them just left them there, but they didn't look like they were hooked on anything.*"
– Youth Councillor and Language Keeper

"I think my experience has worsened, I guess, since growing up in a time where the water quality isn't good and the effects of what happened in the past affects my generation, and what my kids are going to have to deal with…"
– Language Keeper

"If the waters have terrible algae along the shoreline like Katepwa, nope, I'm not taking my children or grandchildren there."
– Women's Councillor

"Our medicines that we get to pick, our sage and our sweetgrass, around here, well, how many chemicals are all over them as well? So, yeah, it (nutrient pollution) affects us quite majorly, I would say."
– Language Keeper

"We can't eat it, and you can't swim in there. At one time, the Qu'Appelle River, I still remember you could go in there and swim. People galore in there. Can't go in there; it's no longer safe. You most certainly can't drink it."
– Language Keeper

"People can't fish anymore. So, it affects our food; the food line of the people that live along the river. I live here, but Fort Qu'Appelle, Qu'Appelle all the people that live along there like at one time they lived probably off the fish but no longer can."
– Language Keeper

"It affects our right to fish, hunt, and our traditional practices because once the water is damaged, we can't use it because it will affect us, and it affects our right to have animals."
– Little Black Bear Youth Councillor

"We usually have gatherings here for our children to show them how to do a cultural gathering and then they brought these horses. It was supposed to be for horse dances, and they brought some water for them, and they wouldn't come to the water or drink the water. They knew there was something wrong with that water."
– Language Keeper

Figure 7.2. Hydrograph (1950-2020), water quality time series (nutrients and Chlorophyll a [algae + cyanobacteria]), and Rights holder knowledge of the lower Qu'Appelle River (area between orange lines on the map in the upper right). Discharge information is from a hydrometric station before Last Mountain Lake (the first green triangle). Data are from the Water Security Agency, Environment and Climate Change Canada, the Qu'Appelle Long-term Ecological Research Program (QU-LTER), and workshops with FHQTC-LRES Advisory Councils. CCME refers to the Canadian Council of the Ministers of the Environment guidelines for nutrients (CCME 2024) and hypereutrophic levels for Chl *a* (~25 μg L^{-1}) in lakes and rivers (Smith et al. 1999; Dodds and Smith 2016), similar to lake thresholds. The first data set is from the Water Security Agency and the second is from the QU-LTER. Note that other data used in the workshops are presented in Appendix A.

Nutrient pollution and harmful algal blooms negatively affect the exercise of Treaty and Inherent Rights of First Nations in the Qu'Appelle River Valley (Figure 7.2). Nitrogen and phosphorus levels and water quality degradation exceed Canadian Council of Ministers of the Environment guidelines for protection of aquatic life in most lakes and the Qu'Appelle River (Figure 7.2, Appendix A Figures S7.2 and S7.3). Nutrients lead to excessive algal blooms that indicate hyper-productive conditions. While source waters from Lake Diefenbaker reservoir are less productive (more oligotrophic), downstream reaches and lakes within the Qu'Appelle River sub-basin are hypereutrophic because of nutrient pollution from point (e.g., wastewater treatment plants) and non-point (e.g., agricultural) sources, internal fertilization (from legacy nutrients in sediments), and naturally high phosphorus influx from soil sources (Appendix A Figures S7.2 and S7.3). Interest groups spoke about water quality affecting tourism, sense of community, and cottage development. Advisory Council members of FHQTC-LRES described how poor water quality and high nutrient levels limit fishing and hunting, medicinal plant gathering, recreational activities, cultural gatherings, and self-determination (Inherent Rights). They also described a time when the water was healthier, the fish were safe to eat, and children could swim in the water without getting skin rashes and illnesses.

Qualitative and quantitative analyses suggest hydrology, nutrients, and algae interact in unexpected ways in the Qu'Appelle River Valley to affect water quality and rights. Total phosphorus increases with flow, total nitrogen generally decreases with high variance in flood years, and Chl *a* has a non-linear, unimodal relationship with flow (Figure 7.3). A government representative suggested there are challenges with greater water allocation because high flows mobilize phosphorus-rich sediments. However, the point where there is low total phosphorus and a marked decrease in Chl *a* and total nitrogen is ~ 9 m^3/s (Figure 7.3), potentially because

nitrogen from point sources and Chl *a* are diluted while sediment phosphorus and diffuse phosphorus and nitrogen runoff are minimized. Researchers spoke about how saturation of the Qu'Appelle River and tributaries with nitrogen prevents nitrogen uptake and cycling by the river, but greater positive nitrogen removal through cycling could also potentially occur at ~ 9 m^3/s. Both researchers and stakeholders spoke about how nitrogen sources increase algae and cyanobacteria in lakes and rivers. In our multivariate model, all algal groups (diatoms, green algae) and cyanobacteria decreased with river flow, whereas there was a positive linear relationship between all nutrient types and flow (Figure 7.3). Other sub-interactions included stimulation of diatom growth from nitrogen, increases in cyanobacteria with temperature, and flow supporting blue-green algae (Figure 7.3). Despite and in addition to these complexities, a lack of regulations controlling water quality and run-off has led to concerns by First Nations. A Councillor of Pasqua First Nation said:

> Another one would be the control of the upper Qu'Appelle, and they control what comes down to us – how much quality and quantity. So, if they're not pushing down enough clear fresh water to our lakes, well, we're ending up being pretty sludgy down here…

Taken together, control of water quantity, hydrologic extremes, run-off, and harmful algal blooms interact to affect the exercise of Treaty and Inherent Rights.

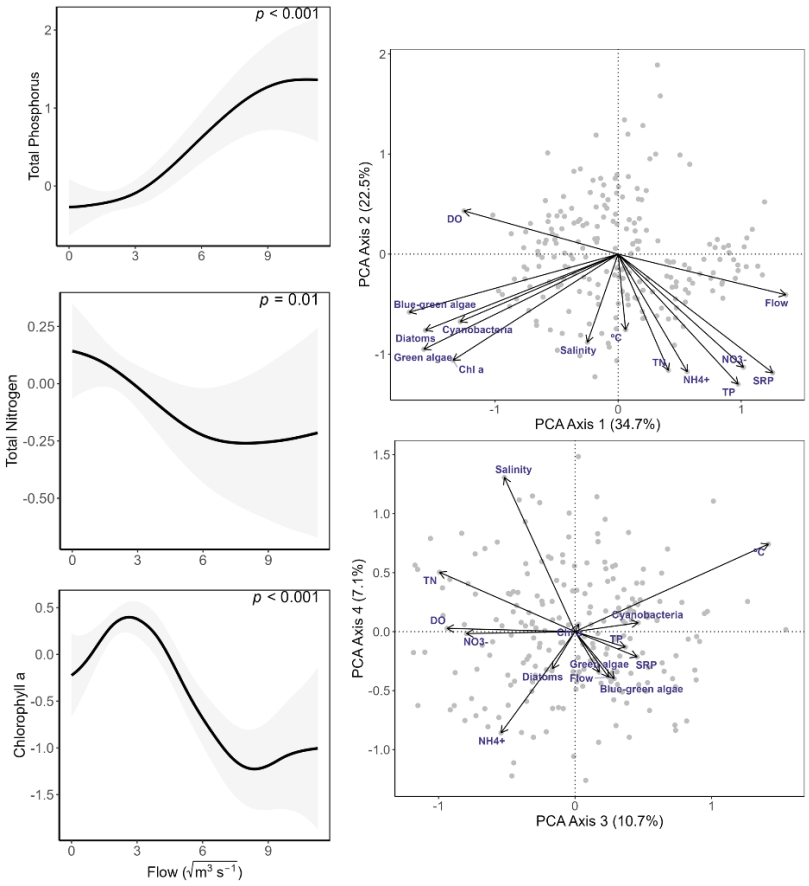


Figure 7.3. Univariate (left) and principal component (right) ecohydrological analyses for the Qu'Appelle River Valley. Data are from four sites measured from 2010-2012 and 2017-2019 between Buffalo Pound Lake and Pasqua Lake as part of the Qu'Appelle Long-term Ecological Research Program (QU-LTER). Generalized additive models from top to bottom explained 55.8%, 61.4%, and 50.4% of deviance, respectively. Abbreviations: TP (Total phosphorus), TN (Total nitrogen), SRP (Soluble reactive phosphorus), NH_4^+ (Ammonium), NO_3^- (Nitrate), DO (Dissolved Oxygen), ºC (Temperature), and Chl *a* (Chlorophyll a). Shaded areas are 95% credible intervals. Note that univariate model y-axes are centred at zero.

7.4.1.2 Trade-Offs of Irrigation and Drainage

Despite regional vulnerabilities, development proposals (irrigation expansion, potash mines, straw biomass plants, canola crushing plants, and drainage) are moving ahead with complex interactions that may either alleviate or exacerbate existing pressures. Perceived benefits and risks of irrigation and drainage are explored in the following section with qualitative information based on interdependencies developed through a network analysis (Appendix A Figure S7.4).

Irrigation and water abstraction projects have been described as offering many benefits to the people of Saskatchewan to support economic growth and manage regional vulnerabilities. For example, a representative from the Upper Qu'Appelle Irrigation District described the benefits they expect from irrigation and the associated upland canal infrastructure at Lake Diefenbaker on the Qu'Appelle side:

> We have the potential to develop 100,000-plus acres of irrigation between the Qu'Appelle Dam and Buffalo Pound. So with that, the concept of that project is you put in an upland canal that would take the stress off of the valley and supply water down to Buffalo Pound, and within that canal, you can develop some reservoirs that will have some environmental impacts in the region, but you're also getting more water down to Buffalo Pound at a higher quality that is not causing erosion down into the valley.

Participants described benefits, such as greater water control, economic growth, and support for stewardship by producers – all with secondary benefits. Reports from the Saskatchewan Irrigation Projects Association and contractors including *Time to Irrigate*, the *Upper Qu'Appelle Water Supply Project: Economic Impact and Sensitivity Analysis*, and *Economic Analysis: Westside Irrigation Rehabilitation Project* refer to many benefits of the irrigation expansion and the upland canal infrastructure (Saskatchewan Irrigation Projects Association 2009; Clifton Associates 2012; KPMG 2024). For example, *Time to Irrigate* (Volume 2, p. 122) suggests that benefits include: increased and more stable agricultural incomes; value added processing; a growing rural population; tourism development; water supply benefits to improve water quality for both small rural centres and the nearby adjacent cities of Saskatoon, Regina, Moose Jaw, North Battleford and Swift Current; environmental benefits in the form of expanded wetlands and native habitat; and increased revenues to federal and provincial governments (Saskatchewan Irrigation Projects Association 2009). The Qu'Appelle upland canal infrastructure, South Saskatchewan westside rehabilitation, and associated economic development are described as a viable strategy to adapt to climate change while maximizing social, ecological, and economic benefits and developing greater food security (Lindenschmidt and Carstensen 2015; Lindenschmidt et al. 2020; KPMG 2024).

The proposed irrigation and water withdrawal projects may also have direct, indirect, and cumulative adverse impacts that exacerbate regional vulnerabilities in the Qu'Appelle and South Saskatchewan sub-watersheds. For example, a Councillor of Pasqua First Nation said:

> Water is life for us. Where we're located with our chain of lakes, I think, and even being in the valley, everything is affecting our water. So yeah, the potash mining, the taking of more and more water that comes down to our area is affecting our quality of water and the quantity of water. The agriculture is affecting our water by their runoff, by their usage

> of their chemicals. The Lake Diefenbaker project, that they're discussing about creating a new irrigation system for the farmers around that area, that's going to have major impacts if that goes through. It's going to greatly decrease the amount of water coming to us as well as the quality of it because there's more fresh water going out to those fields and running off. Well, then there's more chemically treated water coming down to us. So, that's of great concern…I think everything, every single project, needs to be evaluated on how it affects everybody across the province, not only just that one little area…

Together, participants described hypotheses based on the potential impacts of irrigation and water withdrawal on water scarcity and flow alteration, water quality and ecosystems, Treaty and Inherent Rights, livelihoods, local market viability, and sustainable alternatives and investment (Table 7.3, Figure 7.4). Critics of the irrigation expansion expect issues related to an eventual drop in the water levels in the Saskatchewan River Delta, accumulation of sediment in the downstream river sections, potential water level fluctuations, impaired hydropower generation, limited economic returns, and increased chemical pollution from agricultural run-off to both the Qu'Appelle and South Saskatchewan rivers (Leavitt 2021; Anderson 2024; Silberman 2024; Geoff 2024). Indigenous People are concerned about potential infringement of Treaty and Inherent Rights from the cumulative impacts of water withdrawal and nutrient pollution (Globalanna 2020; FHQTC 2021a; FSIN 2021; Kurz 2021; Baldwin 2023).

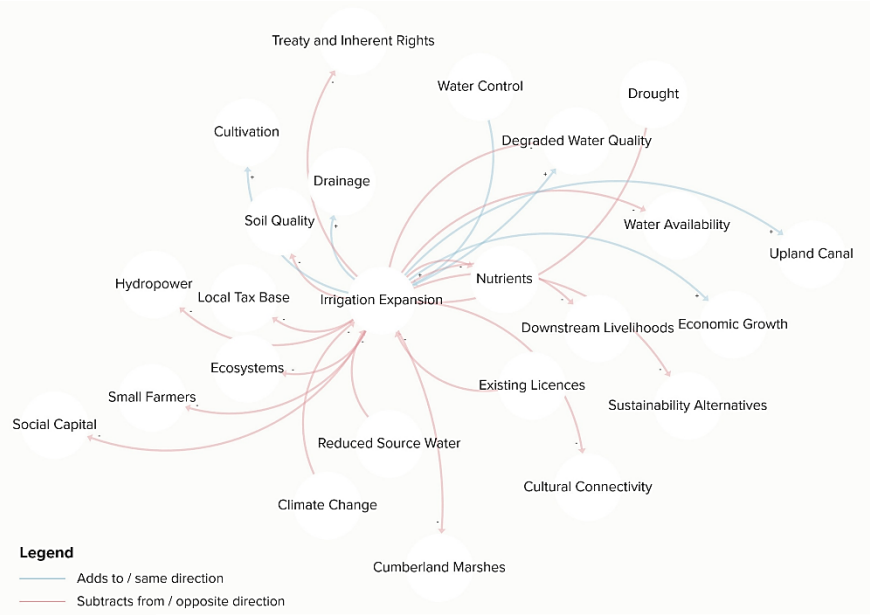


Figure 7.4. A causal diagram of direct positive (blue) and negative (red) associations with the irrigation expansion in the Canadian Prairies, focusing on the Qu'Appelle River with additional information from the South Saskatchewan River. Links between circles represent quotes from government, stakeholders, and Rights holders. The figure was created in Kumu (2025). The full causal diagram is Figure S7.4.

Table 7.3. Perceived risks of irrigation described by participants.

Proposal	Value	Anticipated Risk and Foreclosed Opportunity Hypotheses Based on Interviews and Workshops
Irrigation Expansion	Water Scarcity and Flow Alteration	▪ "It is going to impact the Saskatchewan River system, and…they're (Indigenous Nations) worried about the water supply coming down because they start destroying those [Cumberland] marshes and that's their livelihood, too." – Non-profit member in Lumsden ▪ "Is it feasible to go through all this work from an expansion standpoint to then only be allocated water for irrigation in two or three out of 10 years because of reduced water flow and allocations that have already been met." – Anonymous contributor
	Water Quality and Ecosystems	▪ "I think it's being used for so many things, like the pipelines, the mining, the potash, the agriculture. I think we're overtaxing it already as it is. What should we be using it for? I think a lot less than we are right now. We need to back off on it and try to let our water heal itself..." – Councillor from Pasqua First Nation ▪ "Water Security Agency and the provincial government are selling hydro off Lake Diefenbaker, so water that goes through the Qu'Appelle is really lost money. One economic consideration is the management of water for irrigation, for profit for hydro, for profit versus for sustaining ecosystems." – USask. Researcher ▪ "The latest proposal certainly will impact the environment because a lot of the land along the Saskatchewan River is native grasslands..." – Former government official
	Treaty and Inherent Rights	▪ "Those are our waterways right now and when you look at that, and you think the province are trying to add more and more projects, I don't think we're heading in the right direction, I think we're heading to a direction that's going to further decrease the quality of our water..." – Language Keeper of FHQTC-LRES ▪ "Maybe there's just a lack of freedom now to what you can do with the water, like to go swimming in that lake." – Language Keeper of FHQTC-LRES ▪ "It would affect everything in the spiritual or the cultural, or traditional…If you can't drink the water, then we can't have those ceremonies. We can't have the sweats, and we can't have any people fasting if the water is undrinkable." – Language Keeper of FHQTC-LRES
	Livelihoods	▪ "It rubs me the wrong way when, in terms of equality, there's not equal access to all farmers. You don't see very many small farmers putting up irrigation for instance and you don't see very many small farmers able to buy more land as time goes on…" – Agricultural producer near Saskatoon ▪ "It's not impacting the local employment because the people who are low skilled are not going to be hired, or if they are, they're hired in and continuing to be very low-skilled, marginally paid forms of employment…and it's not improving livelihoods because a livelihood analysis would say it's not just market earnings, it's people's ability to do non-market activities that improve their livelihood, which might be berry harvesting." – URegina researcher
	Local Market Viability	▪ "We're just operating on an extractive colonial model instead of trying to find sustainable ways of feeding ourselves that will keep us healthy and come up with a food sovereignty system that works for everybody, not just wealthy landowners." – Sask writer ▪ "I think the problem is the government only asked the irrigation districts whether they want more water and guess what the answer is. I've been really disappointed by what I've heard in terms of the value-added crops that we're supposedly going to grow…" – URegina researcher ▪ "[Industries] declare their taxes as corporations out of province, and also their employees, even if they're living here, are probably still declaring their profits …out of province. So, it doesn't actually benefit the tax base here, and then you have the local community taking all these risks." – URegina researcher

		▪ "A lot of canola is produced in Regina, but in a changed climate, canola prefers lower temperatures…our modeling indicates there may be many more days above 30 degrees in the future in the Regina area, so maybe they should be building those plants further north where canola is more likely to be growing..." – PARC member
	Sustainable Investment	▪ "I'm just not sure how if I was going to spend 4 billion dollars to make the Saskatchewan more sustainable, what's a good use of that money? Somebody said to me, you could spend $40,000 on each house putting in solar panels and retrofitting them to be more energy efficient…" – Hydrologic engineer ▪ "If you were doing the irrigation for small users that would have a huge impact – all agricultural small households, whose food prices have gone through the roof and helping them do gardening so that they can actually recover their household budgets. If that's where the water was going for irrigation and/or if it was going to water storage on land, and then having micro irrigation around it, that makes sense." – URegina researcher ▪ "If you divert water out of Lake Diefenbaker, you're not only reducing (hydro)power generated at Lake Diefenbaker, you are reducing power at all the downstream plants right down to Hudson Bay, so there's about 10 hydro plants there that all have reduced flows." – Hydrologic engineer

Table 7.4. Perceived risks of wetland drainage described by participants.

Proposal	Value	Anticipated Risk and Foreclosed Opportunity Hypotheses Based on Interviews and Workshops
Drainage	Water Scarcity and Flow Alteration	▪ "Even this summer, we're looking at drought throughout a lot of rural municipalities in Saskatchewan. How many wetlands were destroyed? That caused a lot of this drought. Trees [as well] are such an important piece of our environment. They cool the land and wetlands absorb carbon." – Last Mountain Lake Stewardship volunteer ▪ "Farmers all level their fields and remove all the wetlands that when we get more extreme weather, which we're told is coming as a result of climate change, then rivers and water bodies, like Echo, Pasqua, and Katepwa, are going to fluctuate much more and that means property damage." – Agricultural producer
	Water Quality and Ecosystems	▪ "If they do that (drainage), they're going to kill all the animals, all the habitat of animals are going to be all gone. I'm sure there's a lot of animals that live off that water – all these little, small pools of water. If the drain them all there is not going to be many animals left. – Language Keeper of FHQTC-LRES ▪ "Our best water is coming from Lake Diefenbaker, and our second-best water is the water that comes over the hills, and so if they start the big irrigation project in around the Lake Diefenbaker and we do not have a wetland policy, we have no hope of ensuring water quality." – Calling Lakes Ecomuseum member
	Treaty and Inherent Rights	▪ "It (water quality degradation) affects our right to fish, hunt, and our traditional practices because once the water is damaged, we can't use it because it will affect us, and it affects our right to have animals." – Language Keeper of FHQTC-LRES ▪ "I think there's certainly going to be continued lack of respect. I certainly would not go out there and say that I went to fish today because are the fish going to be clean?" – Language Keeper of FHQTC-LRES

Agricultural producers and associations also described the benefits of wetland drainage. Drainage is described by agricultural producers as a tool to increase yields and steward agricultural land because reducing small ephemeral wetlands in potholes makes cultivation easier with fewer tractor emissions. A representative of the Saskatchewan Farmers' Stewardship Association described the challenges to producers of holding back water and the benefits to downstream communities and aquatic ecosystems of drainage networks:

> We have these drainage networks that are holding back water, reducing flooding, reducing those peak flows, and we have landowners that are waiting 10 days to two weeks to get on their landscape in the spring or they're actually like experiencing crop loss because they're holding back water mid-season if they have to and they're doing that to protect their farm, but also their communities, and their neighbors and downstream.

Participants described how water stewardship through drainage can lower farming emissions, improve soil quality, reduce flooding, support cultivation, and improve efficient nutrient application. Overall, agricultural producers and associations described the benefits of drainage and drainage networks to their livelihoods, downstream neighbours, and flood mitigation.

Concern about unregulated drainage of small agricultural wetlands has been expressed by non-governmental organizations, Indigenous Nation representatives, and academics. A Saskatchewan writer spoke of the services that small wetlands provide for the prairies and why they should be protected:

> Prairie people don't realize how rare it is to live in a landscape that was pockmarked by hundreds of 1000s of beautiful, small wetlands. That dimpled landscape of the glaciated northern Great Plains is quite rare on the planet. This is one of the greatest spots on earth for small wetlands and the rich diversity that those wetlands offer, but we have spent probably nearly a century getting rid of that water as fast as we can instead of letting it naturally move from land into the groundwater systems and flow into springs and streams naturally and go through a natural evaporation process, which creates local weather systems that provided the right amount of rainfall in some years, most years. Instead of that, we're swiftly removing water from the land as fast as possible and destroying the natural processes, such as the management systems that beavers would on their own provide in slowing water down and helping it to percolate into the soil and feed the

> groundwater…I get it that if we're going to have cropping agriculture you can't have as many wetlands as we perhaps had historically on the open prairie, but when we've turned an entire region of Canada into an agricultural sacrifice zone for exporting commodities, instead of growing healthy food, we're now just growing commodities for an export market.

Collectively, wetland drainage is described by participants as potentially increasing water scarcity and hydrologic alteration, damaging water quality and ecosystems, and affecting Treaty and Inherent Rights (Table 7.4, Figure 7.5). Specifically, concern was expressed about groundwater recharge, a RAMSAR bird sanctuary at Last Mountain Lake, water availability for the Calling Lakes, soil salinity, downstream farmer livelihoods, nutrient run-off, wetland carbon sequestration, and further water quality degradation (Figure 7.5). Critics of drainage have proposed a comprehensive wetland protection strategy because of past and expected future cumulative losses to migratory bird habitat, biodiversity, and carbon sinks, among others (Ritchie 2023).

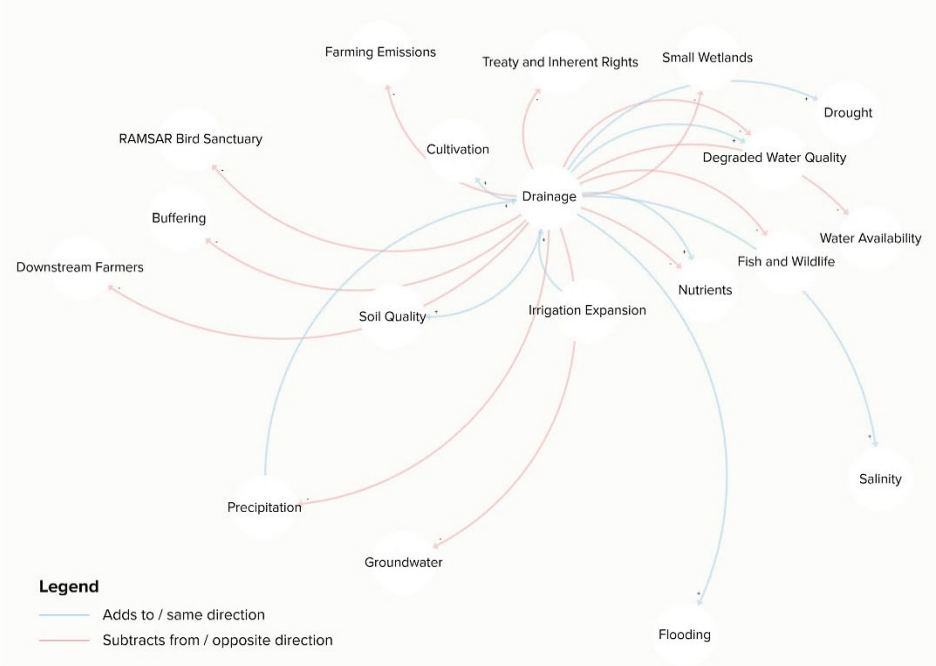


Figure 7.5. A causal diagram of direct positive (blue) and negative (red) associations with drainage in the Canadian Prairies, focusing on the Qu'Appelle River with additional information from the South Saskatchewan River. Links between circles represent quotes from government, stakeholders, and Rights holders. The figure was created in Kumu (2025). The full causal diagram is Figure S7.4.

7.4.1.3 Alternatives to the Current Trajectory

Participants identified several possible alternatives to the current irrigation and drainage trajectory that could potentially support regional sustainability. These included scenarios in which new conditions were applied to existing projects and scenarios featuring other approaches that could be implemented to strengthen the region's social-ecological systems, including entirely new uses of limited water resources (e.g., potash mining, urban development), or evaluation of the null option of a future without any new water-centred projects. For example, participants mentioned conditions on agricultural producers to use the most efficient irrigation technologies and optimal nutrient application strategies and conditions on drainage to prioritize permanent wetlands over ephemeral wetlands and compensate producers for wetland and grassland preservation, similar to strategies employed by Alberta and Manitoba. Along with conditions on existing water development, participants suggested alternative adaptation strategies that could benefit the sub-basins, such as micro-irrigation projects suitable for small farms or rural households, preservation of water for hydropower, solar and wind farms to offset energy losses from reduced lost hydropower production, and block grants for Indigenous Nations' self-determination in their sustainable development. A University of Regina researcher said:

> If you were doing the irrigation for small users that would have a huge impact – all agricultural small households, whose food prices have gone through the roof and helping them do gardening so that they can actually recover their household budgets. If that's where the water was going for irrigation and/or if it was going to water storage on land, and then having micro irrigation around it, that makes sense.

Similarly, a hydrologic engineer in Saskatoon said,

> If you divert water out of Lake Diefenbaker, you're not only reducing (hydro)power generated at Lake Diefenbaker, you are reducing power at all the downstream plants right down to Hudson Bay, so there's about 10 hydro plants there that all have reduced flows.

Ultimately, given the unavoidable need for climate adaptation, some actions are likely required for current projects, project conditions, and alternatives to be further evaluated.

7.4.2 Test of Regional Sustainability Criteria

In evaluating irrigation and drainage in the Qu'Appelle and South Saskatchewan, application of the six context-specific, flow-based criteria from Chapter 6 is a potentially viable

approach to evaluate the sustainability of irrigation and drainage but require further refinement to present a platform that offers net sustainability gains in the present and into the future (Pope et al. 2004; Bond et al. 2012; Gunn and Noble 2015). The definitions for these criteria from Chapter 6 are presented in Table 7.2, and a synthesis of indicators and main considerations from qualitative and supportive hydro-ecological analysis are displayed in Table 7.5. Applications of all sustainability criteria individually and taken together are likely to reveal associated trade-offs, suggesting a need for greater consideration and assessment of both projects and their alternatives.

Table 7.5. Perceived regional vulnerabilities and trade-offs (benefits and risks) described by participants for irrigation and drainage in the Qu'Appelle and South Saskatchewan sub-basins categorized into sustainability criteria. Alternatives are discussed under benefits and risks.

Sustainability Criteria	Regional Vulnerability	Perceived Benefits of Irrigation and Drainage	Perceived Risks of Irrigation and Drainage
1) Improvement of Water and Native Grasslands for Sufficient Quality and Quantity	- Regulated, yet variable, hydrology in the Qu'Appelle River with extreme flood years and droughts. - Impairment of water quality in the Qu'Appelle does not meet CCME guidelines. -Fluctuations in Lake Diefenbaker levels.	- Qu'Appelle upland canal infrastructure for irrigation will convey higher quality water and reduce erosion and sediment transport to Buffalo Pound Lake, cities, and potentially further downstream. - Expanded wetlands and native habitat from westside and Qu'Appelle upland irrigation canals. -Drainage networks facilitate flood management and farm stewardship. -Fewer cultivation emissions from more efficient farming.	- Low flows in Saskatchewan River Delta. - Fluctuations in the Calling Lakes because of climate change and wetland removal from drainage. - Concern about water quality for the water treatment plant at Buffalo Pound Lake. - Losses to biodiversity, habitat, groundwater replenishment, carbon sequestration, and local weather systems from wetland and grassland removal. - Irrigation and drainage together may prevent the conveyance of higher water quality because of continued diffuse sources of nutrient pollution. - Inability of water to heal itself from legacy pollutants.
2) Lasting Upstream-Downstream Livelihood Opportunity and Access	- Losses to Treaty and Inherent Rights, homes, recreation, tourism and in downstream waters from degraded water quality and flooding.	- Growth and revitalization of rural population in irrigated areas. - Support local, national, and international food markets. - Irrigation revenues to federal and provincial governments. - Support local agricultural livelihoods through irrigation and drainage. - Tourism development upstream in irrigated areas and downstream if water quality improves - Employment opportunities for local residents and Indigenous peoples. - Irrigation canals also supporting potash, canola crushing, and straw biomass plant development	- Irrigation may benefit corporate farms, whereas small producers will not have access to benefits. - Limited benefit to non-market activities (e.g., berry harvesting) if current agri-chemical application and poor water quality continue downstream. - Potential hiring bias away from low-skilled local individuals. - Potentially no benefit to local tax base because of water withdrawal (potash, canola, straw biomass plants) companies and employees declaring taxes out of province, but risks to local communities. - Movement away from a potential local food security system that supports micro-irrigation. - Unclear market demand for vegetables (e.g., corn, tomatoes).
3) Treaty-Informed Equity in Water and Land-Use Management	- No co-management, but existing legislation respects water quantity maintenance, not necessarily water quality management.	- Support for agricultural producer involvement in irrigation and drainage decision-making with the Water Security Agency through groups like the Saskatchewan Farmers Stewardship Association. -Development of Agricultural Water Stewardship Policy (drainage) with community input.	- Lack of self-determination and impairment of rights of Indigenous Nations if they are not at the decision-making table and water resources continue to be polluted from legacy nutrients and water level reductions. - Potential water damage from irrigation and drainage poses a risk to the infringement of Treaty and Inherent Rights in the Qu'Appelle and South Saskatchewan sub-watersheds.
4) Shared Watershed Identity through Learning, Openness, and Transparency	- Abandonment of watershed and source water protection plans. -Conflict over Lake Diefenbaker water uses.	- Movement towards regional water advisory groups through the creation of the Saskatchewan Association of Watersheds that may unite players involved in irrigation and drainage.	- No clear relationship building between Indigenous Nations, agricultural producers, and watershed groups because of limited watershed planning, communication of development plans, and transparency on irrigation and drainage (FHQTC 2021a; FSIN 2021; Quon 2024).
5) Respect Climate and Water Uncertainty by Preparing to Mitigate and to Adapt for Seven Generations	- Climate model simulations using greenhouse gas emission scenarios described by researchers and independent consultants show a high likelihood of future dry conditions in the Canadian Prairies.	- Prairie agricultural climate adaptation strategy based on water development. - Irrigation revenues support sustainability initiatives in the future. - Drainage networks that support agricultural producer stewardship. - A thriving Saskatchewan economy that benefits future generations.	- Less water allocated for irrigation permits in low flow years and when existing entitlements need to be met. - Current locations of canola crushing plants may not be align with future climate variability and optimal canola growth areas. - Reduction of water flows to support hydropower of ~10 plants down to Hudson Bay. - Potential movement of revenues away from renewables in the immediate future because of investment in irrigation infrastructure and hydropower rather than alternatives– e.g., solar panels and energy efficient household retrofitting.
6) "Enough, For All, Forever"	- Difficulty achieving sustainability.	- Economic gains with some benefits to the environment and livelihoods.	- Potential losses to the core asset base of downstream ecosystems and communities.

7.4.2.1 Sustainability Criterion #1: Improvement of Water and Native Grasslands

Consideration of criterion one and indicators (Table 7.1) suggests some movement towards water quality restoration and flood management as conditions of irrigation and drainage, at the expense of losses to native grasslands and water flows and quality because of adverse cumulative impacts (Table 7.5). There are expectations from some research participants of greater water allocation from irrigation canals to improve water quality to Qu'Appelle's Buffalo Pound Lake and the water treatment plant that services the cities of Regina and Moose Jaw (27.9% of Saskatchewan residents) (Statistics Canada 2021; Buffalo Pound Treatment Corporation 2025). Terry et al. (2022) report that greater diversion of water from Lake Diefenbaker would improve water quality parameters, especially if water is transferred in dry years when local runoff is minimal. However, study participants also expect cumulative adverse environmental and other impacts of withdrawal and drainage further downstream in the South Saskatchewan and Qu'Appelle sub-basins related to low flows, water level fluctuations, and continued diffuse nutrient pollution. There also appear to be lost opportunities to restore native grasslands and water bodies impaired from cultivation and legacy pollutants. New information about irrigation and drainage issues point to further refinement of this criterion to increase applicability to grasslands, unique waterways, and restoration strategies. This includes specification of native prairie grassland habitat criteria requirements and effects and specifics of the unique landscape of the Saskatchewan River Delta that includes the Cumberland Marshes (Jardine et al. 2023). For the Qu'Appelle River, restoration could include creating a river with a set spring-summer baseflow regime (~9 m^3/s), supported by the new upland canal infrastructure. However, this may be an oversimplification because of the influence of wet and dry years, the risk of hydrologic forcing causing high nutrient delivery, and the notion that hydrology only accounts for a portion of variance explaining water quality degradation, both nutrients and algal blooms (Hall et al. 1999; Mccullough et al. 2012; Vogt et al. 2018). Therefore, a suite of management interventions are needed, including prescribed flow regimes, run-off management, and strategies to remove legacy pollutants and internal phosphorus loading that is triggered by low oxygen conditions (Horne et al. 2017a; Bestgen et al. 2020; Tonkin et al. 2021). Ultimately, this sustainability criterion needs adjustment to emphasize multiple restoration strategies for improvements to water quality and native grasslands.

7.4.2.2 Sustainability Criterion #2: Lasting Upstream-Downstream Livelihood Opportunity and Access

Criterion two and indicators (Table 7.1) show support for upstream large farmers and rural revitalization through irrigation and drainage projects but fewer opportunities for small farmers and downstream livelihoods (Table 7.5). Participants in this study and economic analyses suggest that the Lake Diefenbaker Irrigation Expansion will support rural revitalization and farmers' livelihoods, offer short-term employment for First Nations, generate revenues from crop diversification at local and national scales, and enable future investment in sustainability-based initiatives from increased revenues (Saskatchewan Irrigation Projects Association 2009; Clifton Associates 2012; Lindenschmidt et al. 2020). However, these analyses have recently been challenged by economists who suggest governments worldwide overestimate benefits, the monetary cost of the irrigation expansion will exceed anticipated revenues, and only 50 agricultural producers (34,128 farms in Saskatchewan in 2021;Government of Canada 2021) in the region will benefit (Geoff 2024). Irrigation is also anticipated to support other developments, like potash, canola crushing, and straw biomass plant development. Drainage is expected to improve producer livelihoods with greater crop yields and more efficient farming practices. However, downstream revitalization, tourism, and Indigenous livelihoods are contingent on water quality improvement and flow maintenance, which was an uncertainty expressed by participants. Therefore, criterion two suggests that local benefits are expected but uncertainties prevail downstream. Overall, criterion two supports an investigation of market demand and proximate producer and First Nation livelihoods, but there is a need for inclusion and substantiation of revenue flows and benefits to local and downstream institutions and communities in this category. Participants in this study suggested equity should extend to evaluating benefits to small farmers, impacts to rights-based livelihoods (e.g., berry harvesting and fishing), transparency on future crop diversification and viable markets, benefits to the tax base of Saskatchewan, efforts to ensure rural and urban residents have control over their food systems and household budgets, and determining if there would be greater benefits from immediate investment in sustainability-based initiatives.

7.4.2.3 Sustainability Criterion #3: Treaty-Informed Decision-Making

Criterion three and indicators (Table 7.1) highlight agricultural organization and producer involvement in irrigation and drainage planning, but limited involvement and decision-making

authority for Indigenous Nations (Table 7.5). This criterion points to procedural justice through regional advisory councils and Indigenous authorities in co-manager roles (as described in for Chapter 4 for regional readiness). Procedural environmental justice emphasizes fair and equitable decision-making that recognizes that decisions that alter the environment are generally made by those who enjoy the benefits rather than the costs (Bell and Carrick 2017; Menton et al. 2020). In the case of the Qu'Appelle River Valley, pristine waters are upstream in Lake Diefenbaker, whereas nutrient-rich waters occur downstream where First Nations people reside (Leavitt et al. 2006; Vogt et al. 2018). Existing vulnerabilities pose a risk to Treaty Four rights, including the right to hunt, fish, and trap (Government of Canada 1966). As described by Rights holders, involvement at decision-making tables for irrigation and drainage has been minimal or absent despite the possibility that downstream First Nations will bear the brunt of hydrologic alteration and diffuse nutrient pollution. Management interventions described under criterion one could be based on adequate water quality and quantity entitlements for Treaty and Inherent Rights (Macpherson et al. 2018; Robison et al. 2018). Considering First Nation knowledge, water data, and stakeholder perspectives in this study, it is apparent that water management in the Qu'Appelle and South Saskatchewan sub-basins should reflect both measured natural science information and lived experiences and oral history in the watershed (Johnson 1992; Kovach 2011; Johnson et al. 2016). This criterion could be refined to describe required roles of upstream and downstream actors in decision-making and develop an indicator of infringement of Treaty and Inherent Rights.

7.4.2.4 Sustainability Criterion #4: Shared Watershed Identity

Criterion four and indicators (Table 7.1) emphasize challenges with communication of irrigation and drainage plans and a need for programs to enable more openness and transparency (Table 7.5). This criterion provides an opportunity to consider steps beyond an evaluation of impacts that could enable the fulfillment of sustainability criteria and address gaps in impact assessment (Lajoie and Bouchard 2006; Kwiatkowski et al. 2009; Escott et al. 2015; Udofia et al. 2017). Some participants remarked that the recent creation of the Saskatchewan Association of Watersheds (SAW) could provide a platform for greater communication, learning, and transparency between government partners, stakeholders, and Rights holders. The SAW offers programs and initiatives related to agricultural beneficial management practices, climate change adaptation, hydrologic drought response, landscape biodiversity, aquatic invasive species, and

education, among others (Saskatchewan Association of Watersheds 2025). For irrigation and drainage, environmental non-governmental organizations and Rights holders noted a need for greater communication and transparency (FHQTC 2021a; FSIN 2021; Quon 2024), potentially facilitated through a return to an active watershed planning process, as noted in Chapter 5 as an opportunity and justification for barriers. The relationship between existing water use and licencing conflict in Lake Diefenbaker and irrigation and drainage development is one example of complex issues for which better monitoring data needs to be developed and shared (Chilima et al. 2021). This criterion could be refined to detail steps towards conflict mitigation and relationship building in light of challenges with transparency from upstream to downstream.

7.4.2.5 Sustainability Criterion #5: Water and Climate Adaptation for Seven Generations

Sustainability criterion five and indicators (Table 7.1) suggest that insufficient precaution has led to compounding effects of climate and water uncertainty and resulting losses downstream. The precautionary principle refers to "when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically" (Kriebel et al. 2001, p. 871). Participants spoke of irrigation and drainage supporting a thriving economy that is in line with Saskatchewan's growth plan (Government of Saskatchewan 2020b). The current model for adaptation to climate change is potentially focused on economic and food security adaptation, rather than water adaptation, through support for irrigation and drainage. However, as shared in interviews and workshops, water management and climate adaptation need to be combined. Water scarcity, exacerbated by irrigation and drainage, may affect water distribution in unexpected ways, such as low flows in the South Saskatchewan and Qu'Appelle rivers, low water levels at Lake Diefenbaker, water licence entitlements and future irrigation demands not being met, ideal locations for canola biomass plants becoming unsuitable, and reductions in hydropower production, that may challenge Saskatchewan's growth model (Table 7.5). As such, this further elaboration of this criterion, climate change mitigation and adaptation for seven generations, could include more attention to the most efficient water uses and development locations that support long-term water demand and capacities to adapt to climate patterns together. Water efficiency was not a key theme mentioned by participants in Chapter 6, but considering new information about irrigation and drainage, efficient water use should be

included as an indicator for this criterion to consider both water and climate adaptation and their overlap.

7.4.2.6 Sustainability Criterion #6: "Enough, for All, Forever"

The trade-offs from the perceived costs and benefits of water withdrawal and drainage suggest a breach of the place-based sustainability criteria (Table 7.5). Both irrigation and drainage projects are advocated as having many social, economic, and ecological benefits, but participants are concerned the cumulative effects of water use and pollution may foreclose benefits to, and opportunities for, the environment, culture, rights, and the economy. Speaking about long-term sustainability, a University of Regina researcher summarizes their concern about current and proposed water development.

> The key thing is in the future of tremendous uncertainty projects will come and go, but if the core asset base of the community and the social capital and the cultural connectivity and all that, if that has been diminished, then, of course, whatever other projects get approved in the future, you've got this ongoing decline, right?

Development trajectories are described as potentially affecting the "core asset base" of the environment and community over time. More research is needed to define sub-categories and indicators for each criterion based on the full suite of values of watershed residents. This next step could make these criteria more accessible to impact assessment practitioners.

7.5 Discussion

7.5.1 Key Regional Sustainability Considerations

While benefits are expected from the proposed expansion of irrigation and drainage projects, reports and interviews also identify concerns that need to be better considered in decisions about the sustainability of these water developments. Promotional reports offer assertions about the many benefits to the economy, society, and downstream ecosystems of irrigation (Saskatchewan Irrigation Projects Association, 2009, Volume 2, p. 122); however, the potential adverse effects of the proposed projects are less clear and well-studied. Although reductions to water levels and hydropower production in the South Saskatchewan River are predicted effects of the proposed irrigation projects (Hassanzadeh et al. 2014; Leavitt 2021), the combined impacts of irrigation and drainage are less direct or clear for the Qu'Appelle River sub-basin, although greater water level fluctuations and further water quality degradation may be

expected due to changes in runoff and nutrient pollution (Leavitt 2021; Ritchie 2023). Similarly, while the Qu'Appelle River receives water from Lake Diefenbaker, as well as snowmelt and runoff from its own catchment (Haig et al. 2021), these processes may be affected by the cumulative impact of the proposed new drainage projects and climate change. In contrast, increased water conveyance from the proposed upland canal infrastructure may mitigate these impacts and improve water quality (Lindenschmidt and Carstensen 2015; Lindenschmidt et al. 2020) if irrigation, new potash mines, and nutrient runoff are also managed effectively through licensing and policies that favour improved nutrient stewardship. Given the uncertain outcome of water developments in the South Saskatchewan and Qu'Appelle catchments, there is a need to evaluate whether or to what extent the cumulative effects of the proposed projects will further infringe on downstream Treaty and Inherent rights and what project alternatives might offer greater protection (Robison et al. 2018; BCSC 1287 2021; Simmons 2021).

7.5.2 Test of Regional Sustainability Criteria

We defined sustainability criteria based on Rights holder and stakeholder visions for water in Chapter 6 and qualitatively tested these criteria in this study. In applying the sustainability criteria to the Qu'Appelle and South Saskatchewan, it is apparent that overall benefits and risks associated with water developments fail to satisfy the six context-specific sustainability criteria. Also, while this test and application of the sustainability criteria demonstrated that they constitute a useable platform to evaluate vulnerabilities and trade-offs of irrigation and drainage, the test also indicated that refinement of the criteria could be advantageous. Based on participants' impression of irrigation and drainage, ways to refine criteria include focusing on irrigation and drainage effects trade-offs on native grassland habitat and the Saskatchewan River Delta and emphasis on restoration strategies, revenue flows, decision-making roles of downstream actors, conflict mitigation, relationship building, efficient water use, and more. However, application of the sustainability criteria to the Qu'Appelle and South Saskatchewan rivers has served as a useful case study to highlight the insights that can result from applying sustainability assessment to irrigation and drainage in these watersheds and other Canadian contexts (Gibson et al. 2005b; Gibson 2017).

7.6 Conclusion

This study offers an example of a test of the alignment between co-created, context-specific sustainability criteria and irrigation and drainage projects. For our case study, the Canadian Prairies' Qu'Appelle and South Saskatchewan River sub-watersheds will be experiencing costs and benefits of irrigation and drainage projects, layered on existing stressors of eutrophication and climate change. We identified perceived benefits of water development, but also the concerns of study contributors about the cumulative impacts of the anticipated withdrawal and drainage projects, including influences on the conveyance of sufficient clean water downstream and implications for water quality and ecosystem function, the preservation of Treaty and Inherent Rights, impacts on market and non-market livelihoods, and constraints due to imposed inattention to more sustainability-enhancing alternatives. Despite a need for continued refinement of sustainability criteria related to irrigation and drainage, these criteria offer a platform for deliberations on ecosystem restoration, downstream equity, procedural justice, and climate adaptation. In this way, context-specific sustainability criteria should be applied in other watersheds in Canada subject to water development that pose risks to water consumption and contamination (Schindler et al. 2012; WWF-Canada 2017; Mahdiyan et al. 2021). This study also demonstrated that the perceived and hidden risks of developments described by Rights holders and stakeholders should be given more attention in impact assessments and management processes (Slovic 2016). Future development and application of criteria for sustainability-based evaluations could involve comparing alternatives for regional-scale land and water management, including strategic planning and regional assessment response options (Gibson et al. 2020). A step in this direction could support a governance regime that is credible and delivers positive contributions to sustainability and Indigenous rights.

7.7 Transition

Chapters 6 and 7 proposed sustainability criteria for water development and then tested those criteria (Figure 7.6). The final co-authored chapter (Ch. 8) builds on these two preceding chapters to suggest regional response options and key underlying programs for the assessment of irrigation and drainage to support collaborative water governance. These regional options and programs were developed to support sustainability criteria that protect water for the environment and rights. Chapter 8 also evaluates the degree to which these programs are already being delivered through government initiatives.

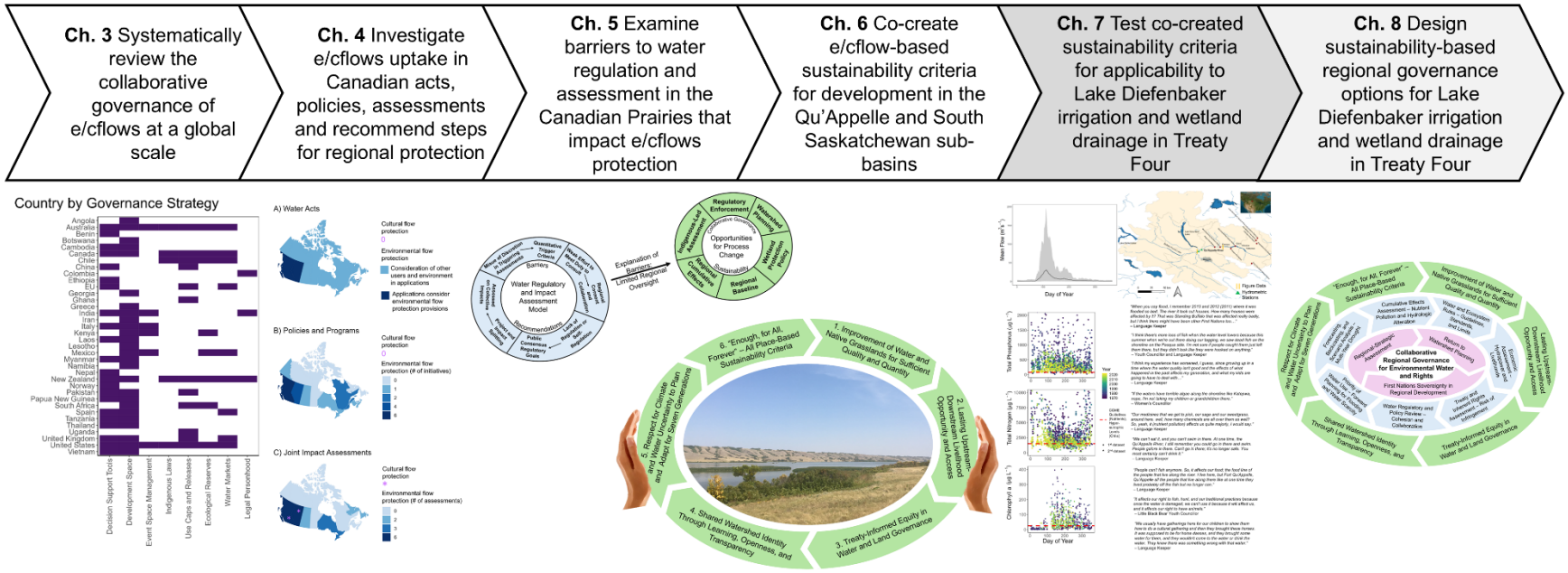


Figure 7.6. A roadmap diagram showing the transition from Ch. 7 to Ch. 8 objectives. E/cflows refers to environmental and cultural flows.

CHAPTER 8. REGIONAL COLLABORATIVE GOVERNANCE FOR IRRIGATION AND DRAINGE IN THE CENTRAL CANADIAN PRAIRIES TO SUSTAIN WATER FOR THE ENVIRONMENT AND RIGHTS

8.1 Overview

Watersheds in the Canadian Prairies (Qu'Appelle, South Saskatchewan) will be experiencing costs and benefits from the Lake Diefenbaker Irrigation Expansion and the Government of Saskatchewan's Agricultural Water Stewardship Policy, layered on existing stressors of eutrophication and climate change. Focusing on the Qu'Appelle River, with information from the South Saskatchewan River, we undertook a case study with elements of action research to identify what regional-scale collaborative water governance responses are needed and what initiatives (i.e., policies, plans, and programs) are occurring for water abstraction (the Lake Diefenbaker Irrigation Expansion) and agricultural wetland drainage projects (Agricultural Water Stewardship Policy). We evaluated if existing initiatives, as a package, could deliver effective regional-scale land and water outcomes in the absence of a regional-scale collaborative governance structure. We spoke with 55 people (government, stakeholders, and Rights holders) through interviews and workshops and analyzed 25 government and consultant documents – programs and technical reports. Regional-scale options nested under a collaborative water governance model identified by participants included a return to watershed planning, regional-strategic assessment, and First Nations sovereignty in regional development. Applying a framework of desired governance initiatives and sustainability criteria, we found a mismatch between available governmental program information and what is needed for regional water sustainability and collaborative decision-making with stakeholders and Rights holders. Existing programs and reports (external to impact assessments) present economic and hydrologic analysis for the Lake Diefenbaker Irrigation Expansion project and a benchmark for wetland retention and adaptive policy review for the Agricultural Water Stewardship Policy. However, there is little attention to water use priorities, cumulative effects, and Treaty and Inherent Rights assessments which First Nations, non-governmental organizations, and researchers identify as needed.

8.2 Introduction

Highly developed and degraded water bodies and ecosystems should be governed and evaluated at a regional catchment scale to protect ecosystems and Treaty and Inherent Rights. Collaborative regional water governance, that supports stakeholders and Rights holders in creating consensus on policies and programs (Harrington 2017; Sultana 2018), requires an understanding of "trends, rates of change, tipping points, safe operating spaces, and pre-impact conditions" (Dearing et al. 2015, p. 220). Decisions (related to policies, plans, programs, and projects) are often made by institutions at a scale that might not match the ecological, social, or rights-based feature (watershed or landscape) in question, in part because these considerations have different boundaries (Epstein et al. 2015; Herse et al. 2020). This leads to losses in natural resources, human well-being, and Indigenous rights because of scalar and institutional mismatches (Cumming et al. 2006; Epstein et al. 2015). Instead, regional collaborative approaches that have congruence with the ecological, social, and/or rights-based boundaries can offer more effective management solutions (Folke et al. 2007; Epstein et al. 2015). Collaborative regional water governance can be supported through shared planning, and impact assessment options (Harmsworth et al. 2016).

In Canada, there is a pressing need for collaborative regional water governance that can transform institutionalized policies and practices (Granberg et al. 2019). Canada is experiencing water degradation and scarcity at watershed levels (Schindler et al. 2012; WWF-Canada 2017, 2020; Mahdiyan et al. 2021), Indigenous Rights infringements across Treaty territories (Simmons 2021), fragmented governance across multiple scales (Bakker and Cook 2011), and a desire to reach local to global sustainability goals while pursuing multiple regional developments (Gibson et al. 2020). These challenges threaten the protection of water for the environment (environmental water/flows) and rights (cultural water/flows) (Horne et al. 2017d). There is a need to democratize water and environmental sustainability governance in Canada for reconciliation, environmental protection and community wellbeing through shared decision-making between Crown and Indigenous governments (Clogg et al. 2017; Phare et al. 2017; Wilson 2020). Regional-scale governance is a means to address these issues through collaborative arrangements that apply an understanding of cumulative impacts and are committed to sustainability. Regional governance requires collaboration and coordination at linked regional and local levels with Indigenous Nations to democratize water governance and

enhance effectiveness and efficiency (Reo et al. 2017; Sultana 2018; Herse et al. 2020). Similarly, the cumulative effects of multiple developments and stressors cannot be adequately investigated at the level of individual development projects and should instead be considered at regional scales (Therivel and Ross 2007; Foley et al. 2017; Sinclair et al. 2017). Lastly, striving towards sustainability in land and water governance requires a regional lens to understand how to avoid risks and maximize benefits across impacted social-ecological systems (Gibson et al. 2020).

Political will and capacity for collaborative regional water governance need to be supported by understanding the essential features and programs that support regional sustainability. In the absence of formal planning and assessment options at the regional level, there is a need to evaluate whether existing programs and initiatives can substitute for regional planning, and/or impact assessment processes. Equally important is investigating how to enable these initiatives and formal regional-scale collaborative governance response options, including by determining whether they can deliver changes that meet context-specific sustainability criteria (Gibson et al. 2005b). Some common initiatives and programs under assessment and planning include future thinking and thresholds for evaluating effects and risks, culture and rights assessments, and cumulative effects assessment, among others (CCME 2009; Dubé et al. 2013; Clogg et al. 2017; Blakley et al. 2020; Gibson et al. 2020). Collaborative regional e governance that combines these initiatives or individual independent initiatives may not occur in many instances because of low political will and issues with funding and capacity building (Sheelanere et al. 2013; Udofia et al. 2017; Nyboer et al. 2021). However, there is a need to determine the links among current initiatives, policies, programs, and their consequences to understand their individual strengths, weaknesses, gaps, and redundancies, that would enable assessment of matches or mismatches between policies/programs and the desires of Rights holders and stakeholders (Cumming et al. 2006; Kishchuk et al. 2018; Nyboer et al. 2021). This understanding can help decision makers allocate funding and build capacity for appropriate initiatives to address new developments and regional change in mutually supporting ways.

To investigate these matters, we explore the policy context and potential for existing and new collaborative regional governance for irrigation, drainage, and other water withdrawal developments in the Canadian Prairies' Qu'Appelle and South Saskatchewan sub-watersheds. The Canadian branch of the World Wildlife Fund describes these watersheds as highly stressed

because of, for example, climate risk, poor water quality, and water scarcity (Sauchyn et al. 2016; WWF-Canada 2017, 2020; Vogt et al. 2018).

The Lake Diefenbaker Irrigation Expansion (water abstraction) and the Agricultural Water Stewardship Policy (drainage) are the focus here. The Lake Diefenbaker Irrigation Expansion is a $4 billion proposed project to expand irrigation canals at the Gardiner Dam (South Saskatchewan River) and Qu'Appelle Dam (Qu'Appelle River) at Lake Diefenbaker (Glover 2020). The Agricultural Water Stewardship Policy is a policy to facilitate the drainage of small and ephemeral wetlands on agricultural land through producer drainage networks (WSA 2023a). For both initiatives, concern has been expressed about adverse cumulative consequences: losses to water quality, water availability, biodiversity, wildlife habitat, and Treaty and Inherent Rights (Leavitt 2021; Ritchie 2023). However, limited evaluation of these regional risks through assessment and planning has occurred as described in chapters 5 and 7, in part because neither irrigation and drainage development have been designated for impact assessment, except for a potential designation for the third phase of the Lake Diefenbaker Irrigation Expansion (Impact Assessment Agency of Canada 2019a, 2021). As such, there is a need to consider collaborative regional water governance to maximize fairly distributed gains in the long-term and avoid negative consequences to diverse regional water and land values (Gibson et al. 2020).

To address these considerations, we undertook participatory qualitative research by interviewing government representatives and stakeholders, holding workshops with Rights holders, and evaluating current sustainability initiatives. Focusing on the Qu'Appelle River, and related conditions within the South Saskatchewan River, we set three main questions for this study. Our aim was to determine: 1) what collaborative regional governance response options and their elements are needed to move towards sustainability and equity in decision-making; 2) in the absence of formal integrated regional-scale governance, to what extent could existing individual governmental policies and programs provide an effective regional substitute; and 3) how might decision-makers enable better collaborative regional governance and/or supportive initiatives?

8.3 Methodology

This research relied upon a blend of case study and action research methodologies to examine water development and policy gaps in southern Saskatchewan and actionable

recommendations for regional governance (Hall and Smith 2000; Crowe et al. 2011; Vaughn and Jacquez 2020). This research methodology can be found chapters 2 and 5. The focus for this chapter from research questionnaires (Appendix B) was key directions and enabling factors for regional governance (primarily through regional assessment and planning options and initiatives) of the Qu'Appelle sub-watershed with information from the South Saskatchewan sub-watershed (Figure 8.1).

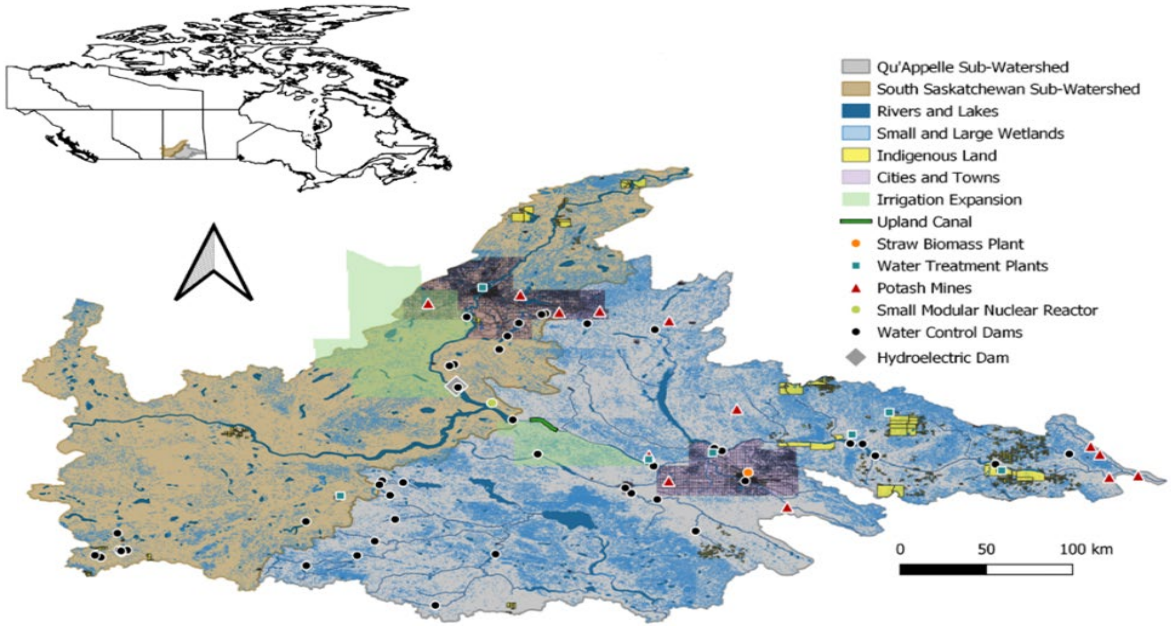


Figure 8.1. A map of the Qu'Appelle and South Saskatchewan sub-watersheds illustrating water development projects and small prairie wetlands. This map is from Chapter 6.3 (Fig. 6.1.).

Using NVivo (QSR International Pty Ltd. 2020), the lead author qualitatively analyzed interview and workshop information inductively (for emergent ideas) and then deductively (based on existing frameworks and definitions). Once the text was grouped into sub-themes related to formal regional governance processes, initiatives/programs under the umbrella of these processes, and enabling factors for regional governance processes, more deductive analysis was completed. Note that enabling conditions were only coded inductively. Deductive analysis for regional collaborative governance processes involved grouping response options mentioned by participants into processes that are well-defined in the literature and practice: watershed planning, regional-strategic assessment, and Indigenous sovereignty in regional development. In contrast, deductive analysis for programs under the umbrella of regional governance involved

coding into initiatives defined in Chapter 6 that could support context-specific sustainability criteria categories.

To investigate policy coherence between needed initiatives described by Rights holders and stakeholders and existing governmental policies and programs, we analyzed documents from Government of Saskatchewan ministries, agencies, and associated consultants. This was done by collecting documents purposively between April and December 2024 from government websites and through consultation processes attended by the lead author (Table 8.1). The focus was on ministry annual reports and strategies, as well as policies, plans, and technical reports specific to irrigation and drainage. A limitation of this study is that information is current to December 2024, but irrigation and drainage policies, plans, and programs will continue to evolve in the coming years. Through document analysis (Bowen 2009; Morgan 2022), we coded information into needed initiatives described by participants. Figures were created in QGIS and R.

Table 8.1. Government documents and technical reports purposively sampled and analysed.

Topic	*Policies, Programs, and Reports*
Irrigation and Water Abstraction	- Agricultural Services (N.D.) Agricultural and Irrigation Water Management Strategy. Accessed March 8, 2024. - Clifton Associates (2012) Upper Qu'Appelle Water Supply Project: Economic impact & sensitivity analysis. Accessed March 8, 2024. - Clifton Associates (2021) Lake Diefenbaker Irrigation Projects: Westside Irrigation Projects. Accessed March 8, 2024. - Government of Saskatchewan (2021) Water allocations. Accessed March 8, 2024. - Kulshreshtha S, Nagy C, Ana B (2012) Present and future water demand in the Qu'Appelle River basin. Accessed March 8, 2024. - KPMG (2024) Economic analysis: Westside Irrigation Rehabilitation Project. Accessed December 18, 2024. - Lindenschmidt K-E, Lloyd-Smith P, Razavi S, et al (2020) Hydrological and economic assessment of the Upper Qu'Appelle Water Supply Project. Accessed March 8, 2024. - Saskatchewan Irrigation Projects Association (2009) A Time to Irrigate. Accessed April 22, 2024.
Agricultural Water Stewardship Policy	- Ritchie E (2023) Bill No. 615 An Act respecting Comprehensive Wetland Conservation Policy. Accessed March 8, 2024. - Water Security Agency (2024) AGRICULTURAL WATER STEWARDSHIP POLICY Draft Indicators. Accessed November 26, 2024. - Water Security Agency (2024) Agricultural Water Stewardship Policy Indicators Monitoring and Reporting Framework (DRAFT). Accessed November 26, 2024. - Water Security Agency (2023) Framework for an Agricultural Water Stewardship Policy. Accessed November 26, 2024. - Water Security Agency (2017) What is the new Agricultural Water Management Strategy? Accessed March 8, 2024.
Higher-Level Government Programs	- Ministry of Agriculture (2023) Business Plan 2023-24. Accessed April 22, 2024. - Ministry of Agriculture (2024) Business Plan 2024-2025. Accessed July 29, 2024. - Ministry of Energy and Resources (2023) Business Plan 2023-24. Accessed April 22, 2024. - Ministry of Energy and Resources (2024) Business Plan 2024-25. Accessed July 29, 2024. - Ministry of Environment (2023) Business Plan 2023-2024. Accessed April 22, 2024. - Ministry of Environment (2024) Business Plan 2024-2025. Accessed July 29, 2024. - Water Security Agency (2019) Ahead of the curve: Strategic Plan for 2022-2026. Accessed March 8, 2024. - Water Security Agency (2023) Business Plan 2023-24. Accessed April 22, 2024. - Water Security Agency (2024) Business Plan 2024-25. Accessed July 29, 2024.
Supportive Documents	- Government of Saskatchewan (2024) Building for the future: Saskatchewan's Growth Plan - 2024 progress report. Accessed October 23, 2024. - Government of Saskatchewan (2020) Saskatchewan's growth plan: The next decade of growth - 2020-2030. Accessed October 23, 2024. - Prairie Water Directive (2009) A collective call to action for water security in the prairie provinces. Accessed September 1, 2023. - Water Security Agency (2012) 25 Year Saskatchewan Water Security Plan. Accessed December 18, 2024.

8.4 Findings

8.4.1 Assessment and Planning Response Options for Water Withdrawal and Drainage

The conceptual framework for collaborative regional water governance to protect water for the environment and Treaty and Inherent Rights in the Qu'Appelle and South Saskatchewan sub-basins developed from interview and workshop data is presented in Figure 8.2. This includes regional response options for irrigation and drainage, programs and initiatives that are key elements under those options, and sustainability criteria that are supported by these process options. Sustainability criteria are presented in Table 8.2. The co-creation of sustainability criteria is summarized in Chapter 6. Planning and assessment options and key initiatives to support collaborative regional governance and sustainability criteria are described below.

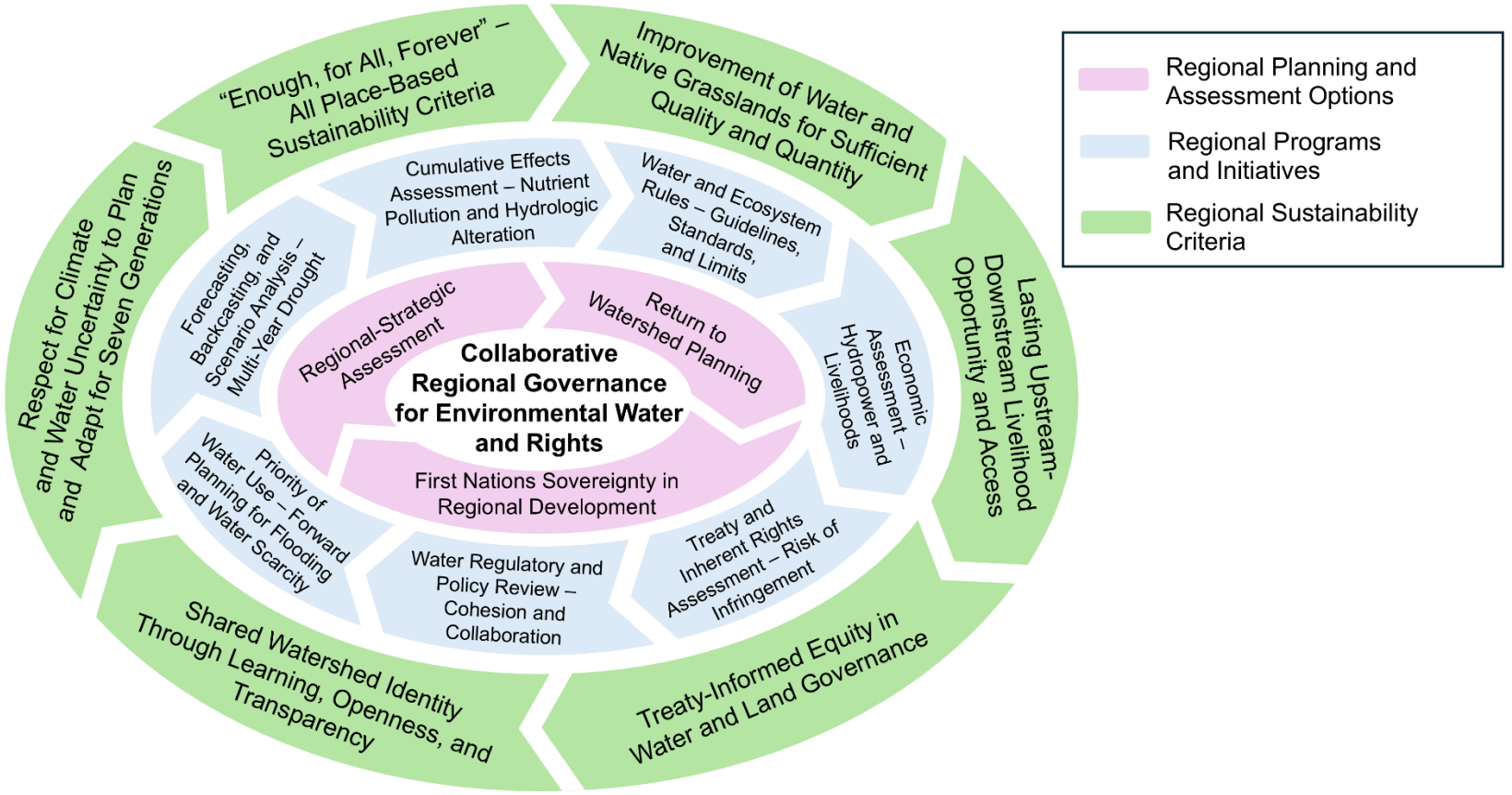


Figure 8.2. Collaborative regional water governance, regional planning and assessment options, supportive programs, and sustainability criteria. Regional sustainability criteria are from Chapter 6. Programs are aligned with sustainability criteria based on their co-occurrence in interviews and workshops; however, there is greater overlap than portrayed here.

Table 8.2. Definitions of sustainability criteria categories for water development in the Qu'Appelle and South Saskatchewan sub-watersheds informed by government representative, stakeholder, and Rights holder visions. Sustainability criteria were derived in Chapter 6.

Sustainability Criteria Categories	Definition
Improvement of Water and Native Grasslands for Sufficient Quality and Quantity	Improve the long-term integrity of freshwater quality and quantity, wetlands, grasslands and native pastures, and dependent people and rights by avoiding pollution, unnecessary drainage, and protecting against drought and flood extremes.
Lasting Upstream-Downstream Livelihood Opportunities and Access	Ensure equal livelihood opportunities (market and non-market) of upstream and downstream people and communities are supported in development trajectories and not limited in any way by impacts affecting the land and water.
Treaty-Informed Equity in Water and Land Governance	Support Treaty- and Inherent Rights-informed democratic water governance through a regional advisory council(s) that aims to reduce gaps (water quality, health, well-being, decision-making authority, and culture and rights practices) between upstream and downstream water and riparian users.
Shared Watershed Identity Through Learning, Openness, and Transparency	Build the shared identity and relationships of individuals, communities and Indigenous and provincial governments to apply sustainability principles to watersheds and grasslands through ongoing learning, openness, and transparency.
Respect Climate and Water Uncertainty to Plan and Adapt for Seven Generations	Mitigate and adapt for seven generations by favouring prairie adaptation and water development trajectories for sufficient agricultural resilience and land and water quality and quantity that supports Saskatchewan residents and improves the spiritual, cultural, environmental, social and economic conditions of Indigenous Nations.
"Enough, For All, Forever" – All Place-Based Sustainability Criteria	Work to meet all the context-specific, interdependent sustainability requirements in the short and long term by respecting water and land and seeking mutual well-being and enjoyment forever.

A collaborative regional water governance model for shared decision-making authority could be established through a coalition between Crown and Indigenous governance centres based in Treaty and Inherent Rights agreements that enshrine the right to pursue hunting, trapping, and fishing (Treaty Four for the Qu'Appelle and Treaty Six for the South Saskatchewan) (Figure 8.2). Collaborative water governance may involve formal co-governance agreements between two parties that then supports incorporation of the values of both parties in planning (co-planning), the operationalization of actions and responsibilities to fulfill co-defined goals (co-management), and evaluation of those actions and programs (impact assessment) (Harmsworth et al. 2016; Bourceret et al. 2021). A Councillor of Pasqua First Nation said:

> I think we need to be at that table, like I said before, as the decision-makers for any and all projects, because they all affect our land, water, and air. So not only just being as

> tokens at the table for information, I think we need to be at that table for the decision-making.

A non-profit member and researcher in the Calling Lakes said:

> Indigenous governments through a Treaty Four coalition or the Treaty-based land concept of the land, it's got potential. It's hard because you're talking about a big area. The different communities don't necessarily know it as a whole any better than farm communities, but it could build, and I think New Zealand has had some successes with the bicultural model with the Māori and the New Zealand governments, but it's a simpler system.

A Language Keeper of FHQTC-LRES spoke about "good governance to make good decision on waterways by Indigenous people." Participants mentioned that shared governance would start from a place of Treaty and Inherent Rights, require a common mandate or vision for the watershed, and build alignment between Western government agencies and Indigenous governments. However, contributors described that a shift to co-governance is challenging because of fragmentation between the provincial government, federal government, municipalities, and Indigenous government. Participants in the interviews and workshops spoke about how collaborative regional-scale water governance could be supported through a return to watershed planning, regional-strategic assessment, and First Nations sovereignty in management and impacts assessment.

8.4.1.1 Return to Strategic Watershed Planning and Source Water Protection

A possibility for greater oversight for water development is a return to watershed planning or source water protection plans. Watershed planning describes approaches to protect water quality and quantity in delineated catchment boundaries (Green and Alby 1997; Agriculture and Agri-Food Canada 2020). This may fall under integrated water management, which is "a continuous adaptive process of managing human activities and ecosystems at the watershed scale that integrates multiple concepts and methods, including water and land use planning and management" (Canadian Council of Ministers of the Environment 2016, p. 3). Participants reported that water quality goals were abandoned in the 2010s because political will and community support were insufficient (Saskatchewan Watershed Authority 2008; WSA 2013). One participant said:

> I would go back to sort of that source water protection plan/concept and sort of build on that in terms of identifying sort of what is happening, specifically within the lower Qu'Appelle watershed, and sort of ranking those activities in terms of their benefits, their risks to the environment, to those cultural and environmental flows, and then from there then you could start to develop thresholds similar to wetland loss. What would be the threshold for an acceptable amount of wetland loss given where you want to go, and I guess, defining what the outcome you want would be the challenge right because everyone will have different ideas on what sort of the watershed should look like and it's easy to make statements like we want economic growth and prosperous producers and clean water, but all those things don't necessarily come at the same time unless specific actions are undertaken.

Similarly, a representative of the Saskatchewan Wildlife Federation said, "I think we've got a platform that we can utilize and revisit and start from and it was just unfortunate we don't seem to have the political will to do it." Returning to watershed planning would be an opportunity for a more proactive consideration of cumulative effects to water quality and land use (Saskatchewan Watershed Authority 2008; WSA 2013).

8.4.1.2 Regional-Strategic Assessment

A regional-strategic assessment to examine regional cumulative impacts, regulatory roles and responsibilities, policy options, and viable futures is a possibility. Regional assessments focus on evaluating multiple project developments in the past, present, and future within a defined spatial region and can potentially offer a multi-authority approach to regional governance (Gunn and Noble 2015; Blakley et al. 2020). Adding a strategic lens to regional undertakings (regional-strategic assessment) broadens the scope to defining goals for regions including by considering and comparing different plausible future scenarios (desirable ones and ones to be avoided) and their implications for governance and determining the alignment of plans, policies, and programs with sustainability objectives (CCME 2009; Noble et al. 2019; Gibson et al. 2020). Participants identified a need to evaluate different futures and alternatives:

> You have a chance to talk about what does the community want regarding water? What are the local communities, this set of people living on farms and towns and First Nations, what do you all have in common that you would like to see? Do you want to have rivers

> that you feel comfortable swimming in; lakes that you feel comfortable swimming in? Water that is reasonably potable right there on the land? Do you want to see nature in wetlands? How much water do you want? How do you want to see water managed in flood or drought? (Saskatchewan writer)

Essential elements of a regional-strategic assessment would include evaluating the existing water regulatory context, assessing cumulative effects of water abstraction and drainage, and assessing alternative trajectories for proceeding with water developments or setting operating and regulatory conditions on withdrawal and drainage. Some participants added that the scale of a regional-strategic assessment could be the Qu'Appelle or South Saskatchewan sub-watersheds or the three prairie provinces through the Prairie Water Board.

8.4.1.3 First Nations Sovereignty in Regional Development

FHQTC-LRES Advisory Council Members discussed what a First Nations-led assessment and decision-making review board on the Canadian Prairies to govern and manage land and water would entail from their perspective. First Nation-led assessments assert First Nation values in local or regional development decision-making and greater sovereignty of the Nation(s) involved (Gibson et al. 2018; FNMPC 2020). Speaking to stewardship as a guiding principle for a Treaty Four First Nations-led assessment of water development, a Councillor from Pasqua First Nation said:

> I think if it's affecting our areas, stewardship is number one. We want to have that in decision-making and control of what happens in our lands, and what else is valuable. What about our medicines that are in the areas and our Elder had brought this up in our last section as well – our medicines, our berries, and everything like that. What about those things? How are they affected?

This same person adds to this idea by talking about where to begin assessments from a First Nations perspective:

> I think for a First Nation-led project, the first thing we would need to know is the history of our lands. What are these lands used for? Those are totally different questions than are asked by non-First Nation, non-Indigenous people when doing projects on their lands. Because of our history, because of our culture, the lands, we have so much more of a

> personal relationship with them than non-Indigenous. So, I think that's an important place to go is to learn about the history of the lands that you're thinking of doing your project on. Getting that history from our Knowledge Keepers, and even finding out if you are, sorry, even welcome to do anything on those lands.

Key guiding topics for an assessment approach centred on Treaty and Inherent Rights and the sovereignty of First Nations in land and water management in Treaty Four included stewardship, relationships to the land and water, and deciding that projects are unacceptable if they cause any decrease in quality and way of life. These guiding topics could be supported through Elder and youth monitoring, life cycle assessment, and through information about pre-settler conditions.

8.4.2 Key Initiatives and Features of Regional Planning and Assessment

Advantages and initiatives of regional planning and assessment under collaborative water governance described by participants included greater support for cumulative effects assessment, economic and livelihood assessment, ecosystem and water rules and guidelines, forecasting/backcasting and scenario analysis, water regulatory review, priority of water use determinations, and Treaty and Inherent Rights assessment. These programs and initiatives are described by study participants as opportunities to fulfill components of sustainability criteria defined in Chapter 6.

The degree to which these regional-scale features/initiatives are evident in existing governmental programs is presented in Table 8.3. For the Lake Diefenbaker Irrigation Expansion, only economic and hydrologic forecasting analysis are in progress. For the Agricultural Water Stewardship Policy, only water and ecosystem rules and adaptative review of policy are defined and planned. Across higher-level government programs and plans, economic analyses, priority of water use, and a review of regulatory roles appeared to be in development to a greater degree than other initiatives. The Government of Saskatchewan's programs have offered or are offering consultation and engagement opportunities, but there are no publicly available plans for an assessment of potential infringements to Treaty and Inherent Rights. Taken together, there is a mismatch between existing government policies, plans, and programs and needed regional initiatives described by Rights holders and stakeholders.

Table 8.3. The status and contribution of government plans and policies to collaborative regional governance based on public information. Colours represent absence (Blue), minimal attention (Purple), or some progress (Green) towards initiatives.

Initiative	*Lake Diefenbaker Irrigation Expansion (Water Abstraction)*	*Agricultural Water Stewardship Policy (Drainage)*	*Government Plans and Programs*
Cumulative Effects Assessment	- Project-level environmental assessments of potash mines are required and include cumulative effects of surface and groundwater (Government of Saskatchewan 2014). - Limited publicly available information for the cumulative effects of irrigation.	- Monitoring indicators (e.g., water quantity, water quality, soil health, public trust) for drainage sites and rivers (not lakes) between SK to MB based on adaptive management (WSA 2024b). - Mitigation hierarchy (avoid, minimize, offset) to design measures and adopt best management practices (WSA 2023a). - Baseline for water quality in small-order streams (WSA 2024b).	- Public hydrology, water quality, and geoscience data, and new effort for water licence monitoring (WSA 2019, 2023b; Ministry of Energy and Resources 2023, 2024). - Ministries are working on impact mitigation, such as designing measures to maintain grasslands at the 2016 level (19.9 million acres), prevent invasive plants, maintain dams, create drought response plans, and help 25% of farmers adopt nutrient stewardship (Ministry of Agriculture 2024; Ministry of Environment 2024; WSA 2024c).
Economic and Livelihood Assessment	- Quantification of the direct benefits of irrigation ($125 million per year in crop revenues) to the province, nationally, and internationally, with some information on crop diversification, food manufacturing development, and an expectation of water use for potash expansion (Clifton Associates 2012; Kulshreshtha et al. 2012; KPMG 2024). - Evaluation of revenues for the current state (dryland) and irrigation expansion for the Westside Irrigation Rehabilitation Project in South Saskatchewan Basin show a $5.9 billion increase over 50 years (KPMG 2024).	- Goal to use the policy to promote profitable and productive agriculture that supports sustainability and SK's economy (WSA 2023a). -A proof of permission for landowners to drain is required by the Water Security Agency to help mitigate impacts to producers downstream (WSA 2023a).	- Goal to grow cultivation in Saskatchewan, diversify crops, and build new market opportunities for potash, grain crushing, and agriculture (Ministry of Agriculture 2024). -Water resources to support a thriving economy (Government of Saskatchewan 2020b).
Water and Ecosystem Rules	- Limited publicly available information. - Baseline and mitigative considerations for the South Saskatchewan River include, for example, Treaty and Inherent Rights, water and soil quality, and habitat (Clifton Associates 2021).	- A floor (threshold) for wetlands in protected areas (e.g., "provincial parks, community pastures, poor soils, steep areas.") is being created as a reference condition (WSA 2024b). - Higher cumulative wetland retention goals based on key source water, wildlife habitat, and uses by Rights holders (WSA 2024b).	- The Water Security Agency is working towards a hydrologic drought response plan, including monitoring to determine what responses and mitigation should occur at different levels of drought. They are also working on water resilience by identifying 117 communities that are at risk of floods and creating mitigation plans (WSA 2019, 2023b, 2024c).
Forecasting, Backcasting, and Scenario Analysis	- Analyses for the irrigation expansion show there is sufficient water for irrigation in water-replete years (3% of reservoir water) but that there may be constraints in water-limited years (1/5 of reservoir water) (Saskatchewan Irrigation Projects Association 2009; Clifton Associates 2012, 2021). - Low flows in the South Saskatchewan Rivers could be mitigated through operation of a balancing reservoir and review is ongoing (KPMG 2024).	-Limited publicly available information.	- Ministries are working on water level risks for terminal lakes and crop diversification for climate resilience (Ministry of Agriculture 2023, 2024; Water Security Agency 2023, 2024).
Priority of Water Use	-Limited publicly available information.	-Limited publicly available information.	- "Water allocation, priority of use, and water usage policies" (Water Security Agency, 2024, p. 5) and plans and policies for conserved and protected areas (Ministry of Environment 2023) are in development.
Water Regulatory and Policy Review	-Limited publicly available information.	- The development of a compliance monitoring framework will encourage openness and transparency (WSA 2023a). -There will be monitoring on program success, development of a program success framework, and adaptive management for continued policy iteration (WSA 2023a).	- The Water Security Agency outlines its efforts to support communities in drought mitigation; involve stakeholders in programs, policy, and service standards; and review the program delivery of watershed associations (WSA 2023b, 2024c). - The Ministry of Environment is working on consultation with First Nations and Métis on permitting requirements and regulatory tools, and they are starting to complete a review of the 1998 Wildlife Act (Ministry of Environment 2023, 2024).
Treaty and Inherent Rights Assessment	- Described past (2020-2024) and future consultation and engagement with Indigenous Nations and key stakeholders (Clifton Associates 2021; KPMG 2024).	- Described consultation and engagement opportunities, including partnership in policy development (WSA 2023a). -Referenced a need to uphold obligations to Rights holders and use of best available traditional knowledge (WSA 2023a).	- The Ministry of Environment outlined efforts to design a multi-species Habitat Management Plan and Framework for the Prevention and Management of Invasive Species with Rights holders, including incorporating Indigenous values into wildlife management planning Ministry of Environment 2023, 2024). - Other ministries (Agriculture, Energy and Resources, Water Security) refer more to Indigenous participation and building public trust in the regulatory and permitting process (Ministry of Agriculture 2024; Ministry of Energy and Resources 2024; WSA 2024c).

8.4.2.1 Cumulative Effects Assessment – Nutrient Pollution and Hydrologic Alteration

There is a need to evaluate cumulative effects regionally ahead of proposed development projects. Such evaluations would depend on availability and quality of monitoring data, anticipation of future flow ranges and potential future demands, and investigation of hydrologic alteration and nutrient pollution from drainage and irrigated crops against an agreed-upon baseline for water level and water quality change. A University of Regina researcher said:

> What is the impact if all farmers started to drain water rapidly off their land rather than (the current approach of) we'll look at this one farmer getting rid of a wetland and now you've gotten rid of the wetlands in most of southern Saskatchewan and that has huge impacts on bird migration.

A Youth Councillor from Little Black Bear said:

> I think I would support a cumulative effect assessment just because I think it will help us assess where we are today and what we can do to further protect our lands and how we can make it better for the future.

Participants recommended continued support for monitoring water quality, hydrology, climate change for wetlands and groundwater in particular but also Indigenous use and occupation, active water licences, farmers' use of four R nutrient stewardship strategies (right source, right rate, right time, right place), and recreation and tourism data. They also encouraged a regional evaluation of cumulative effects and establishment of a baseline for hydrology and water quality, with room for iteration and adaptive management.

Monitoring, information sharing, and mitigation for indicators and measures relevant to cumulative effects is underway by government (Table 8.3). As part of project-level assessments, proposals for potash mines require consideration of cumulative effects (Government of Saskatchewan 2014), but no cumulative effects assessment has been completed for the Lake Diefenbaker Irrigation Expansion for project-level phases or at the regional scale. The Agricultural Water Stewardship Policy for drainage includes monitoring indicators and mitigation options but not a cumulative effects assessment of drainage networks or drainage projects alongside water abstraction projects (WSA 2024b). Government of Saskatchewan ministries are also making environmental data more publicly accessible and creating mitigation

strategies for grassland protection, drought, dams, invasive species, and nutrient runoff (Ministry of Agriculture 2024; Ministry of Environment 2024; WSA 2024c). Together, a more proactive regional approach to the cumulative effects of multiple water withdrawal and drainage projects is recommended by representatives from FHQTC-LRES, universities, and environmental non-government organizations beyond monitoring, information sharing, and impact mitigation.

8.4.2.2 Economic Assessment – Hydropower and Livelihoods

For a greater understanding of how the irrigation expansion and drainage supports livelihoods and local to international food markets, participants described a need for economic and livelihood analyses. A University of Regina researcher said:

> It's just not clear to me that there's much value to it (the Lake Diefenbaker Irrigation Expansion) relative to the crop irrigation that's done in Alberta and is well ahead of us. What kind of part of the market are we actually going to get by deviating our resources? The thing about irrigation is the water use is destructive in two ways. One, most of the water is evaporated to the atmosphere. We don't get that back. So, it's a net loss to the hydrosphere locally and then the second thing is the water that doesn't evaporate is often so heavily contaminated with sediments, pesticides, or nutrients that it's going to damage the remaining water.

An agricultural producer near Last Mountain Lake also questioned what crops would be grown and how this might affect their livelihood:

> I would like to see a plan of this is where we're headed like we're trying to get the potatoes and we're trying to get the cucumbers and stuff to go here. So, then we could actually diversify because I don't need more canola hitting the market because it is just going to make my canola worth less.

People questioned what crops would actually be supported by irrigation, if there is a market for these crops, and whose downstream and potentially non-market livelihoods would be affected by irrigation and drainage. Taken together, there is a need for a livelihood analysis to understand who benefits from irrigation and drainage and how to maximize and support the greatest benefits. There is also a need for more information on crop diversification and viable national and international food markets.

The Saskatchewan Government and consultants have undertaken research about the net economic benefits of irrigation, but not indirect costs and benefits of irrigation and drainage (Table 8.3). Crop revenues and food manufacturing development locally, nationally, and internationally have been predicted for the irrigation expansion, but less is known about indirect economic effects, such as producers' choices to grow certain crops, reduction of hydropower revenue, downstream livelihood losses, uncertainty about the adoption of irrigation, a dependence on canola biomass processing plants, and Buffalo Pound water treatment plant effectiveness (Lindenschmidt et al. 2020). The drainage policy requires proof of government permits to drain (WSA 2023a), but, to our knowledge, there has not been an analysis of expected crop revenue losses of downstream agricultural producers if upstream drainage causes flooding. As suggested by participants, this analysis could be integrated into the permit application process. At a higher-level, the Government of Saskatchewan seeks to support cultivation, diversification, and new market opportunities for agriculture. While there has been investigation of market benefits from irrigation, more regional analysis is needed about the indirect economic and livelihood impacts related to both irrigation and drainage (Lindenschmidt et al. 2020).

8.4.2.3 Water and Ecosystem Rules - Guidelines, Standards, and Limits

To protect water and grasslands at a regional level, participants mentioned a need to set rules, including guidelines, standards, and limits. A Pasqua First Nation Councillor said, "What has been already done to our land, water, and air and how much has the quality already diminished? Do we have room for any further projects? Can our waters, lands, and our air take any additional projects?" A University of Saskatchewan researcher spoke about the role of a regional advisory council to establish rules:

> A Qu'Appelle River basin board with real capacity to do science, document management, work on flow rules. I mean, lacking flow rules for so much of the system is just abysmally shocking. Building up that understanding of what we are doing, what that means to the ecosystems and the people who rely on them, and then working on future visioning to understand what are the changes, what are the stressors that will be layered on, and then what are the priorities we're going to need to consider in terms of management?

Another participant added to this idea of establishing rules but stressed the role of balance:

> I think it's important that care should be taken to determine the rules around water protection and water use in order to prevent contamination or deterioration of the water, but we also have to have an acknowledgement that it's an important economic resource. So, a balance needs to be had between the importance of economic resources and it's also very important socially to people in the area. So, whether it be for recreation, overall enjoyment of the ecosystem that it creates, and cultural importance from everyone's but significantly a First Nations perspective. So, you need to put rules in place to allow that economic growth while allowing water quality and quantity for those that live in the area, and those that are downstream of us.

Overall, participants described the need to identify acceptable levels and standards for water use, cyanobacteria, mercury, fishing success, and farmland loss and develop protective measures to minimize grassland loss, wetland loss, and nutrient runoff.

Flooding and drought response triggers and wetland retention rules are in development (Table 8.3). No guidelines or standards for ecosystems and Treaty and Inherent Rights have been set ahead of irrigation development, but mitigation measures will be created. For drainage, a floor (limit/goal) for wetland retention is being developed and cumulative retention will increase for areas with key source waters, wildlife habitat, and Rights holder uses (WSA 2023a). However, no response rules or triggers have been developed – for example, there is no determination of when a certain level of river and lake water degradation would lead to rules for greater wetland retention (WSA 2024b). At a higher-level, the Water Security Agency is working on drought response triggers (WSA 2019, 2023b, 2024c). Despite these initiatives, participants identify a need to expand drought response triggers to include co-defined water quality, habitat, and water level standards and limits for lakes and rivers that are unique to individual First Nations ahead of drainage and irrigation development.

8.4.2.4 Forecasting, Backcasting, and Scenario Analysis – Multi-Year Droughts

Water foresight and scenario analysis based on both historic and future wet and dry cycles is needed for the Qu'Appelle and South Saskatchewan basins to support decision-making. A representative of the Prairie Adaptation Research Collaborative said:

> The current government has some fairly ambitious plans for the growth of Saskatchewan's economy that will rely entirely on water. They're just assuming there'll be

> sufficient water to support all these proposed economic activities and, because my group studies climate change, we know that they have an unrealistic picture of how much water is actually available for these various activities. I think they're very much biased towards what is available in wetter years.

A non-profit member from the Calling Lakes said:

> I think generally on development they've taken old data and extrapolated it from what I understand. They haven't factored in [that] the thick glaciers are shrinking in the mountains and on our supply of which we rely on the South Saskatchewan River – that's a very finite resource and getting scarce…

Participants spoke to the government not having a scientific understanding for the high variability of weather and hydrology year to year in the Canadian Prairies and the need for drought reconstruction (models based on paleolimnology and tree ring studies) and the Intergovernmental Panel on Climate Change approach (three different models and a minimum of three scenarios) to account for multi-year drought probabilities.

Hydrologic scenario analysis is occurring by government and hired consultants for irrigation (Table 8.3). Analysis of water requirements for the Lake Diefenbaker Irrigation Expansion has been completed for water-replete and water-limited years (Saskatchewan Irrigation Projects Association 2009; Clifton Associates 2012, 2021). For drainage, to our knowledge, there is no consideration yet of how the Agricultural Water Stewardship Policy differs between wet and dry years. According to university participants, both irrigation and drainage require an investigation of water availability for multi-year droughts, based on paleo-history, that are expected because of climate change. There is a need to evaluate viable and attractive future alternatives that would protect water availability and quality in light of runoff from drainage, multi-year droughts, and if municipal, irrigation, industrial, and environmental water requirements would be met in the long-term for the Qu'Appelle and South Saskatchewan basins.

8.4.2.5 Priority of Water Use – Forward Planning for Flooding and Water Scarcity

Participants described a need for greater clarity on which economic, environmental, and cultural values take priority for water in wet and dry periods. An independent consultant spoke to this:

> When they say growth, they mean economic GDP growth, and anything that gets in the way of that won't be viewed favorably. Therefore, they're inclined to prioritize the use of water for economic purposes, as opposed to either environmental or cultural or any other purpose. So, that's where they're coming from, and my personal concerns are that they're so far tilted over in that direction that they will abstract more water than they should from both the South Saskatchewan and the Qu'Appelle.

A Councillor of Pasqua First Nation said:

> If people are pulling out of our water, industry, mining, potash, whatever, there should be a limit what they could take. If we're going through a drought and our lakes are really low, those amounts that they can pull from our water should also be lowered.

Participants described consideration of a prior right for nature and water for rivers and lakes ahead of development and consumptive use. Other participants identified a need to assess trade-offs in water use, create a priority water use list, and prepare forward plans for what to do when flows are dwindling in drought years.

Saskatchewan ministries are currently taking action to identify priority water uses (Water Security Agency, 2024) and conserved and protected areas (Ministry of Environment 2023) (Table 8.3). At this point, however, it is unclear how these strategies support the irrigation expansion and wetland drainage regulation and promote stakeholders' and Rights holders' active involvement in decision-making for these projects. Overall, participants stressed there could be more transparency and collaboration in setting water priorities.

8.4.2.6 Water Regulatory and Policy Review – Collaboration and Cohesion

Participants described a need for a review of water regulations, policies, and roles and responsibilities of managers. Speaking to investigating regulatory enforcement, a representative of the Saskatchewan Wildlife Federation said, "There is no active enforcement or compliance requirements on development." I think all those things could easily have a very positive impact

very quickly." An agricultural producer in the Qu'Appelle spoke to wetland policy and drainage regulation:

> I would try to pin [down] the government to various government departments. One on the water quality/environment, and two developing a wetland policy which should involve probably environment, agriculture, and whoever, and three to hold agriculture accountable to illegal drainage and not enforcing the laws that are there now.

A former ministry official said:

> I guess, for me, the real challenge is that I don't know that all of the different agencies are working collaboratively enough to be able to really tackle this issue, like water security, in its conceptualization is a really good idea, like having water brought together. And when I was in environment, they pulled off some of our folks to join that ministry so that they would have that capacity. I don't think Environment and Water Security (Ministries) always worked together as well as they could to start to create kind of a wrap-around regulatory model.

To improve the regulation of water withdrawal and drainage, contributors reported a need for greater transparency, alignment and coordination between ministries, and more regulatory enforcement. Some participants suggested that Saskatchewan needs water policies similar to those of Manitoba and Alberta which protect environmental flows and offer no-net-loss wetland protection (Manitoba Clean Environment Commission 2022; Government of Alberta 2023).

There is some opportunity for Rights holders and stakeholders to inform and audit the development of regulations, policies, and plans (Table 8.3). While limited information is available about review and auditing of irrigation plans, the Agricultural Water Stewardship Policy will have a program success framework for adaptive management and policy iteration. At a higher-level, the Water Security Agency has offered opportunities for stakeholders to provide input on the current roles and responsibilities of the organization (WSA 2023b, 2024c) and the Ministry of Environment is consulting with First Nations and Métis on permitting requirements and regulatory tools (Ministry of Environment 2023, 2024). Overall, a majority of participants identified a need for greater inclusion of stakeholders and Rights holders in policy and regulation development, regulatory alignment between ministries, and cohesion of water policies through combined attention to irrigation and drainage projects.

8.4.2.7 Treaty and Inherent Rights Assessment – Risk of Infringement

Language Speaker, Women, and Youth Councils identified a need for greater involvement in environmental policies, programs, and assessments to express their governance and analyze risks to Treaty and Inherent Rights. A University of Regina researcher said, “Where is the structure that allows those communities to come together and say, ‘We've got good ideas about how we would like to develop?’” Concerning this need for First Nations decision-making, a Pasqua First Nation Councillor said:

> The decisions that they are making affect our lives, our livelihoods, our traditions, our culture, our medicines, our berries, our animals, our everything. We need to be part of that decision-making and not just used as a resource for information.

A Youth Councillor from Little Black Bear added, “I think one thing that should be included is having youth opinions and just having more youth involved because it is up to us to fix the problems and it's the next generation coming up.” Participants described how we need different institutional structures, policies, and practices to include Indigenous values and protect and assess potential infringements to Treaty and Inherent Rights.

Values of Indigenous Nations are being considered to some degree in Ministry programs and drainage policy development, but there is no comprehensive adoption of Treaty and Inherent Rights assessment (Table 8.3). Consultation with Indigenous Nations is expected to occur in the future for the Lake Diefenbaker Irrigation Expansion (Clifton Associates 2021; KPMG 2024), whereas the drainage policy framework describes partnership in policy development and a need to protect culture and rights (WSA 2023a). At a higher-level, Rights holders are involved in habitat management and invasive species prevention. At the level of impact assessment, there is currently no opportunity to substitute First Nations-led assessment for environmental impact assessments completed under the provincial process, but duty to consult obligations can offer opportunities for Indigenous involvement in knowledge generation and assessment studies (Government of Saskatchewan 2020a, 2023). However, Rights holders from FHQTC-LRES mentioned going beyond duty to consult obligation to free, prior, and informed consent during irrigation and drainage decision-making. Ultimately, no government programs offer an opportunity to regionally assess potential infringements to Treaty and Inherent Rights from cumulative effects.

8.4.3 Enabling Conditions for Planning and Assessment Response Options

8.4.3.1 Challenges to Creating the Conditions

Creating the conditions for higher-level assessment (*ad hoc* or compliance-based) or a watershed planning equivalent that could house the initiatives above is challenging because of perceived limited political will, cost and capacity, and conflict between economic interests as well as over water and baseline values. Under Saskatchewan's *Environmental Assessment Act*, there is an opportunity for the Minister to designate sensitive areas for regional studies, but this is rare in application and would fall well short of collaborative governance action (Government of Saskatchewan 2020a). In water contexts, this is unlikely because of contention over water values and uses, blame, and fear of paralyzing development. It would also conflict with Saskatchewan's Growth Plan that encourages expanding water uses for economic growth (Government of Saskatchewan 2020a). An agricultural producer in the lower Qu'Appelle described this challenge from their perspective: "Landowners and farmers often get villainized in the public eye because maybe a lot of people don't understand what the farmers are doing. You're improving land and making it more productive." Another agricultural producer said, "I'd certainly be adamantly opposed to imposing much of anything regional. In other conversations, I always argue with the federal government [that] you have to respect regions and how they farm differently." Additionally, some participants agreed that finding consensus on a baseline to measure change and trigger regional initiatives is challenging because of conflicting beliefs about the watersheds being naturally eutrophic and a need for baseline studies and knowledge dissemination, as described in Chapter 5 as a barrier to the assessment and water regulatory model. Conflict about water values makes initiating more collaborative regional water governance difficult.

8.4.3.2 Enabling Conditions and Leverage Points

Participants observed that enabling *ad hoc* regional-strategic or planning initiatives may be promoted through proactive relationship-building and trust; changes in attitudes and values through land-based education; Indigenous leadership; federal involvement; transboundary discussion between Alberta, Saskatchewan, and Manitoba; a champion or community leader; changes to policy or legislation; or crises, like climate change and the infringement of Treaty and Inherent Rights, for initiation. Relationship-building could involve working to find consensus on water values and fostering self-awareness where identities and responsibilities are not localized

to lakes or rivers but are watershed-wide, similar to regional readiness described in Chapter 4. Participants described how climate change might be the catalyst that could help people create more regional collective action to protect Saskatchewan watersheds. Interestingly, both agricultural producers and FHQTC-LRES Language Keepers described how greater regional consensus could be fostered through stakeholders and Rights holders spending more time on the land, both traditional areas and drainage networks. If collaborative regional water governance is not pursued, a participant described how this could potentially emerge in the next several decades if there is a crisis wherein human rights or Treaty and Inherent Rights are seen to be infringed upon because of the cumulative effects of water abstraction and degradation (Simmons 2021).

8.5 Discussion

This section first discusses exemplary cases for collaborative regional water governance management in Canada and abroad and how they could be applied to southern Saskatchewan to protect regional environmental water and Treaty and Inherent Rights. Second, features of collaborative regional water governance and their achievement in current government irrigation and drainage programs are discussed. Third, support of enabling conditions for collaborative regional water governance is explored in light of constraints and possibilities.

8.5.1 Regional Assessment and Planning Response Options

Rights holder and stakeholder study participants described supportive, complementary options for collaborative regional water governance for the Qu'Appelle and South Saskatchewan sub-basins. This included a return to watershed planning, regional-strategic assessment, and First Nations sovereignty in regional development. For all options, adaptive design and management is needed: establishing continuing, multi-authority regional water-centred governance with monitoring, a response to findings, and reviewing and approving new programs and initiatives is needed (Walker et al. 2004). In Canada, movement towards collaborative water governance with Indigenous Nations is occurring, for example, in British Columbia (e.g., Council of Haida Nation and Government of BC) and under land claims agreements in the territories (Phare et al. 2017; Swerdfager and Armitage 2023). For watershed planning, there is varying uptake in Canada with the strongest enabling legislation in Manitoba, Quebec, and Ontario (CCME 2016). In contrast, regional assessments have occurred in an *ad hoc* way across Canada over the last 20 years, such

as the Elk Valley Cumulative Effects Assessment (British Columbia, Indigenous-led), the Great Sand Hills (Saskatchewan), regional assessment of offshore wind (Newfoundland and federal process), the Ring of Fire (Ontario), and North Yukon Regional Land Use Plan (Yukon, Indigenous-led) (Blakley et al. 2020). Lastly, examples of First Nations-led assessments in Canada include the Tsleil-Waututh Nation's Pipeline and Tanker Expansion Assessment (Tsleil-Waututh Nation 2015), Wîyôw'tan'kityiaskino Mikisew Cree Culture and Rights Assessment for Frontier Project (Candler et al. 2015), the Ajax Panel led by Stk'emlúpsemc te Secwepemc Nation (Stk'emlúpsemc te Secwepemc Nation 2013), and the co-developed TŁĮCHǪ Assessment of the Nico Project (Gibson et al. 2018). These regional initiatives serve as exemplary cases for potential applications in the Qu'Appelle and South Saskatchewan sub-basins.

Regional environmental water and rights-based values need to be asserted in the Qu'Appelle and South Saskatchewan rivers through collaborative regional water governance that is ongoing and adaptive (Douglas et al. 2019). Study participants described a possible collaborative regional water governance model for southern Saskatchewan watersheds based in treaty agreements (Treaty Four [Qu'Appelle] and Six [South Saskatchewan]), common watershed visions, and coordination between First Nations governments and municipal, provincial, and federal governments. New Zealand collaborative governance practices were highlighted as a potential model for Treaty Four and Six Territories in Canada. In New Zealand, the *Resources Management Act 1991* and *Local Government Act 2002* set the context for devolution of water decision-making to Regional Advisory Councils that match catchment boundaries (Fenemor 2017). These acts informed the creation of the 2014 National Policy Statement for Freshwater Management that supports the Treaty of Waitangi by centring Māori values (mana [authority] and mauri [life force] of water, relationship between water and tengata whenua [people of the land]) through a national framework called Te Mana O Te Wai (Fenemor 2017). In the most successful regional examples, regional governments co-govern, co-plan, and co-manage with Māori iwi by setting goals and limits for water quality and quantity together through the Te Mana O Te Wai framework (Harmsworth et al. 2016; Fenemor 2017; Taylor et al. 2020; Parsons et al. 2022a). In this way, goals for water quality could be set by returning to water source protection and watershed planning, as done to produce the upper and lower Qu'Appelle source water protection plans (Saskatchewan Watershed Authority 2008; WSA 2013); however, greater inclusion and partnership with First Nations authorities in watershed planning would be

needed. A regional-strategic assessment could offer recommendations for watershed planning and offer an assessment of the existing water regulatory context, cumulative impacts, and alternative options for water developments (Gunn and Noble 2009). It could, and likely must, also recommend a mechanism for continuing collaborative water governance.

In this study, a proposed Treaty Four First Nations-led assessment model was described in a workshop that included stewardship, ongoing monitoring by Elders and youth together, evaluating the lifecycle of projects, protecting Treaty and Inherent Rights, considering the pre-settler historical context, personal relationships to the land, and deciding that projects are unacceptable if they cause a decline in the quality of life because of losses to rights to hunt, fish, and trap. This potential process would be different from the Crown's project-focused assessment process (Government of Saskatchewan 2014, 2020a). First Nations-led assessments are rarely at one discrete level of assessment, but move between scales to make the assessment as comprehensive, connected, and relational as necessary (Squamish Nation 2015; Tsleil-Waututh Nation 2015; FNMPC 2020). To embrace any of these collaborative regional governance response options, settler governance systems may require substantial modification, particularly in regions where existing Treaties are often misinterpreted by regional governments (Arsenault et al. 2018). Ultimately, water and land governance, planning, management, and impact assessment in Treaty Four must be built on recognition of Treaty Rights and the self-determination of First Nations to govern themselves (Arsenault et al. 2018; Leonard et al. 2023).

8.5.2 Features of Regional Governance and Their Achievement

There is evident mismatch between government programs and needed regional initiatives to protect water for the environment and rights in the Canadian Prairies' Qu'Appelle and South Saskatchewan sub-basins. This mismatch is both scalar and institutional in that drainage and water abstraction risks are regional, but current decisions are being made at the level of individual projects and institutional partnerships at a regional level have not been established to meet environmental water and rights-based challenges (Folke et al. 2007; Epstein et al. 2015b; Chapter 5). Government programs are in progress for irrigation (hydrologic forecasting and economic analysis) and drainage (wetland retention floor and adaptive policy review), but these programs generally omit multi-year drought predictions, market externalities, and diffuse impacts to rivers, lakes, and downstream livelihoods. Additionally, there is little attention to

cumulative effects, priority of water use, and Treaty and Inherent Rights assessment for irrigation and drainage. These program deficiencies are barriers to meeting regional sustainability criteria related to ecosystem improvement, decision-making transparency, and procedural justice (Chapter 6). Collaborative regional water governance for water abstraction and drainage projects in the Canadian Prairies that supports features/initiatives described in this study could be an opportunity for water justice (Clogg et al. 2017; Robison et al. 2018; Sultana 2018).

8.5.3 Enabling the Conditions for Collaborative Regional Governance

Enabling the conditions for collaborative regional water governance is perceived as being challenging because of weak political will, conflict over water values, costs and limited capacity identified by participants in this study. Strong political will is dependent on consensus among multiple levels of government on objectives for sustainability supported by enabling policy and validation of initiatives by stakeholders and Rights holders (Nyboer et al. 2021). These may not be in place under the current governance model. In addition, there is no clear agreed-upon baseline to inform water decision-making and assessments because of contention over water values and what constitutes a reference condition (Chapter 5). Lastly, capacity building and collaboration are challenges in impact assessments for most Canadian jurisdictions, including Saskatchewan, because of timelines, funding, other community obligations, and limited relationship building and learning (Lajoie and Bouchard 2006; Kwiatkowski et al. 2009; Escott et al. 2015; Udofia et al. 2017). To address challenges in enabling regional assessment and planning, there is a need to support collaboration, vertical and horizontal linkages, watershed baselines, and enabling legislation (Sheelanere et al. 2013). Vertical and horizontal linkages are being built through the *Master Agreement on Apportionment* between Alberta, Saskatchewan, and Manitoba (Swainson et al. 2011; Morgan et al. 2014), but greater collaboration on water between Saskatchewan's ministries, the federal government, and First Nation authorities is needed (Bakker and Cook 2011; Yates et al. 2017; Bakker et al. 2018; McGregor 2021).

8.6 Conclusion

The Qu'Appelle and the South Saskatchewan rivers are experiencing water scarcity, poor water quality, climate change, and additional demands from new development (Sauchyn et al. 2016; Vogt et al. 2018; Leavitt 2021). However, current water governance and management supports a water-for-the-economy model, not broader ecological, social, and economic

sustainability initiatives (Government of Saskatchewan 2020b). For sustainable and equitable water management, water abstraction and drainage projects in the Qu'Appelle and South Saskatchewan sub-basins require collaborative regional water governance that links higher-level planning, management, and impact assessment o protect water for the environment and rights. In the absence of this approach, governmental programs could provide sufficient substitutes for some key features of regional assessment and planning, if they were to 1) evaluate the downstream cumulative effects of hydrologic alteration and nutrient pollution; 2) establish context-specific water and ecosystem disturbance limits and guidelines for respecting them; 3) support economic investigation of losses to hydropower and livelihoods; 4) establish forward planning for water use priority during flooding and drought; 5) forecast and hindcast regional futures and pathways considering multi-year drought potential; 6) assess risk of Treaty and Inherent Rights infringement; and 7) review water policies with Rights holders and stakeholders in the context of the Lake Diefenbaker Irrigation Expansion and Agricultural Water Stewardship Policy. However, this is generally not done under the current water governance regime in Saskatchewan as described in this chapter and Chapter 5. Failure to assess developments together regionally may lead to an infringement of Treaty and Inherent Rights because of adverse cumulative effects, as happened in the Blueberry River First Nations case in British Columbia, *Yahey v. British Columbia* (2021 BCSC 1287). To avoid this outcome, relevant Crown and Indigenous authorities on the Canadian Prairies should collaborate to enable conditions that support higher-level assessments and planning to review the cumulative effects of current and proposed water abstraction and drainage projects and establish joint means of regional decision making and follow-up governance.

CHAPTER 9. CONCLUSION

9.1 Synthesis of Findings and Theory

This dissertation examined collaborative governance and higher-level impact assessment options for environmental and cultural water/flows (terms used interchangeably) at global, national, and regional scales. Key findings are presented in Figure 9.1.

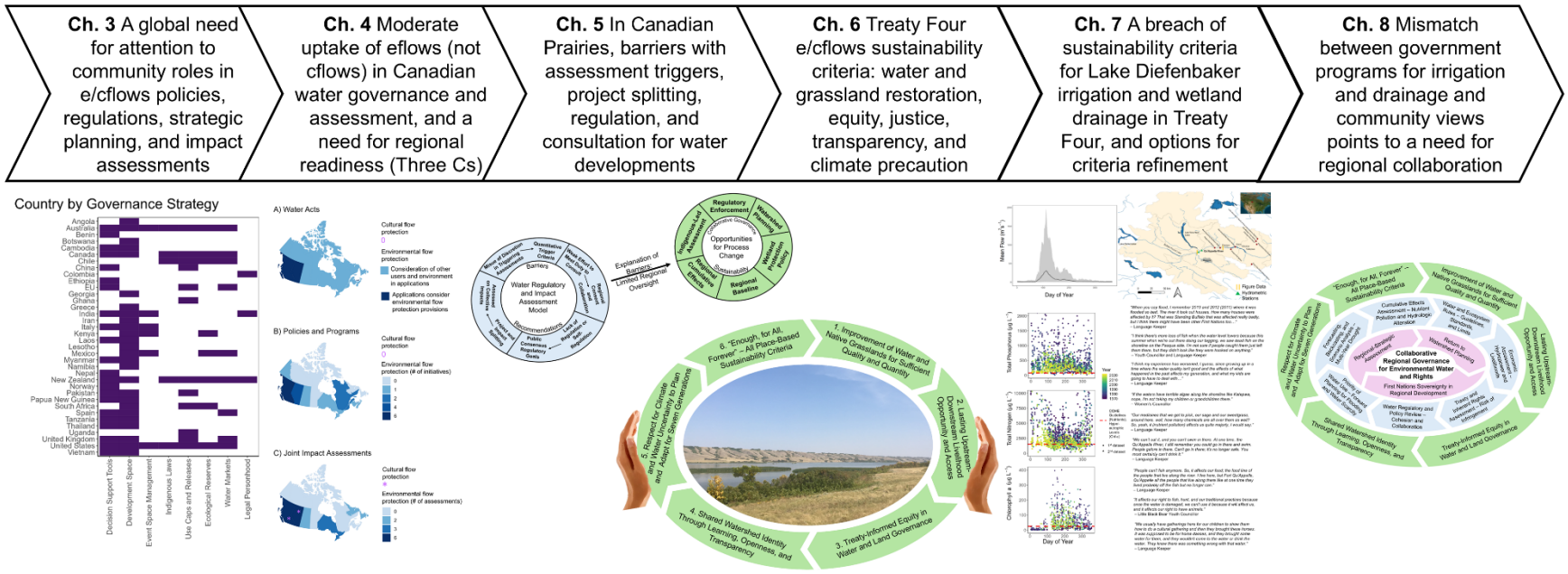


Figure 9.1. A roadmap of chapters 3 to 8 and their key findings. Diagrams below are key figures from each data chapter. E/cflows refers to environmental and cultural flows.

Internationally and in Canada there is a need for greater community involvement in the governance and assessment of environmental and cultural water (Figure 9.1). At a global scale, countries that decentralized the governance of environmental or cultural water supported management strategies that were more inclusive and sustainability-based, such as ecological and Indigenous reserved water rights, legal rights for rivers, Indigenous water laws, and water development spaces (Chapter 3). However, communities were generally involved in water use strategies rather than policy creation, strategic planning, or impact assessment (Chapter 3). In Canada, acts (British Columbia, Prince Edward Island, and Alberta), policies (e.g., British Columbia, Alberta and Québec), and project-level impact assessments (e.g., British Columbia, Alberta, and Ontario) that protect environmental (not cultural) flow needs exist, but practitioners, regulators, and policy advisors point to a need for more regional effort to protect both environmental and cultural water ahead of water developments and their assessments (Chapter 4). From discussions with experts and exemplary cases (e.g., Mikisew Cree Culture and Rights Assessment, Action Plan for Wood Buffalo National Park, Yinka Dene Surface Water Management Policy) environmental and cultural water protection ahead of assessment (regional readiness) would be facilitated by: 1) regional advisory councils that can set rules for environmental, cultural, and rights-based needs (water councils); 2) identification of existing hydrologic and water quality change to inform a regional baseline (water change); and 3) development of consensus on waterbodies' ecological and cultural sensitivity and significance (water consensus) (Chapter 4).

In the Canadian Prairies' Treaty Four region, there is moderate appetite for regional planning and assessment of this kind, and barriers limit the assessment of projects and water licence applications (Chapter 5). With Rights holders, stakeholders, and government representatives, I proposed regional sustainability criteria to preserve water for the environment, human uses, and rights for water development (Chapter 6). These criteria reflect a need for water and grassland restoration, upstream-downstream equity, procedural justice, transparency, and climate precaution (Chapter 6). Tested in an assessment of the Lake Diefenbaker Irrigation Expansion and agricultural wetland drainage projects, these criteria serve as a useful framework to evaluate attention to sustainability considerations (vulnerabilities, trade-offs, and alternatives) and determine implications for long-term sustainability based on perceived risks and existing hydrologic variability and water quality degradation (Chapter 7). Government of Saskatchewan

programs address some of the evident problems through hydrologic and economic analysis (irrigation) and adaptive policy review and wetland retention thresholds (drainage), but initiatives to address many sustainability concerns are absent, suggesting a need for adoption of collaborative regional water governance supported by a return to watershed planning, regional-strategic assessment, and/or First Nation-led assessment centred in water laws and land-use plans (Chapter 8). Taken together, these contributions of the dissertation lay out a conceptual package of elements (Figure 8.2, Figure 9.1) to protect water for the environment, human uses, and rights inter-generationally and recommends greater attention to cultural flows, water governance democratization, and sustainability assessment.

Throughout this dissertation, I presented implications for the theory of environmental and cultural flows and water considering impact assessment and regional planning, sustainability-based criteria, and Indigenous research paradigms through co-creation with FHQTC-LRES. I synthesize and expand on these ideas here and in practice (9.2) and future research (9.3) sections. The concept of environmental flows began as in-stream flows in 1940s, particularly in the United States and Europe, to mean setting a minimal flow for rivers and aquatic species (Poff and Matthews 2013). Since then, environmental flows have been called environmental water, water for the environment, and expanded to mean adequate and context-specific water quantity and quality for all water bodies (Horne et al. 2017f; Arthington et al. 2018); however, the focus in applications of the concept largely remains on hydrologic alteration from single megaprojects, not water quality or cumulative effects (Stewardson et al. 2017; King and Brown 2018). Cultural flows and water emerged in 2007 in Australia in response to the lack of inclusion of Indigenous rights, self-determination, and water sovereignty (Murray Lower Darling Rivers Indigenous Nations and Northern Basin Aboriginal Nations 2007). In impact assessment and regional planning, impacts on environmental flows and Indigenous rights are generally assessed and mitigated if there are residual impacts, but linkages between protecting environmental and cultural flows across linked project and regional levels remains challenging (Chapter 4). Instead, to fulfill context-specific environmental and cultural water obligations and promote collaborative governance (Chapter 3), distinction-based approaches (unique to each Indigenous Nation) for adequate water quality and quantity that must be ahead of development are needed. As developed in this dissertation, there is potential for this to occur through respect for regional water councils, change, and consensus (Chapter 4, Figure 4.3) and supportive higher-level assessment and

planning initiatives from priority of water use to cumulative effects assessment and a water regulatory and policy review (Chapter 8, Figure 8.2). For sustainability-based assessment (essential for impact assessment), generic sustainability criteria and environmental and cultural water principles are largely compatible, but environmental and cultural water principles have no clear mention of intergenerational water equity and a land-water interface, both of which are needed for social-ecological system sustainability (Gibson 2012; Grupper et al. 2025) (Chapter 6). Working with FHQTC-LRES through action research and supporting an Indigenous research paradigm, I reflected on Advisory Council Members perceiving environmental and cultural water needs as "reciprocal relations" (Craft and King 2021; Goodchild 2021) (Chapters 5 to 8). From my perspective, the two (or three) theoretical water framings can be reinforcing and mutually supportive. Taken together, I believe a sustainability-based theory for linked collaborative environmental-cultural water governance requires regional water advisory councils, distinction-based water quantity and quality guidelines, intra- and intergenerational water equity, water-land interface dynamics, and reciprocal water relations.

9.2 Policy and Management Implications

9.2.1 Canada and Abroad

9.2.1.1 Applying International Environmental and Cultural Water and Flow Examples to Democratize Water Governance in Canada

Cultural flows are an opportunity to reform how Canada governs water for the environment and rights. As described in the systematic scoping review (Chapter 3), the uptake of cultural flows by New Zealand and Australian governments is an example for Canada. Application of the concept of cultural water in Australia means Indigenous authority over water availability, flows, and quality. It sets a new precedent for ensuring water for Indigenous rights (Murray Lower Darling Rivers Indigenous Nations and Northern Basin Aboriginal Nations 2007). Cultural flows assert Indigenous sovereignty over water resources and development through an agenda of "Water Back" which means "the reclamation and rematriation of Indigenous Water Knowledges that are inclusive of not only rights to Water but responsibilities to Water" (Leonard et al. 2023, p. 378). In this way, cultural flow declarations and policies are a platform to fulfill Canada's obligations to UNDRIP. Article 26 of UNDRIP (2007) articulates this reassertion of Indigenous sovereignty over land and water:

> 1. Indigenous peoples have the right to the lands, territories and resources which they have traditionally owned, occupied or otherwise used or acquired.
>
> 2. Indigenous peoples have the right to own, use, develop and control the lands, territories and resources that they possess by reason of traditional ownership or other traditional occupation or use, as well as those which they have otherwise acquired.
>
> 3. States shall give legal recognition and protection to these lands, territories and resources. Such recognition shall be conducted with due respect to the customs, traditions and land tenure systems of the indigenous peoples concerned.

Canada has agreed to commit to implementing UNDRIP in 2021 by passing the *United Declaration on the Rights of Indigenous Peoples Act* (2023b), but these promises may fall short without attention to cultural flows in Canadian water policy.

Aotearoa/New Zealand's approach to collaborative regional water governance and devolution of water decision-making is an example for Canada. Aotearoa's approach to water governance has been noted as an example throughout this thesis: Chapter 3, Chapter 4, Chapter 6, and Chapter 8. In New Zealand, legislative (*Resources Management Act*, *Local Government Act*, Treaty of Waitangi) and policy (National Policy Statement for Freshwater Management, Te Mana O Te Wai) anchors set the context for greater protection of water for Indigenous rights, Māori-centred river restoration, and Māori cultural water assessment frameworks to monitor progress towards regional and national goals (Tipa and Nelson 2012b; Harmsworth et al. 2016; Taylor et al. 2020; Moggridge et al. 2022; Parsons et al. 2022b). However, New Zealand, like Canada, also has many water governance challenges related to settler colonialism, water quality degradation from dairy farming and waste disposal, and water bottling and drinking-water export (Fenemor 2017; Parsons et al. 2022c). In Canada, there is no overarching framework similar to Te Mana O Te Wai potentially because of a lack of political will, overlap in jurisdictional authority for water, multiple Treaties, and diverse First Nations, Inuit, and Métis Peoples. However, given a lack of Indigenous water values in legislation and policy in Canada (Arsenault et al. 2018; Curran 2019), there is a need for jurisdiction-specific and distinction-based policy frameworks that recognize the unique rights, interests, and circumstances of Indigenous Peoples, similar to Te Mana O Te Wai, that embed Indigenous authority and water values in decision-making. In the Canadian Prairies, there is a recognized desire by some stakeholders and Rights

holders (Chapter 8) for a Treaty Four governance model similar to co-governance between iwi and regional councils in New Zealand. This will require greater recognition of Treaty Rights through the creation of a policy framework that asserts First Nations' water and land values in regional decision-making.

Australia's complex, polycentric water governance regime is another example for Canadian water law and governance reform. Australian water governance was discussed in chapters 3 and briefly in 4. Australia's water governance regime (the Murray-Darling Basin as a prime example) is complex with decision-making centres at local, regional, state, basin, and national scales; an environmental water holder; and opportunities for Indigenous co-governance (Garrick et al. 2012; Bischoff-Mattson and Lynch 2017; Jackson and Nias 2019; Jackson et al. 2020; Hartwig et al. 2022). Also unique is the Echuca Declaration (2007) that defined cultural flows/water and that led to Australia's Indigenous-led National Cultural Flows Research Project (O'Donnell 2023a). This project proposed law and policy reform, including transforming the relationship between Indigenous Nations and the Crown, increasing the authority of Indigenous Peoples in waterscapes, and more water rights allocated to Indigenous Peoples (O'Donnell 2023a). However, Australia has water governance challenges related to, for example, settler colonialism, water extraction in the Northern Territory, water markets, and cumulative impacts on groundwater (Holley and Sinclair 2016; Marshall 2016; O'Donnell et al. 2022). To follow Australia's cultural flows progress, as Canada reforms the national *Canada Water Act*, there is an opportunity to create enabling legislation for a cultural flow policy that supports a Canadian Indigenous-led national cultural flow research program.

Taken together, New Zealand and Australia have water governance challenges but serve as examples for Canada to reform colonial water law through Indigenous-led regional water decision-making frameworks and a national cultural flow research program.

9.2.1.2 Enabling Legislation and Policy in Canada's Provinces and Territories for Environmental and Cultural Water and Flows Protection

Canadian jurisdictions must include more protections for environmental and cultural flows in their legislation and policies. As described in Chapter 4, environmental flows are only explicitly protected in legislation in British Columbia, Alberta (to a degree), and Prince Edward Island, whereas there is moderate uptake of environmental flows in policies and impact assessments

across the country. However, there is no recognition of cultural flows, except through the efforts of First Nations in impact assessment processes in British Columbia and Alberta (Candler et al. 2015; Yinka Dene ‘Uza’hné 2016a). Without explicit protections, the context-specific volume and quality of water needed to sustain waterbodies is not prescriptive and jurisdictional ministers have discretionary decision-making authority over when water can be allocated to other non-extractive uses (e.g., the environment and rights) (Renzetti and Dupont 2017). Such may be the case in the Canadian Prairies where the Miniter may allocate water for other uses under the *Water Security Agency Act*, such as water for the environment and rights (Renzetti and Dupont 2017). This potentially leads to barriers in impact assessment and water regulation (Chapter 5) because of no prescriptive rules for environmental and cultural water protection in rivers, wetlands, and lakes. Instead, a regional, consensus-based approach to the protection of water for the environment and rights is needed (Chapters 6 to 8). This could be supported through explicit consideration of environmental and cultural flows in Saskatchewan’s provincial water act (*Water Security Agency Act*), promotion of regional-strategic assessments in Saskatchewan’s *Environmental Assessment Act*, and the co-development of a collaborative regional water governance framework.

9.2.1.3 Regional Oversight in Canada: Defining the Role of the Canada Water Agency

Establishment of the Canada Water Agency is an opportunity for greater coordination between Canadian jurisdictions on environmental and cultural flows and policies, plans, programs, and impact assessments for their protection. I identified a need for regional readiness to set protections for water for the environment and rights ahead of impact assessments in Chapter 4. This largely aligns with the mandate of the Canada Water Agency, which is “to improve freshwater management in Canada by providing leadership, effective collaboration federally, and improved coordination and collaboration with provinces, territories, and Indigenous Peoples to proactively address national and regional transboundary freshwater challenges and opportunities” (Government of Canada 2024a, p. 1). In this way, the Canada Water Agency could act as a tiering platform to create horizontal and vertical linkages between federal, provincial/territorial, Indigenous, and municipal institutions (Chapter 4), policies, and programs (Arts et al. 2011; Gibson et al. 2020). With a practical approach to regional readiness, the Canada Water Agency could facilitate consensus-based regional advisory councils in watersheds (Phare et al. 2017; Government of Canada 2024i). To my knowledge, the Canada

Water Agency's role does not currently include operating between water-related impact assessments, watershed plans, regional assessments, and water licence permitting regulations. This is a missed opportunity because coordination of these initiatives is lacking, leading to limited consideration of water quality and quantity together, emerging cumulative impacts, and potential infringements of Treaty and Inherent Rights (Simms et al. 2016; Renzetti and Dupont 2017; Bakker et al. 2018). This coordination could be piloted in the Canada Water Agency's identified water bodies of national significance: the Great Lakes, Lake Winnipeg, Lake of the Woods, St. Lawrence River, Saint John River, Fraser River, Mackenzie River, and Lake Simcoe (Government of Canada 2024d). In the Canadian Prairies, this could potentially involve building Treaty-based regional water advisory councils, synthesizing nutrient flux and rights-based indicators, and setting rules for wetlands and water bodies for protections to inform the Lake Diefenbaker Irrigation Expansion and Agricultural Water Stewardship Policy.

9.2.2 Canadian Prairies

9.2.2.1 Supporting Collaborative Regional Governance

A tri-provincial (Alberta, Saskatchewan, Manitoba) super-regional assessment for the Canadian Prairies might be needed in a future of water and climate uncertainty. While I described place- and flow-based sustainability criteria (Chapter 6), water abstraction and drainage trade-offs (Chapter 7), and regional assessment initiatives (Chapter 8) for the Qu'Appelle and South Saskatchewan rivers, these considerations extend to water allocation between Alberta, Saskatchewan, and Manitoba. Suggested sustainability criteria, trade-offs, and supportive regional initiatives in this thesis could be adapted and scaled up for application through the Prairie Water Directive (2009). *The Master Agreement on Apportionment*, that prescribes 50% water transference between provinces and identifies goals for water quality, may be difficult to fulfill in the future (Prairie Provinces Water Board 2021). Reflecting on chapters 4 and 5, a regional assessment for the prairie provinces is only likely to occur through a joint panel review or the equivalent with collaboration between federal, provincial, and Indigenous authorities. However, a new leverage point might be the Canada Water Agency's focus on Lake Winnipeg, into which the prairie sub-watersheds in question drain (Government of Canada 2024d).

9.2.2.2 Policies and Plans to Protect Environmental and Cultural Flows

The Government of Saskatchewan's water policies and plans need to be amended in light of communities' concerns. I identified a mismatch between current policies and plans for water abstraction and drainage and the needs described by Rights holders and stakeholders (Chapter 8). For water abstraction (irrigation expansion, potash mine), for example, more transparency on policies for prioritizing use is needed, alongside alternative scenarios for water use and nutrient runoff in dry and wet years. Alternative scenarios could inform, for example, actions to protect in-lake reservoir services at Lake Diefenbaker, hydropower and irrigation trade-offs, cropping and restoration strategies around small ephemeral wetlands, and prescribed flows from Lake Diefenbaker to the Qu'Appelle River. Considering the Saskatchewan Water Security Agency plans to monitor water licences and is moving away from the prior appropriation doctrine for water rights (i.e., first licenced person to use a water source has the priority right to divert and use it) (Chilima et al. 2021), there may also be opportunities for ecological reserves and Indigenous reserved water rights (both quantity and quality) that must be met ahead of consumptive use (Horne et al. 2017e). For drainage, the Agricultural Water Stewardship Policy will set a floor (minimum threshold) for wetland retention (WSA 2023a). However, to my understanding, there are no guidelines for when change (water level alteration, water quality degradation, and/or rights impacts) in downstream rivers and lakes would trigger greater wetland retention. Additionally, there are no distinction-based approaches for wetland retention specific to the unique rights and culture of individual First Nations. A distinction-based, no-net-loss policy is needed with inspiration from initiatives in Manitoba and Alberta (Government of Alberta 2013; Manitoba Clean Environment Commission 2022). These policy changes could offer more protection for water for the environment and dependent rights.

Asserting their own water laws and policies may also be appropriate for First Nations in Treaty Four and Six to respond to development. I have noted that ecosystem rules and standards, cumulative effects assessment, and rights assessments are absent or limited for wetland drainage and the irrigation expansion in Saskatchewan (Chapter 8). To respond to this omission, FHQTC-LRES could develop a First Nations-led assessment policy and water declaration. These processes could build evidence and consensus to inform duty to consult and consent processes, court cases, and future potential co-development of assessments. A process to develop recommended principles for a First Nations-led assessment policy was discussed in Chapter 8,

reflecting on other cases across Canada during a workshop with advisory councils (Gibson et al. 2018; FNMPC 2020). While the development of a First Nations-led assessment policy is underway by FHQTC, a distinction-based water declaration could also be developed. This policy could take inspiration from several declarations mentioned throughout this thesis: Treaty #3 Nibi Declaration (Craft and King 2021), the Yinka Dene ‘Uza’hné Surface Water Management Policy (2016a), and the Echuca Declaration (Murray Lower Darling Rivers Indigenous Nations and Northern Basin Aboriginal Nations 2007). Together, these policies reflect what cultural water values must be fulfilled ahead of development and impact assessment processes to build consent-based development processes.

Alternatively, legal action may be needed to prevent infringements of Treaty and Inherent Rights from the cumulative effects of water development – hydrologic alteration and nutrient pollution. Similar to Blueberry River First Nation (Macdonald and Ecotrust Canada 2016; Simmons 2021), FHQTC-LRES could develop a cumulative effects atlas for Treaty Four Territory that overlays all land and water development. This could initiate legal action similar to the *British Columbia v. Yahey* case (2021) that promoted the implementation of UNDRIP’s free, prior, and informed consent in impact assessment matters related to cumulative effects (Macdonald and Ecotrust Canada 2016; Simmons 2021). Other legal protections could build on the growing rights of nature movement through Earth law (Earth Law Center 2024b). Earth law supports nature’s “right to exist, thrive, and evolve” and “defend its rights in court” (Earth Law Center 2024b). Earth law “may be expressed in constitutional, statutory, common law, and customary law, as well as in treaties and other agreements both public and private” (Earth Law Center 2024b). The South Saskatchewan River and the Qu’Appelle River Valley could be recognized as legal rights holders within a granted rights of nature framework similar to declarations made for the Magpie River in Québec to recognize the right to flow and to life-supporting good water quality (Innu of Ekuanitshit 2021; O’Donnell 2023b). However, legal action is likely more feasible than legal personhood because of challenges granting rights of rivers and preventing rescindment (O’Donnell 2023b).

9.3 Future Research

9.3.1 Canada and Abroad

9.3.1.1 Environmental and Cultural Water Governance

Environmental and cultural water governance needs to be investigated for countries' institutional settings beyond the academic literature. Institutional settings are both formal and informal rules and norms that dictate how decisions about water and the environment are made (Ostrom 2009; Pahl-Wostl et al. 2012; Plummer et al. 2013). Here, formal refers to governmental acts, regulations, policies, programs, and markets, whereas informal institutions may be relationships and networks among individuals and organizations (Hassenforder and Barone 2019). I evaluated countries' environmental and cultural water governance against the Organisation for Economic Co-operation and Development Water Governance Principles based on what was reported in the published academic literature (Chapter 3). While this systematic scoping review examined 158 papers, 112 watersheds, and 42 countries' environmental and cultural water governance, the academic literature lags behind the state of countries' institutional settings and does not encompass all governance considerations. Future research should evaluate effective water governance principles (e.g., effectiveness, efficiency, legitimacy, legal and administrative frameworks, organizational capacity, and partnerships) with extensive information about countries' legal and policy frameworks, watershed plans, impact assessment processes, and formal and informal actor networks (O'Donnell and Garrick 2017b). This could be achieved through internationally agreed-upon governance evaluation indicators, tailored to the unique requirements of both environmental flows and cultural flows (Taylor et al. 2019). The international environmental flows working groups presents an opportunity for this standard to emerge (Arthington et al. 2023).

Collaborative strategies for effective environmental and cultural water governance need to be researched in new contexts, especially in light of climate change. Extreme storm events, warmer temperatures, wildfires, floods, and droughts from climate change will impact water availability, quantity, and quality (Grantham et al. 2019; United Nations Water 2020; Mills-Novoa et al. 2022). Greater protection of environmental and cultural flows during climate change-driven events is more likely to occur when water governance is collaborative with Rights holders and stakeholders (Pahl-Wostl et al. 2013; Capon et al. 2018; Wineland et al. 2022). In Chapter 3, I reviewed and proposed eight strategies for the collaborative governance of

environmental and cultural flows. Some of these strategies may be more promising than others to support collaborative governance and adapt to climate change. These included, for example, promoting ecological reserves and Indigenous reserved water rights, water development spaces, Indigenous laws and water justice, and legal personhood for rivers. The uptake and utility of these approaches to protect environmental and cultural flows in integrated water management, strategic planning, higher-level assessment, and land-, energy-, and water-use strategies are likely to vary among jurisdictions and water context. They need to be studied internationally. Pursuing research about these eight strategies is an opportunity to understand how climate change adaptation can be supported through collaboratively defined protections for ecosystems and rights.

In Canada, standard indicators and strategies for effective environmental and cultural water governance could be piloted and studied. This initiative could be supported by the international environmental flows working group and emerging pan-Canadian environmental flows strategy. While Canada has developed a gradient of low-risk to high-risk watersheds from multiple stressors (WWF-Canada 2017, 2020), no water governance or rights-based indicators have been tracked or assessed across the country (Renzetti and Dupont 2017). Therefore, there is no understanding of the governance successes and failures of provinces and territories in protecting water for the environment and Indigenous rights. Without standardized indicators for the environment, rights, and governance, it is difficult to determine whether environmental and cultural water strategies (e.g., legal personhood, licence conditions, water markets) are or could be effective and if they should be applied in the management of Canadian waterbodies. Legal personhood, for example, has not been enacted federally or provincially for the Magpie River but has been declared by the Innu of Ekuanitshit and supported by the Minganie regional municipality (Eckstein et al. 2019; O'Donnell 2020; Innu of Ekuanitshit 2021). Similarly, rights of nature have been encouraged for other rivers in Canada, such as the Athabasca and Saint Lawrence (Eckstein et al. 2019; Cárdenas and Turp 2023). However, without an understanding of the effectiveness of legal personhood to protect water for the environment, Indigenous rights, adaptation to climate change, and affordance for more democratic governance, there is limited opportunity for more widespread uptake of rights of nature. Similarly, critics of legal personhood suggest that rights of nature is not an adequate substitute for recognition of Indigenous sovereignty in water governance (Marshall 2019). Therefore, indicators and strategies for

environmental and cultural water governance should be piloted and studied in Canada for more proactive protections for aquatic environments and Indigenous rights.

9.3.1.2 Higher-Level Assessment of Environmental and Cultural Flows

There is a need to investigate examples of environmental and cultural flows being adequately protected in institutional governance processes like project-level impact assessments and through links to higher-level assessment and planning (Acreman et al. 2017). This dissertation defined higher-level assessment as forms of impact assessment (strategic, regional, and Indigenous-led) that assess regional development, programs, and policies, and asked the question of how environmental and cultural water and flows are protected in these decision-making processes. In Chapter 4, I proposed steps to protect environmental and cultural flows in impact assessment (King and Brown 2018), recognizing the need to tier guidance from higher-level planning and regional-strategic assessment to water-related project-level assessments (Arts et al. 2011; Noble and Nwanekezie 2017; Blakley et al. 2020). This study emerged because of the notion that ecological, cultural, and rights-based water values cannot be adequately determined and assessed at the project level (Arsenault et al. 2019; Curran 2019; Douglas et al. 2019). Steps included establishing higher-level water advisory groups, identifying hydro-social-ecological change, and setting the sensitivity and importance of waterbodies for ecological and rights purposes. They are similar to, and blend, three environmental and cultural water governance strategies identified in Chapter 3 that are crucial for higher-level impact assessment: water development space, Indigenous laws and water justice, and ecologic reserves. Together, the simple, yet challenging, idea is that ahead of water developments (mines, dams, drainage, irrigation, mills), there is a need for some regional consensus, data gathering, and authoritative rule setting about what water (both quantity and quality) must be maintained as a priority for the aquatic environment and Indigenous rights ahead of water consumption and pollution. This proposal for higher-level guidance has implications for sustainability assessment, cumulative effects assessment, and research on meeting the duty to consult and respecting "free, prior and informed consent" rights under UNDRIP.

Research is needed to evaluate when and how to include environmental and cultural flow values as part of the sustainability-based terms of reference for water-related regional-strategic assessments in Canada. The one example of this in Canada is the Wood Buffalo National Park

World Heritage Site Action Plan for the Peace-Athabasca Delta (PAD), which set environmental flows goals based on a strategic assessment (Parks Canada 2018, 2019). For example, the Action Plans states:

> To enable informed decision-making, conduct environmental flows assessments to the highest international standards for the Peace, Athabasca and Slave Rivers as they pertain to the health of the PAD, in order to identify water flows needed to sustain the ecological functioning of the PAD under the circumstances of existing and planned future dams and water withdrawals. These assessments should incorporate projections of climate change and should determine the cumulative effects on the PAD and the property of flow regulation of all existing and proposed dams on all three rivers. (p. 65)

While this shows incorporation of an environmental flow assessment in the conditions of approval for proposed dams and has led to many studies (e.g., Peters et al. 2023), more proactive approaches to include determination of environmental and cultural water status and needs ahead of and as part of new project assessments could be beneficial. In Chapter 6, I laid the foundation for this in the Canadian Prairies by creating place- and flow-based sustainability criteria for water abstraction and drainage in the South Saskatchewan and Qu'Appelle sub-watersheds. However, more research is needed to link sustainability assessment with environmental and cultural flows.

Determining the reinforcing linkages between cumulative effects assessment and environmental and cultural flow assessment is another future avenue for research. I observed that few initiatives linked cumulative effects and environmental flows in the academic literature (Chapter 3) or in Canadian programs and policies (Chapter 4), except the Wood Buffalo National Park World Heritage Site Action Plan. Diffuse hydrologic alteration and water quality change from small farm dams, water licences, and drainage, for example, are rarely the focus of an environmental flows assessment (Horne et al. 2017c; Meenakshi et al. 2017). Similarly, project-level cumulative effects assessments investigate individual water developments (mines, dams, irrigation canals) but not the cumulative effects of all watershed developments – roads, agricultural operations, and small dams (Duinker and Greig 2006; Sinclair et al. 2017; Elk Valley Cumulative Effects Management Framework Working Group 2018). To add complexity, hydrologic alteration is regulated at the water licence permitting level, whereas guidance on

water quality is offered in watershed plans (Renzetti and Dupont 2017). However, the two are ecological and hydrologically linked, especially in nutrient-rich basins with diffuse sources of pollution (Meenakshi et al. 2017). There is clearly a need for a process that harmonizes strategies to protect against hydrologic alteration and water quality degradation from cumulative impacts. Regional assessments might be that process, but a study that synthesizes information about the co-application of cumulative impacts assessment and environmental and cultural flow assessment is needed.

Lastly, investigating how to best incorporate environmental and cultural flow requirements into duty to consult obligations and opportunities for free, prior, and informed consent is needed for research that supports consent in water-related policy development and impact assessment. Phare et al. (2017) identified the role of environmental flows in collaborative consent for the Canadian Province of British Columbia:

> The Province must work with Indigenous nations through collaborative consent tables to develop the framework and scope of a provincial environmental flows regulation, while localized co-governed decision-making tables and/or advisory boards determine thresholds and critical flows for ecological health and protection of core related rights, such as fishing, hunting and ceremonial water uses. (p. 2)

Setting thresholds for water flows and quality for ecosystems and rights can serve as a basis for an assessment determination of whether those limits will be met with proposed development projects. Similarly, as synthesized in Chapter 4, Yinka Dene set out a water guideline consent-based process for determining whether duty to consult obligations are met (Yinka Dene ‘Uza’hné 2016a). These guidelines identify which waterbodies’ water quality and quantity must be maintained based on their sensitivity and rights-based importance (Yinka Dene ‘Uza’hné 2016a). Future research could synthesize examples in Canada and abroad of how agreed-upon environmental and cultural water rules can support free, prior, and informed consent in assessment of duty to consult processes.

9.3.1.3 Movement Towards Cultural Flows

More attention to cultural flows research is needed in Canada. Cultural flows are an opportunity for rematriation and “Water Back” to Indigenous Nations (Leonard et al. 2023). Chapters 3 and 4 demonstrate that there is more focus on environmental flows than on cultural

flows abroad and in Canada. Comparative case studies of cultural flows initiatives across Canada, similar to Anderson et al. (2019), would be a useful project to offer insight and contrast Indigenous methodologies and opportunities for water back. This could include, for example, advancements in cultural flows research by the Mikisew Cree and Athabasca Chipewyan (Candler et al. 2010), Yinka Dene (Yinka Dene 'Uza'hné 2016a), Cumberland House Cree and Métis (Andrews et al. 2018; Jardine et al. 2023), and Okanagan Nation Alliance (Curran 2019). This research would contribute to the establishment of best practice frameworks for cultural flows approaches in Canada.

*9.3.2 Canadian Prairie*s

9.3.2.1 Key Environmental and Cultural Water/Flow Values

For the Qu'Appelle and South Saskatchewan rivers, there is a need to investigate what constitutes an adequate baseline to fulfill environmental and cultural water values. In chapters 5 to 7, not having consensus about a reference condition was a recurring theme. Some study participants reported that these systems have always been degraded, whereas others advocated for water quality similar to the pre-agricultural onset. The concern from stakeholders and Rights holders was that the hydrologic and water quality baseline could change, from climate or pollution, without any recourse or consideration of what that means for Treaties. While many paleolimnological studies in the Qu'Appelle and South Saskatchewan have been completed (Haig and Leavitt 2019), there has been no synthesis report respectfully bridging First Nations knowledge with these historical natural science baseline perspectives. Similarly, no study has investigated what an acceptable baseline is from the perspective of stakeholders and Rights holders groups, nor is there adequately disseminated and linked oral history and paleo information to offer context for this study (Leavitt et al. 2006). A future transdisciplinary study with knowledge dissemination is needed to offer clarity on an adequate baseline that can inform management goals.

To establish a term of reference for regional water development, place- and flow-based sustainability criteria should continue to be iterated and defined in the Qu'Appelle and South Saskatchewan basins. In Chapter 6, I brought together government, Rights holder, and stakeholder perspectives to create English-language sustainability criteria for water development in the Qu'Appelle and South Saskatchewan basins. These criteria reflect a need for restoration of

land and water, downstream-upstream equity, respect for Treaties, transparency in decision-making, understanding climate uncertainty, and procedural justice. However, while First Nations' Language Keepers and Councillors were part of this discussion, criteria were developed in English. The English-language words may have omitted ideas, connections, history, and meaning, whereas First Nations' languages and knowledge systems are rooted in observation, management, culture and identity, ethics and values, and past and current uses (Houde 2007). File Hills Qu'Appelle Tribal Council's 11 Member First Nations represent five distinct official language and cultures (Nakoda, Saulteaux, Cree, Dakota, and Lakota). Research internal to the Lands, Resources, Environment, and Stewardship Department could translate sustainability criteria developed here and expand criteria names, definitions, and indicators through a distinction-based process for each unique language and cultural group. As in the Ring of Fire (Regional Assessment Working Group 2024), these criteria could continue to be iteratively developed to build the terms of reference for an assessment of regional water development.

To support the implementation of environmental and cultural water values in management, opportunities to build trust and cooperation between government, agricultural producers, and Indigenous Nations should be prioritized. While studies have separately brought together researchers and producers (Bradford et al. 2019) and researchers and First Nations for participatory water modelling (Sardarli 2013), to my knowledge, no studies have brought together agricultural producers and First Nations. This might be a next step to mitigate ongoing conflict in areas surrounding Lake Diefenbaker (Chilima et al. 2021). In Chapter 8, I described how both agricultural producers supporting drainage networks and First Nations community members with knowledge about the land and waters desire land-based learning for greater understanding and collaboration. A future social science study could focus on on-the-land learning as a water management intervention. This research could work to build relationships between agricultural producers and First Nations community members for on-the-land learning on producers' fields and First Nations' riparian areas. Participants from both perspectives could then partake in focus groups about what new understanding this intervention brought them and if this could inform their water usage or role in water governance. A study of this nature would require a skilled facilitator with abilities in conflict resolution and social-ecological systems (Madden and McQuinn 2014).

9.3.2.2 Risks and Trade-Offs Impairing Water for the Environment and Rights

Research is needed about hydrologic alteration, water quality change, and rights infringements in both wet and dry years from drainage and irrigation. The Saskatchewan Water Security Agency has piloted studies for single drainage works (WSA 2024b). In Chapter 7, many risks of drainage and irrigation were described, and Chapter 8 identified the need for cumulative impact assessments before hydrologic alteration and water quality change. Other natural science studies could involve a multi-factor-paired design of river reaches and lakes with drainage, no drainage, irrigation and drainage, and multiple drainage projects. Indicators related to water quality, low flows, flooding, and rights practices would need to be investigated across this gradient. This could then inform a more distinction-based and cumulative effects approach to agricultural water stewardship.

An analysis of indirect livelihood costs and benefits from irrigation and drainage is necessary. While some analysis of direct benefits of irrigation has been completed (Lindenschmidt et al. 2020; KPMG 2024), there has been no analysis of equity in the distribution of gains and losses between small- and large-scale producers and rights-based livelihoods of First Nations that depend on water flow and good water quality in the contexts of drainage or irrigation. This was identified in both chapters 7 and 8. An economic research project of this kind is needed alongside the potential development of impact benefit agreements between the Province of Saskatchewan and First Nations for drainage networks and the Diefenbaker Irrigation Expansion.

An evaluation of alternative scenarios for development in the Qu'Appelle and South Saskatchewan is needed to support sustainable water use and agriculture. Considering that irrigation expansion and drainage networks have not been designated for impact assessments, nor considered under a regional/strategic assessment about water sector expansion, there is limited investigation of project alternatives, conditions on project operation, and absence of projects (Morrison-Saunders and Pope 2013; Gibson 2017). In Chapter 7, I described possible alternatives, including micro-irrigation, hydropower revenues, investment in sustainable energy, water treatment plant effectiveness, and block grants for First Nations. In fact, greater water use for potash production, rather than irrigation, may offer more revenues to the province and Canada based on market demand of irrigated crops (Geoff 2024). Without an analysis of these

alternatives and other scenarios, optimizing water use for maximum sustainability, efficiency, and revenues is not possible.

9.3.2.3 Policy and Program Evaluation to Protect Water for the Environment and Rights

Saskatchewan's water-related policies and programs need to be evaluated for their ability to protect water for the environment, human use, and rights. Study participants in this research spoke about a need to evaluate the institutional setting in which water abstraction and drainage policies and programs are created and the content of those strategies (Chapter 8). The Agricultural Water Stewardship Policy will need to continue to be evaluated to determine whether it accommodates and/or facilitates an approach to water sustainability. During consultation for this policy, policymakers described an adaptive management approach. This institutional approach to adaptively update wetland drainage permitting and the larger policy will need to be evaluated. Adaptive management is not feasible unless the projects or other activities to managed are adaptable (Fitzpatrick and Williams 2020). Lastly, options for improving the coordination of Saskatchewan ministries on goals and objectives for the environment and conditions for designation for impact assessments should be investigated (e.g., to determine what drainage networks might require an assessment based on trigger criteria).

9.4 Concluding Remarks

Cumulative disturbances from climate change and economic development threaten the long-term sustainability of downstream water bodies that support ecosystems, people, and Indigenous rights. To address this, collaborative regional water governance processes are needed to support water justice and sustainable management actions. This dissertation moved from global to Canadian to regional (Saskatchewan) scales to offer a co-creation model for the context-specific development of regional sustainability criteria that could begin a dialogue about ecological and cultural water values that must be met ahead of and guaranteed alongside water abstraction and drainage development. The sustainability assessment criteria framework developed in this thesis merits broader application. Like the Qu'Appelle River and South Saskatchewan River sub-basins, watersheds in Canada and around the world are experiencing similar pressures without regional consensus on development trajectories and goals for watersheds. I recommend water managers and researchers operating in these basins centre

environmental and cultural flows in water-related planning and higher-level impact assessment to evaluate the viability of existing management actions.

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APPENDICES

Appendix A: Supplementary Figures and Tables

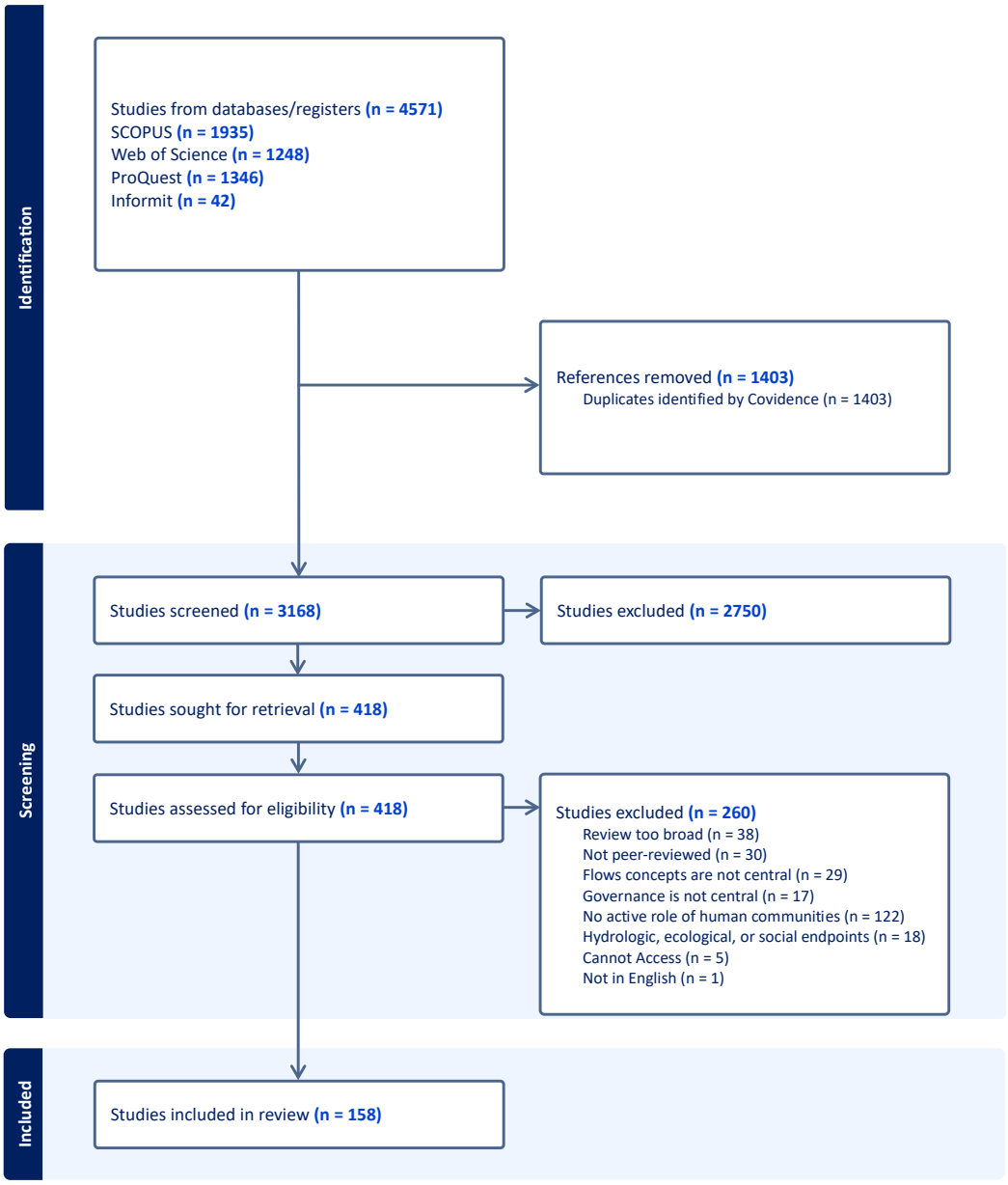


Figure S3.1. The Covidence Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram from our search process.

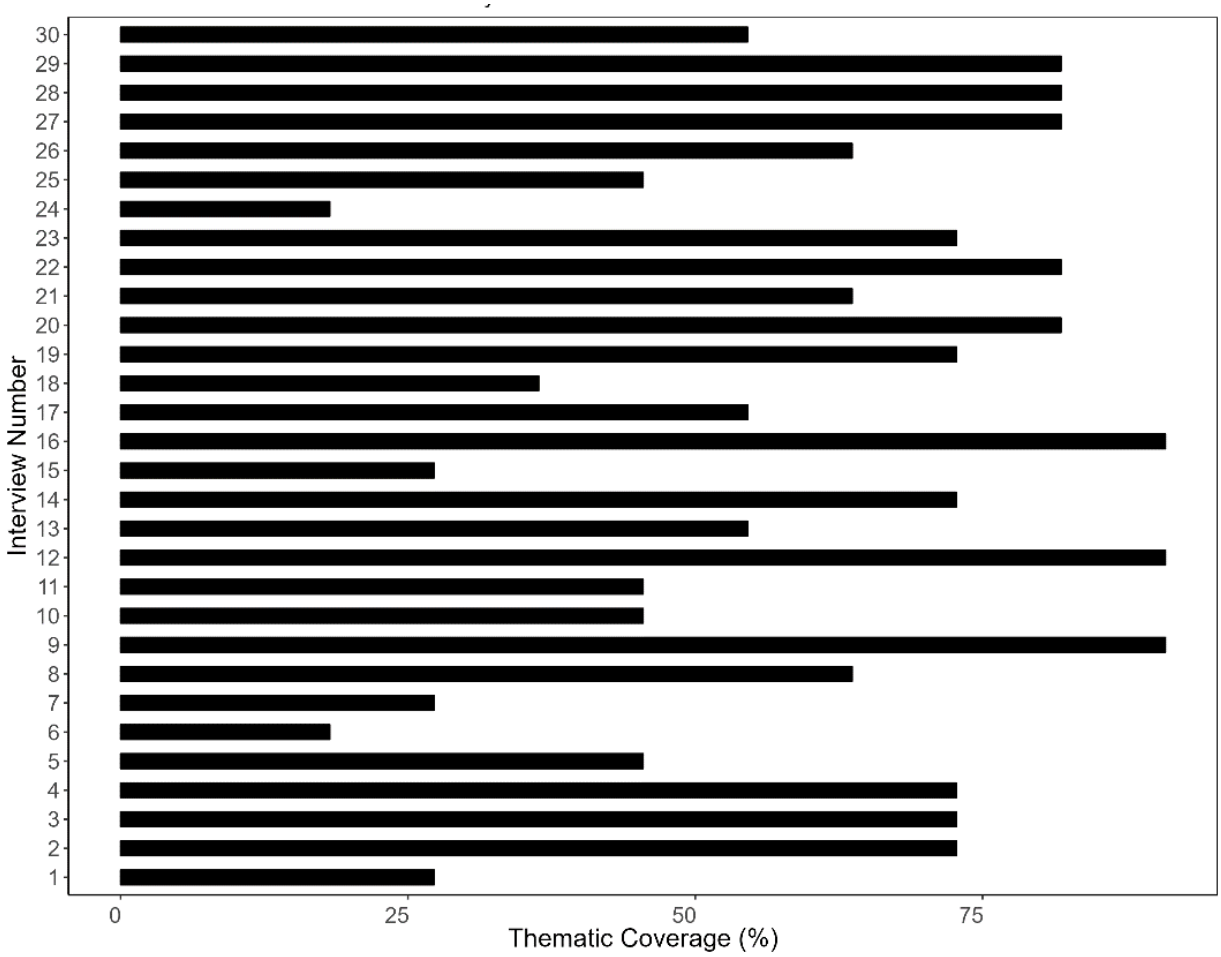


Figure S4.1. The thematic coverage (%) of grounded theory open codes by interview number. Interviews with greater than 80% coverage are key contributors. This process reached theoretical saturation in that, over the course of 30 interviews, 91% of themes were mentioned in three key contributor interviews and 81% of themes were mentioned in six additional key contributor interviews. In addition, greater than 90% of total major themes emerged within the first six to nine interviews.

Table S4.1. Acts, policies, program initiatives and impact assessments included in the scoping review.

Federal Acts	Provincial and Territorial Acts	Regulations	Policies and Program Initiatives	Impact Assessments
1. Canadian Environmental Protection Act 2. Canadian Navigable Waters Act 3. Canada Water Act 4. Federal Sustainable Development Act 5. Fisheries Act 6. Migratory Birds Convention Act 7. Species at Risk Act 8. Impact Assessment Act	1. Alberta - Water Act 2. British Columbia - Water Sustainability Act 3. Manitoba - The Water Protection Act 4. New Brunswick - Clean Water Act 5. Newfoundland - Water Resources Act 6. Northwest Territories - Waters Act 7. Nova Scotia - Water Act 8. Nova Scotia - Water Resources Protection Act 9. Nunavut - Nunavut Waters and Nunavut Surface Rights Tribunal Act 10. Ontario - Water Resource Act 11. Prince Edward Island - Water Act 12. Québec - Act respecting compensation measures for the carrying out of projects affecting wetlands or bodies of water 13. Québec - Act to affirm the collective nature of water resources and to promote better governance of water and associated environments 14. Québec - Gas, Water and Electricity Companies Act 15. Québec - Water Resources Preservation Act 16. Québec – Dam Safety Act 17. Québec – Watercourses Act 18. Saskatchewan - The Water Security Agency Act 19. Yukon - Waters Act	1. British Columbia – Water Sustainability Regulation 2. British Columbia – Groundwater Protection Regulation 3. British Columbia - Water Sustainability Fees, Rentals and Charges Tariff Regulation 4. British Columbia - Dam Safety Regulation 5. Prince Edward Island – Water Withdrawal Regulation 6. Prince Edward Island – Water Supply System and Wastewater Treatment System Regulation 7. Prince Edward Island – Well Construction Regulation 8. Prince Edward Island – Sewage Disposal System Regulations	1. Alberta - Environmental Flows Program 2. Alberta - Environmental Flows Projects 3. Alberta - Future Flows 4. Alberta - Surface water allocation directive-2019 5. British Columbia - Application of Water Allocation Notations to Water Authorizations 6. British Columbia - Beneficial Use Declaration 7. British Columbia - Environmental Flow Needs Policy 8. British Columbia - Refusal of Applications on Over-subscribed Sources 9. British Columbia - Water Authorization Application Assessment and Processing 10. Environmental Flows Guidelines for Resource Development in New Brunswick. 11. New Brunswick - Water Strategy 12. Nova Scotia - Guide to Surface Water Withdrawal Approvals 13. Nunavut - Ayookxw Responding to Climate Change 14. Ontario - Aquatic Ecosystem Assessments for Rivers 15. PEI - Environmental Stream Flow Study 16. PEI - Water Resources Allocation Canada 17. Prairie Water Directive 18. Québec – Water Policy 19. Québec – La Politique de Débits Réservés Ecologiques pour la Protection du Poisson et de ses Habitats 20. Saskatchewan - Water Allocations 21. Saskatchewan – Agriculture Water Management Strategy 22. Saskatchewan – Aquatic Habitat Protection 23. Saskatchewan – Flood Damage Reduction Program 24. Yukon - Yukon Waters: An Assessment of Climate Change Vulnerabilities	1. Ajax Mine Project 2. All Season Road to Wollaston Lake 3. Blackwater Gold Project 4. Grassy Mountain Coal Project 5. Highwood Storage and Diversion Plan for Little Bow Project 6. Horizon Oil Sands Project 7. Jackpine Mine Expansion Project 8. Joslyn North Mine Project 9. Kemess Underground Project 10. Lower Churchill Hydroelectric Generation Project 11. Marathon Platinum Group Metals and Copper Mine Project 12. Milton Logistics Hub Project 13. Mount Milligan Gold Copper Mine 14. New Prosperity Gold-Copper Mine 15. Rainy River Project 16. Site C Dam 17. Springback Off-Stream Reservoir 18. Tazi Twe Hydroelectric Project 19. Valentine Gold Project

Table S4.2. Examples of environmental flow protection and priority in British Columbia and Prince Edward Island water acts.

Water Act	Example consideration of environmental flows
2014 *British Columbia Water Sustainability Act*	*Environmental flow needs* **15** (1) Except in relation to an application exempted under the regulations, the decision maker must consider the environmental flow needs of a stream in deciding an application in relation to the stream or an aquifer the decision maker considers is reasonably likely to be hydraulically connected to that stream. (2) For an application in respect of which the decision maker must consider, or decides under subsection (4) to consider, the environmental flow needs of a stream, (a) the applicant must provide to the decision maker the information and reports of assessments the decision maker directs for the purposes of paragraph (b) of this subsection, and (b) the decision maker must determine, in accordance with any applicable regulations, the environmental flow needs of the applicable stream. (3) For the purposes of subsection (2) (a), the decision maker may require that a specified assessment be performed, and a report of the assessment be prepared, by a person with the qualifications specified by the decision maker. (4) Despite subsection (1), a decision maker may take into account the environmental flow needs of any stream the decision maker considers may be affected by granting the application. *Precedence of rights* (9) Despite subsections (1) to (8), if an order under section 86 (1) or (3) *[declarations of significant water shortage]* applies to a stream and the comptroller has determined the critical environmental flow threshold for the stream under section 87 (1) *[critical environmental flow protection orders]*, the amount of that critical environmental flow threshold for the stream has precedence over the rights (a) under any authorization issued in relation to the stream or a hydraulically connected aquifer referred to in subsection (1) of this section, or (b) of a person described in subsection (8) of this section *Order designating area for planning process* **65** (1) The minister, on request or on the minister's own initiative, by order, may designate an area for the purpose of the development of a water sustainability plan (a) if the minister considers that a plan for the area will assist in (i) preventing or addressing (A) conflicts between water users, (B) conflicts between the needs of water users and environmental flow needs, (C) risks to water quality, or (D) risks to aquatic ecosystem health, or (ii) identifying restoration measures in relation to a damaged aquatic ecosystem *Declarations of significant water shortage* **86** (1) If the minister considers that one or more streams in an area have fallen or are at risk of falling below their critical environmental flow thresholds, the minister may make a temporary order declaring a significant water shortage in the area designated in the order. (2) An order under subsection (1) must specify the term of the order, which term may not exceed 90 days. (3) Whether or not a temporary order under subsection (1) has been made or expired, if the Lieutenant Governor in Council considers that one or more streams in an area have fallen or are at risk of falling below their critical environmental flow thresholds, the Lieutenant Governor in Council may make an order declaring a significant water shortage in the area designated in the order. (4) When an order of the Lieutenant Governor in Council under subsection (3) comes into force, an order under subsection (1) in relation to the same designated area expires. (5) Section 124 (4) (d) *[general regulation-making powers]* applies to an area designated in an order under subsection (1) or (3). *Critical environmental flow protection orders*

	87 (1) If an order under section 86 (1) or (3) is in force, the comptroller must, for the purposes of section 22 (9) *[precedence of rights]*, by order, determine in accordance with any applicable regulations, the critical environmental flow threshold for each stream that meets all of the following criteria: (a) the stream is in the area designated in the order and has a regionally significant aquatic ecosystem; (b) water is being diverted from the stream under this Act or the stream is hydraulically connected to an aquifer from which water is being diverted under this Act; (c) the comptroller considers that enforcing the precedence of the stream's critical environmental flow threshold under section 22 (9) will assist in preventing significant or irreversible harm to the aquatic ecosystem of the stream. (2) If the comptroller considers that more than one stream in an area to which an order under section 86 (1) or (3) applies is described in subsection (1), the comptroller may determine the critical environmental flow thresholds for the streams based on the degree of benefit the comptroller considers the aquatic ecosystems of the streams would derive from enforcement of the precedence of their critical environmental flow thresholds, in descending order, beginning with the stream that would derive greatest benefit and stopping (a) when the critical environmental flow threshold has been determined for all of the streams described in subsection (1), or (b) if the order under section 86 (1) or (3) expires before paragraph (a) applies, upon that expiry. *Advisory boards* **115** (1) The minister may establish advisory boards to provide advice in relation to (a) establishing water objectives, (b) methods for determining environmental flow needs or critical environmental flow thresholds, (c) qualifications of well drillers and well pump installers, and competencies of professionals, as defined in section 48 *[definitions for Division 3 of Part 3]*, generally and in relation to specific activities, (d) standards and best practices in respect of the diversion and use of water, (e) standards and best practices in respect of activities in relation to wells and groundwater protection, (f) standards and best practices in respect of activities in relation to artesian flow, (g) methods for estimating amounts of water diverted or used, or (h) any other matter under this Act.
2021 *PEI Water Act*	Order for purposes of reserving water for future use The Minister may by order direct that an approval to withdraw water for commercial purposes, industrial purposes or recreational purposes shall not be given if, in the opinion of the Minister, the withdrawal would interfere with (a) the availability of water for domestic purposes; or (b) the maintenance of sufficient water flow in a watercourse for environmental flow needs. 2017,c.17,s.8. 31. (1) Order re development of water sustainability plan The Minister may, by order, establish a process by which a water sustainability plan is to be developed for the purposes of preventing or addressing threats to, or maintaining or restoring, (a) the quality of water resources; (b) the quantity of water resources; (c) the environmental flow needs of a watercourse; or (d) the health of aquatic ecosystems, in a watershed, an assemblage of watersheds or a part of a watershed.

Table S5.1. News articles purposively sampled from Factiva and Google for each emergent case study.

Development Project	News Article
Lake Diefenbaker Irrigation Expansion	Globalanna (2020). Conservation group calls for environmental assessment on $4B Lake Diefenbaker irrigation project. *Glob. News*. Postmedia, 2021. From Big Dig to Lake Dief: Regina's Clifton Associates chosen for irrigation project. Postmedia Break. News. Olson, J., 2021. $4B lake project needs assessment; Letters to the editor. Leader-Post. Zinchuk, B., 2021. Moe sees lots of opportunity with irrigation expansion. Can. Press. Baldwin, C., 2023. Expanding Irrigation in Saskatchewan. Can. Press. Peterson, J., 2023. SARM wants Sask. government to speed up Lake Diefenbaker irrigation expansion project. Can. Press. Ruttle, D., 2024. Early work on Lake Diefenbaker irrigation expansion to begin. Glacier Media Gr. Quon, A., 2024. FSIN raises concerns about lack of consultation as Sask. announces work on irrigation project. CBC.
Quill Lakes Diversion Project	Fraser, D.C., 2017. Battle continues over Quill Lakes drainage plan; Residents at odds over best, safest way to divert water downstream. Leader. Mandryk, M., 2017. Drainage Woes Plague Province; With an estimated 100,000 to 150,000 unlicensed drainage sites changing Saskatchewan's landscape, some fear an environmental disaster in the making. The StarPhoenix. Northeast Sun, 2017. Clarification of Saskatchewan's Agricultural Water Management Strategy. Northeast. Holderness, K., 2017. Common Ground: Solving The Quill Lake Flood Problems. Northeast Sun. Northeast Sun, 2018. Pasqua chief wary of Quill Lakes project withdrawl. Northeast Sun. Harbron, C., 2018. Opinion: A long-term conservation plan for the Quill Lakes. Postmedia Break. News. Ingram, A., 2018. Quill Lakes flooding was avoidable. The StarPhoenix. Harder, B., 2018. Water agency slammed for handling of Quill Lakes area drainage ditches. Leader. Mandryk, M., 2018. Mandryk: Quill Lakes flooding bogged down by inability to discuss solutions. Postmedia Break. News. Mandryk, M., 2018. Province ignoring drainage violationa. Nipawin J. Harder, B., 2018. Federal petition for environmental assessment of Quill Lakes project picks up steam. Leader-Post. Ackerman, J., 2018. Pasqua First Nation reaches settlement over future Quill Lakes projects Jennifer. Leader-Post. Harder, B., 2018. Withdrawal of proposal for Quill Lakes project sparks confusion, unease. The StarPhoenix. Steffenson, M., 2022. Quill Lakes pose risk of flooding. The StarPhoenix. Walter, R., 2023. Provincial water policy gaps illustrated by letters to the Legislature. MooseJawToday.
Yancoal Potash Mine	Johnstone, B., 2016. Environmental group warns proposed Yancoal potash project could harm Buffalo Pound Lake. Leader-Post. Kuna, 2016. Canada : Yancoal Potash Mine Receives Conditional Environmental Assessment Approval. Kuwait News Agency. Mandryk, M., 2016. Mandryk: Yancoal potash project latest mess for Wall Murray. Postmedia Break. News. The Canadian Press, 2016. Proposed Yancoal potash mine gets environmental OK in Saskatchewan. Can. Press. Mandryk, M., 2016. Sask. government can't rush approval of Yancoal potash mine. The StarPhoenix. Fraser, D.C., 2017. Critics want inquiry into Yancoal project. Leader-Post. MacPherson, A., 2017. Yancoal has not applied for Southey potash mine permits: government. StarPhoenix.

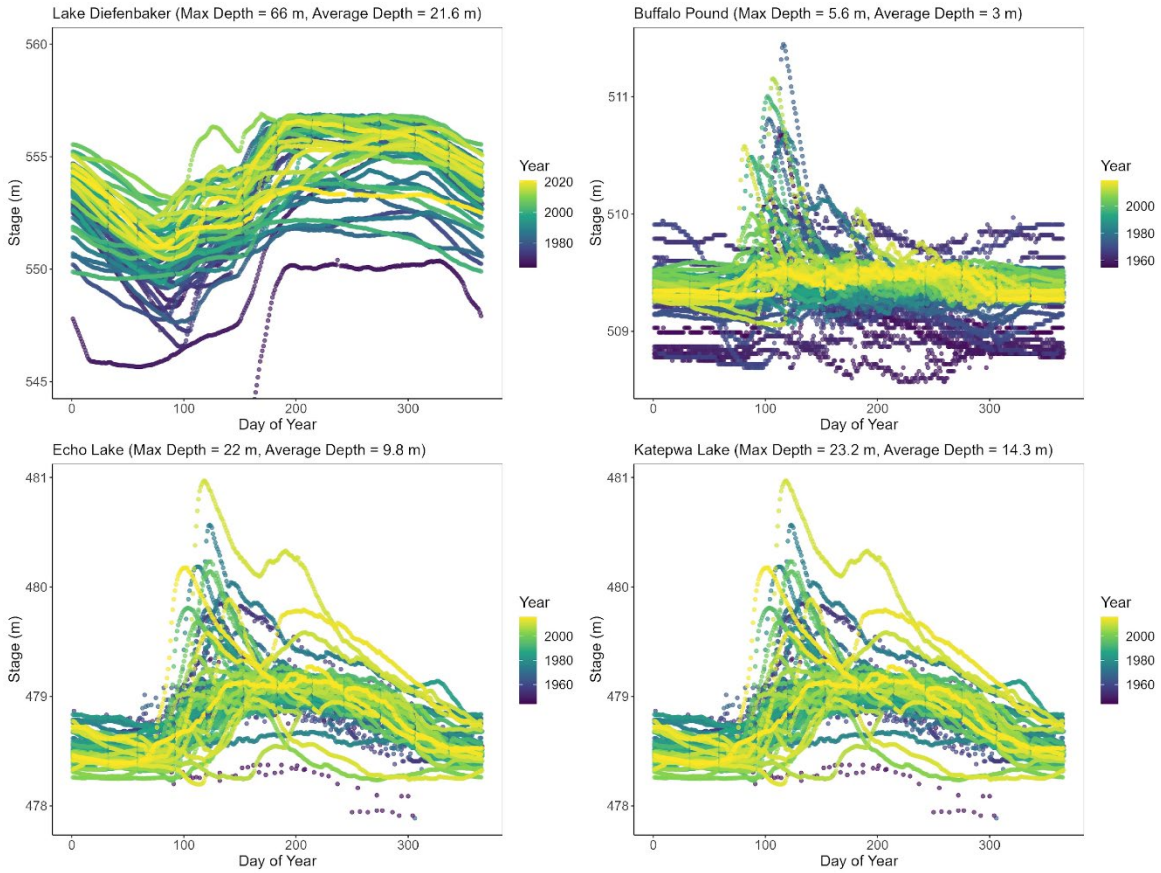


Figure S7.1. Water levels across the year and between 1950 to 2020 of four lakes within the Qu'Appelle River system. Note that Buffalo Pound, Echo, and Katepwa Lakes are part of the Calling Lakes. Information is from Environment and Climate Change Canada's website.

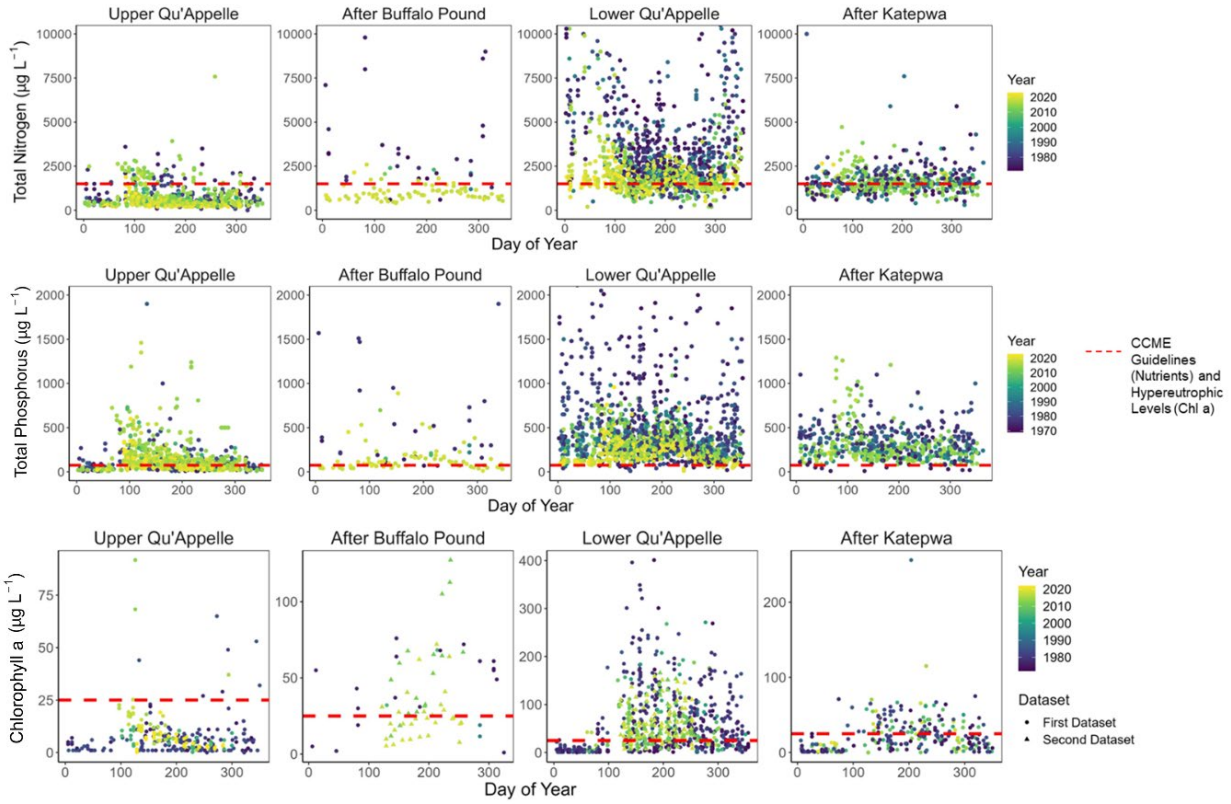


Figure S7.2. River nutrients and algae + cyanobacteria (Chlorophyll a) from 1970 to 2020 at four site ranges between Lake Diefenbaker and after the Calling Lakes. CCME refers to the Canadian Council of the Ministers of the Environment guidelines for nutrients (CCME, 2024) and hypereutrophic levels for Chl *a* (Dodds and Smith, 2016). Note the variation in y-axes. Data are from the Water Security Agency and the Qu'Appelle Long-term Ecological Research Program (QU-LTER).

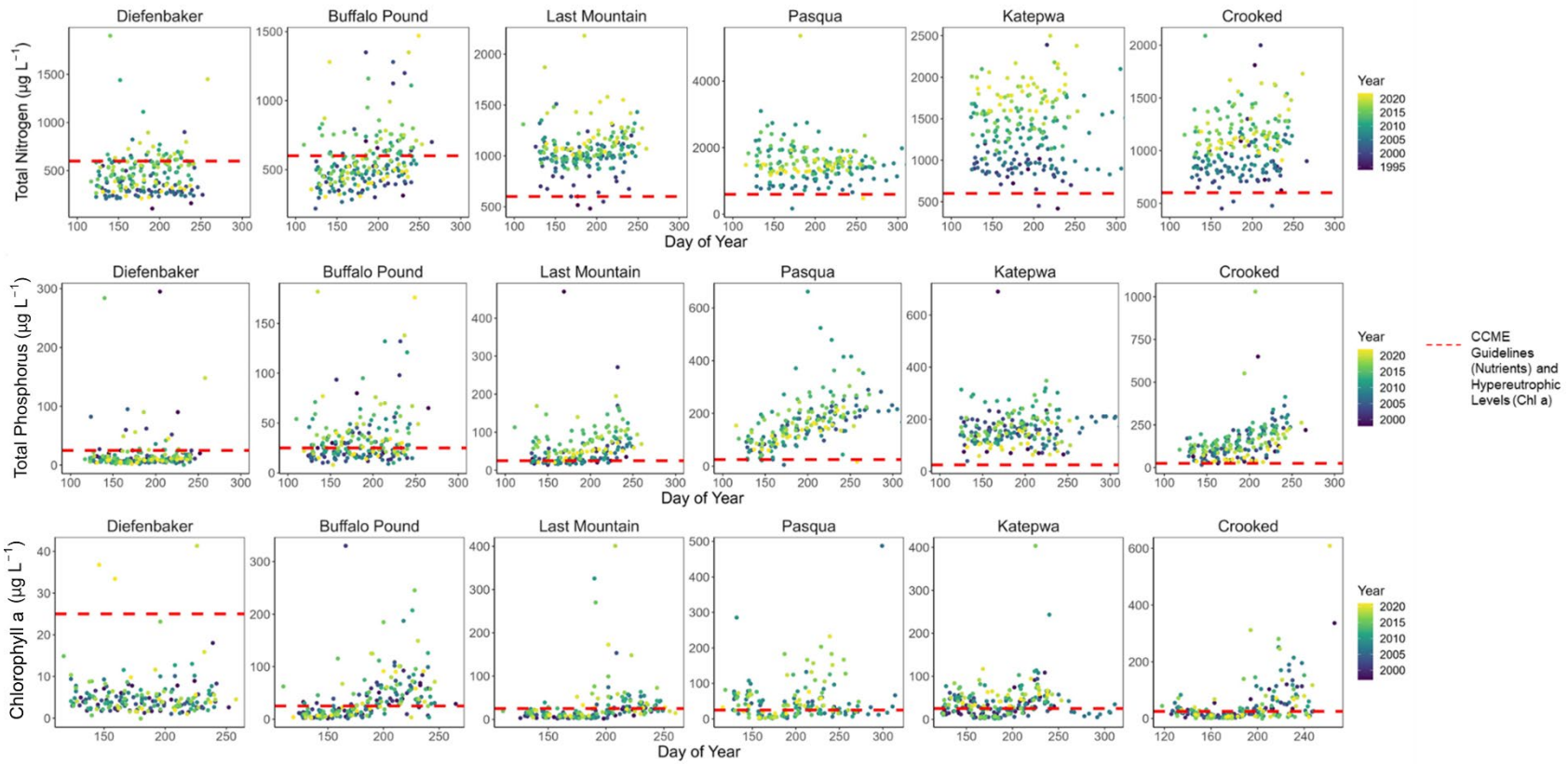


Figure S7.3. Lake nutrients and algae and cyanobacteria from 1995 to 2020 at six lakes from west to east. Pasqua and Katepwa lakes are part of the Calling Lakes. CCME refers to the Canadian Council of the Ministers of the Environment guidelines for nutrients (CCME, 2024) and hypereutrophic levels for Chl *a* (Smith et al. 1999). Note the variation in y-axes. Data are from the Qu'Appelle Long-term Ecological Research Program (QU-LTER).

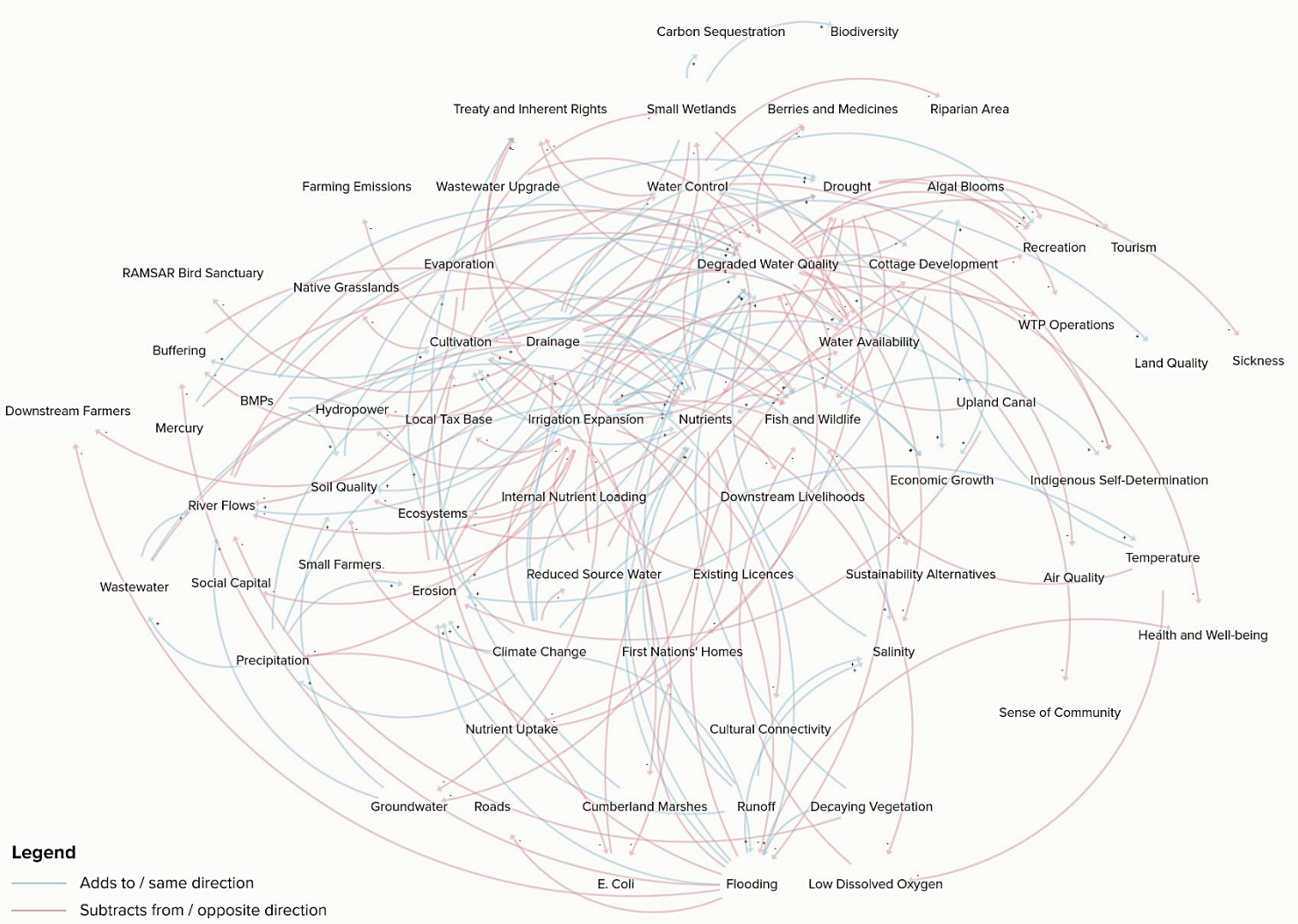


Figure S7.4. A causal diagram of positive (blue) and negative (red) associations of irrigation, drainage, and regional water and land variables in the Canadian Prairies, focusing on the Qu'Appelle River with additional information from the South Saskatchewan River. Links between circles represent quotes from government, stakeholders, and Rights holders. The figure was created in Kumu (2025).

Appendix B: Interview and Workshop Guides

Chapter 4

Questionnaire

Student Investigator: Nathanael Bergbusch

Study Title: Integrating Environmental and Cultural Flows within Impact Assessment through Dialogue with Experts and Practitioners in Canada to Inform Sustainable Decision-Making

Study Duration: June to August 2022 (Phase One) and September to November 2022 (Phase Two)

Interview Durations: 45 min to an hour and 15 min

Interview Location: Zoom

Phase One: Script for Interviews with E-flows Experts, Researchers, and Practitioners

Thank you for joining me for this interview to discuss perceptions around environmental and cultural flows and impact assessment in Canada. I have sent you a document about impact assessment prior to this interview to provide background information. First, I will begin with some demographic and preliminary inquiries.

Demographic/Preliminary inquiries:

1. Where, geographically, are you currently based?
2. What is your current occupation (e.g., professor, environmental consultant)? Please do not indicate the organization that you work for you.
3. What is your experience with environmental or cultural flows in Canada?
4. What is your experience with impact assessment in Canada?

Main inquiries:

Today's interview and this study are intended to discuss how environmental and cultural flows approaches are currently integrated within impact assessment and how they might be integrated so that planning and implementation of developments are better informed about the interests of downstream or regional communities and ecosystems.

Topic I: Regional impacts to communities and ecosystems

1. Do you believe that Canada (and/or particular sub-national jurisdictions) adequately include(s) attention to regional or downstream communities and ecosystems in industrial development decisions? Why or why not?
2. Do you have any concerns with how Canada (and/or particular sub-national jurisdictions) currently evaluates (predicts in impact assessments and/or monitors/manages post-approval) development impacts on regional or downstream communities and ecosystems? Please describe.
3. What do you perceive as needed additions to how Canada deals with regional impacts, especially on waterways?

Topic II: Environmental and cultural flows

1. Please describe what environmental flows and cultural flows mean to you.

2. How are environmental and cultural flows related to downstream or regional communities and ecosystems? Please describe.

Topic III: Integrating E-Flows and impact assessment

1. How have you seen eflows considered in environmental impact assessment? Or how have you used eflows in environmental impact assessment in the past? What about cultural flows?
2. How would you define cumulative impacts in the context of environmental impact assessment?
3. Do you think eflows or cultural flows and cumulative impacts are related?
4. There are 200+ environmental flows methods and many cultural flows approaches that are currently in development. Which approaches do you think have the greatest potential to be used in impact assessment? This includes consideration of valued ecosystem components, streamlining assessments, impact predictions and monitoring/management, cumulative effects, existing EIA models, as well as social and biophysical considerations.
5. How might certain environmental and cultural flows approaches be used to identify and inform indicators for EIA practitioners examining downstream impacts and cumulative effects?
6. For what kinds of projects subject to impact assessment requirements are environmental and cultural flows analyses most likely to be useful?
7. Are you aware of ELOHA and SUMHA environmental flow frameworks or other similar frameworks?
8. If you are aware of eflows frameworks [and more holistic approaches that engage communities like ELOHA or SUMHA], how might we adapt existing eflows frameworks for impact assessment?

Topic IV: Higher-level decision making

1. What use are environmental and cultural flows for decision making?
2. What is your understanding of regional and strategic assessment? What do you think of situating project-level assessment in regional and strategic assessment?
3. How might environmental flows and cultural flows fit into higher-level assessment (especially regional and strategic level assessments of policy, plan and program matters)?
4. Does the consideration of eflows have a place in environmental impact assessment legislation or other related acts and regulations?
5. What future directions do you see for eflows or cultural flows implementation in Canada?

Topic V: Rights, consent, and water justice considerations

1. How familiar are you with the United Nations Declaration on the Rights of Indigenous People and its implementation in Canada? What about Bill C-15: An Act respecting the United Nations Declaration on the Rights of Indigenous Peoples (commonly known as UNDRIPA)?
2. Do you perceive environmental and cultural flows analyses as possible contributions in addressing UNDRIP (especially its provisions requiring free, prior and informed consent) and Indigenous rights in impact assessment? Please elaborate.

Thank you for your responses and time. We appreciate your answers and will send you transcripts of the recordings to verify that we have accurately represented your responses. I will send you a copy of my dissertation or a summary once this it is completed.

Phase Two: Script for Interviews with Environmental Impact Assessment Experts, Researchers, and Practitioners

Thank you for joining me for this interview to discuss perceptions around environmental and cultural flows and impact assessment in Canada. I have sent you a document about environmental and cultural flows prior to this interview to provide background information and potential applications for impact assessment. First, I will begin with some demographic and preliminary inquiries.

Demographic/Preliminary inquiries:

1. Where, geographically, are you currently based?
2. What is your current occupation (e.g., professor, environmental consultant)? Please do not indicate the organization that you work for you.
3. In what capacity have you been involved with impact assessment in Canada?
4. How familiar are you with environmental and cultural flows concepts and approaches?

Main inquiries:

Today's interview and this study are intended to discuss how environmental flows and cultural flows approaches are currently integrated within impact assessment and how they might be integrated so that developments are more inclusive of downstream or regional communities and ecosystems. A previous interview series was completed with environmental flows experts and practitioners to identify how eflows concepts can be applied in impact assessment. This is the second interview series to ask for feedback on these applications and identify gaps in impact assessment practice related to regional or downstream communities and ecosystems. You should have received a document outlining the application of environmental and cultural flows concepts for impact assessment.

Topic I: Regional impacts to communities and ecosystems in impact assessment

1. Do you think the current impact assessment process [either federal, provincial, territorial, or Indigenous] addresses downstream or regional impacts well? How does this process address those impacts?
2. What gaps do you perceive in project-level, regional, and strategic assessment related to downstream communities and ecosystems?
3. What do you perceive as needed additions to how Canada deals with regional impacts, especially on waterways?

Topic II: Impact assessment and environmental and cultural flows

1. Were you aware of environmental and cultural flows concepts before this interview?
2. How common do you think use of environmental and cultural flows concepts is in impact assessment in Canada? Please describe.
3. Which of the identified environmental and cultural flows applications do you think would be most useful in impact assessment to address regional concerns?
4. How might environmental and cultural flows address uncertainty in assessment?
5. How would you define cumulative impacts in the context of environmental impact assessment?
6. What are the challenges with doing good cumulative impacts/effects assessment in Canada?
7. Do environmental and cultural flows approaches have the potential to address impact prediction and monitoring difficulties with cumulative impact assessment?

8. What are the limitations to applying environmental and cultural flows approaches to impact assessment?

Topic III: Higher-level assessment

1. What role, if any, do you think environmental or cultural flows could play in regional or strategic level assessment (on policy, plan and program matters)?

Topic IV: Rights, consent, and water justice considerations

1. How familiar are you with the United Nations Declaration on the Rights of Indigenous People and its implementation in Canada? What about Bill C-15: An Act respecting the United Nations Declaration on the Rights of Indigenous Peoples (commonly known as UNDRIPA)?
2. How are UNDRIP and Indigenous rights currently addressed in impact assessment?
3. Do you perceive environmental and cultural flows analyses as possible contributions in addressing UNDRIP (especially its provisions requiring free, prior and informed consent) and Indigenous rights in impact assessment? Please elaborate.

Thank you for your responses and time. We appreciate your answers and will send you transcripts of the recordings to verify that we have accurately represented your responses. I will send you a copy of my dissertation or a summary once it is completed.

Chapters 5 to 8

*Note that the first questionnaire guide about regional management and assessment differed in certain sections by participant group (Rights holders, government and former government, industry professionals, academics, and environmental non-governmental organizations). The example below is from the workshop with Rights holders.

The second questionnaire was a second workshop about First Nations-led assessment that was specific to File Hills Qu'Appelle Tribal Councils Advisory Councils.

These questionnaires and complementary datasets contributed to content for chapters 5 to 8.

Questionnaire One

Student Investigator: Nathanael Bergbusch

Title: Envisioning Regional Management and Assessment for the Qu'Appelle River Watershed

Study Duration: January to November 2023

Interview Duration: 1-3 hours

Interview Type: Interview or workshop with breakout rooms

Interview Location: On Zoom or in-person in Saskatchewan

Interview Participants: First Nations leaders, Knowledge Holders, Elders, and Councils

Research Approach: Participatory Action Research and Case Study

Script: Thank you for joining me for this three-hour morning workshop to discuss the development of a regional assessment in the Qu'Appelle River Watershed, what could enable this process, and what a regional assessment might look like with water and rights considerations included as key lenses. I have several sections to explore these questions.

Introductory Poll:

1. How familiar are you with environmental assessment?

Not familiar Familiar Very familiar

2. How familiar are you with the idea of cumulative impacts?

Not familiar Familiar Very familiar

3. Are you familiar with the terms environmental or cultural flows or environmental and cultural water?

Not familiar Familiar Very familiar

4. How familiar are you with regional assessments?

Not familiar Familiar Very familiar

Presentation

A. Background Questions

1. What is your current occupation, livelihood, or role in your organization or Nation?

Youth Advisory Council ☐ Elder/Language Keeper ☐ Land User ☐ Land Manager ☐

Women's Council ☐ Leadership ☐ Other ☐

If other, please specify:

2. What Saskatchewan First Nation, city, town, or village do you live in?

3. Do you live close to any water body within the Qu'Appelle River Watershed? Which bodies of water?

4. What part of the Qu'Appelle River Watershed are you most familiar with?

Breakout into smaller groups of 3-5 people.

B. Main Questions for Everyone

Environmental Assessments in Saskatchewan

Description of environmental assessment:

Environmental assessments evaluate the impacts of proposed projects (mines, dams, pulp and paper mills, irrigation) on the environment, society, and the economy. (Muldoon et al. 2020).

1. Please describe your experience with environmental assessments conducted in Saskatchewan.

Cumulative Impacts in the Qu'Appelle River Watershed

Definition of cumulative impacts:

Impacts are often cumulative in that stressors (e.g., metals, floods, extreme low flows, nutrients) from human activities (e.g., agriculture, cities, dams, oil and gas) in the past, present, and future interact to affect the environment and human well-being (Clogg et al. 2017; Hackett et al. 2018; Blakley and Russell 2021).

1. Cumulative impacts affecting the Qu'Appelle River Watershed:

a) What key stressors and management activities do you think are most important with respect to cumulative impacts within the Qu'Appelle River Watershed?

b) What conditions in the Qu'Appelle River Watershed are most affected by cumulative impacts?

c) How are the cumulative impacts detailed above impacting the practice of your Inherent and Treaty Rights?

2. Would you or your organization support the development of a cumulative impacts assessment for the Qu'Appelle River Watershed? Why or why not?

3. If yes, at what scale or parts of the region or watershed do you think a cumulative impacts assessment could be completed?

Development Projects in the Qu'Appelle River Watershed

1. What are your impressions of different water-related developments in the Qu'Appelle River Watershed? For example, irrigation, potash mining, oil and gas, hydropower, and agriculture. Walk through different types of developments.

Environmental Water/Flows, Water Relationships, and Rights

Description of environmental and cultural flows/water provided to help with discussion:

Environmental and cultural flows are water set aside for the environment and water for local people to flourish. They are a scientific approach and a tool for water planning. In more detail, they are the quantity, timing, availability, and quality of water to sustain downstream ecosystems, communities, rights, and livelihoods.

1. What is your experience with water flow, water quality (algae, fish), and social-economic (rights, livelihoods) considerations in the Qu'Appelle River Watershed? Would you share stories or information with me?

2. What are your views on how water should be used, valued, or related to in the Qu'Appelle River Watershed?

3. How is water in the Qu'Appelle River Watershed related to the practice of Treaty and Inherent Rights?

4. How is water in the Qu'Appelle River Watershed related to use and occupation of the waterways?

5. What is your traditional or cultural knowledge about water? How does this relate to your spiritual relationship to water in the Qu'Appelle River watershed?

Development of Regional Management/Assessment

An approach to assessment concerned with region-based environmental planning or development and assessing the impacts of area-specific plans and program initiatives.

Regional management/assessment can be used to:

- Identify baseline for future project-specific impact assessments.
- Establish region-specific thresholds to inform future project decisions.
- Develop standard mitigations procedures for future projects.
- Identify potential impacts on rights and interests of Indigenous peoples.
- Provide guidance for planning initiatives to manage cumulative effects (e.g., land-use and marine-use planning)

From Government of Canada (2022b).

1. Please describe what you think a regional assessment in the Qu'Appelle River Watershed would look like and include? In other words, what regional guidance do we need to inform future development decisions? (go to questions a-e if the group needs to be prompted)

    a) What information and data do we need to inform development decisions?
    b) What regional thresholds and limits might we develop?
    c) How are Treaty and Inherent Rights of Treaty Four Nations part of this process?
    d) What guidance do we need to manage cumulative impacts?

2. What is your vision for future water management in the Qu'Appelle River Watershed? Is this different in wet and dry years?

3. How do we create the conditions for a regional assessment in the Qu'Appelle River Watershed?

4. How could environmental and cultural flow/water considerations be included in a regional assessment for the Qu'Appelle River Watershed?

5. How could Inherent and Treaty Rights considerations be included in a regional assessment for the Qu'Appelle River Watershed?

6. How could we build a relationship with the watershed?

C. Questions for Each Interviewee Group Related to Regional Water

File Hills Qu'Appelle Tribal Council Elders and Knowledge Holders

1. Are there specific locations or important places within the Qu'Appelle River that you value in particular, either for culture, rights, or both?
2. Have you observed any changes in these important places (culture, rights, sustenance from a treaty right to fish, or environmental change)? What changes have you observed?

3. What do you want this place or these places to provide to you?

4. Over your lifetime, would you say that the use of the Qu'Appelle River Watershed (both lakes and river) by your family has:

   Decreased Stayed the Same Increased

   What is the reason for this change?

5. Have changes in the Qu'Appelle River Watershed (water level, flow or water quality) affected how your family uses or feels about living on the land, the river, or the lake? Please describe.

   No Somewhat Yes

   Description:

6. Have changes in the Qu'Appelle River Watershed (water level, flow or water quality) affected the practice of your or your families Inherent and Treaty Rights on the land, the river, or the lake? Please describe.

   No Somewhat Yes

   Description:

7. Are there certain dates, times of the year, or years when changes in the Qu'Appelle River (water level, flow or water quality) have resulted in an inability to use and occupy the lands and waterways and may have caused a breach to your Inherent or Treaty Rights? Please describe and specify the date(s) and location(s) that this has happened in.

   Date(s)/Time(s): Location(s):

   Experience:

8. Do you think the practice of your Inherent and Treaty Right as well as your relationships to the land and water will change as development projects progress? If so, how?

9. What are your concerns for how climate change will affect the Qu'Appelle River Watershed?

File Hills Qu'Appelle Tribal Council Leadership or Member Nation Leadership and Land Managers

1. How does the Tribal Council or your Nation want to protect water for the environment and for First Nations and their Inherent and Treaty Rights within the Qu'Appelle River Watershed?

2. How does your organization relate to other organizations within the Qu'Appelle River Watershed?

3. What are your impressions of how water is currently managed in the Qu'Appelle River Watershed (the flow, water level control structures, and the water quality)?

4. Does your organization face any challenges in being part of water management decision-making?

5. What relationships does your organization want to have with other organizations that are part of decision-making in the Qu'Appelle River Watershed?

6. How are you part of water management decision-making in flood and dry years in the Qu'Appelle River watershed?

7. How could we offer training to change relationships to the watershed?

Larger Workshop

Return to the larger workshop and discuss key themes that emerged about how to conduct a regional assessment for the Qu'Appelle River Watershed.

Questionnaire Two

Student Investigator: Nathanael Bergbusch

Title: Co-developing a Water and Rights Framework for First Nation-led Impact Assessment and Project Review

Study Duration: May 2023 to November 2023

Workshop Duration: Three hours

Workshop Type: Workshop with breakout rooms

Workshop Participants: FHQTC councils and 11 member Nations

Research Approach: Participatory Action Research

Script: Thank you for joining me for this three-hour afternoon workshop to discuss the development of FHQTC's impact assessment policy and a potential water and rights monitoring program for the Qu'Appelle River Watershed. We will start with an interactive presentation and discussion about previous Indigenous-led impact assessment and cultural flows approaches.

A. Presentation

A presentation will be given about Indigenous-led assessment approaches across the country and holistic water programs. Handouts will be provided alongside this presentation. Workshop contributors will have the potential to circle or note key approaches on their handouts at the start of the session and before the group discussion/interview.

B. Group Discussion and Interview

Now we will have semi-structured breakout rooms about developing FHQTC and Member First Nations' impact assessment and project review process and a supportive monitoring program.

Breakout into smaller groups of 3-5 people.

Preliminary Question

1. Within the context of the Qu'Appelle River Watershed and developments (agriculture, dams, irrigation, oil and gas, potash mining), what do you want to know in order to be able protect the waterways and land? What information do we need?

2. What has to be done to ensure water remains sustainable for humans and wildlife?

Impact Assessment

Reflections on Indigenous-led Assessments Across the Country

1. What elements from the Indigenous-led assessment processes we talked about would be useful for a First Nation or Tribal Council led approach to impact assessment? What did you like about certain approaches? (Please circle text on the handouts and write on the paper provided.)

Stages of Project Review Process

2. What could be different steps or stages of a First Nation led approach to impact assessment?

Traditional Impact Assessment Steps:

a) *Pre-project planning* – Proponents consult with affected communities about the project's purpose, potential impacts, benefits, and create a community engagement plan. Benefit-sharing agreements

could be developed at this stage. Governments cannot completely discharge the duty to consult so must work with communities to discuss land use and title.

b) *Project description* – A project description is prepared by the proponent, including the justification for the project and alternatives.
c) *Screening* – A decision is made as to whether an impact assessment is required, who is responsible (proponent or government), and what type of assessment should be undertaken. This is quite dependent on the jurisdiction the project is taking place in.
d) *Scoping and baseline assessment* – If an impact assessment is needed, the issues to include and the spatial and temporal boundaries are identified. Monitoring is done to attain baseline data/information and determine the past changes in selected valued ecosystem components. This is generally iterative and may be completed with project proponents, communities, regulatory bodies, and stakeholders.
e) *Impact assessment* – Expected impacts are predicted and characterized using scenarios, scientific and local/traditional knowledge and patterns, and past related projects and experiences.
f) *Strategies for managing impacts* – Management strategies are developed that could consist of, for example, avoidance, mitigation, and compensation. Protective plans, adaptive management plans, and follow-up and monitoring plans may be developed here.
g) *Significance determination* – The significance of impacts to valued components is identified based on management, residual effects, uncertainties, vulnerability, and sometimes thresholds, sustainability objectives, or regulatory standards.
h) *Submission and review of the environmental impact statement* – The environmental impact statement (EIS) is prepared by the proponent, consultants representing the proponent, or government (for generally smaller projects). The EIS includes technical documents and reports and is submitted for public and technical review. The review process varies by jurisdiction.
i) *Recommendations and decision* – A decision is made by a minister as to whether the project may proceed. Net benefits and adverse effects are generally considered.
j) *Implementation and follow-up* – After project approval, monitoring programs and adaptive management strategies are generally applied to determine and respond to the effectiveness of impact management.

From Noble (2021).

Screening Development Projects

A federal assessment is triggered if a project meets a series of numbered criteria, such as the diversion of water greater than 10 000 000 m3/year, a fossil-fuel generating facility with greater than 200 mega watts, a mine with a production capacity greater than 5000 tons per day, etc.. A provincial assessment is triggered when the project is considered to be a “development” in section 2(d) in the Act and cause, for example, widespread public concern; influence a unique, rare, or endangered feature and have a significant impact on the environment.

3. When do you think that a First Nation or a Tribal Council should be leading an assessment? What conditions have to be met for a First Nation or a Tribal Council to lead an assessment?

Scoping and Assessing Impacts

4. What information would we need to understand the impacts of projects on people and the environment? Walk through key projects: irrigation, oil and gas, potash mines, oil and gas, etc.

5. What key valued components, relationships, or guiding topics would you want to include in an impact assessment for a development project on the water or land?

Examples from the presentation include:

a) Language – culture, stories, place names and instructions on cultural transmission
b) Governance – ability to engage in decision-making about collective welfare

c) Knowledge – continuation of knowledge about the land and skills passed over generations
d) Spirituality and ceremony – the sense of connection to a wider force which may provide individuals with a sense of power and responsibilities
e) Stewardship – rules regarding resource management
f) Livelihood – means of sustenance and economy
g) Cultural continuity – the ability to engage in the same activities in the same places as ancestors did and to pass those skills and knowledges down to future generations
h) Sense of community – social networks, shared values, roles, norms of reciprocity and participation in collective events and activities
i) Sense of place – experience of attachment to particular places
j) Identity – the sense of belonging to a unique collective

From Leonard 2020.

6. How would you consider the impacts of stressors on your valued components, relationships, or guiding topics? What about cumulative impacts or multiple stressors?

7. When thinking about time, how far into the past and future would you think about impacts to your valued components?

8. When thinking about space and geography, how would impacts on valued components in your region be considered?

9. How would you determine if an impact on a valued component is significant? What criteria would need to be considered?

Relating Member Nations' Processes to Federal and Provincial Assessment

10. How would you, FHQTC, or Member First Nations want their assessment process to relate to the federal or provincial assessment process (see options a-c)?

a) Indigenous-led Studies – Studies within an assessment that is primarily led by proponent (industry, company) or Impact Assessment Agency. Types of studies:
    i. Indigenous knowledge studies
    ii. Indigenous land use studies
    iii. Cultural impact assessment studies
    iv. Cumulative effects assessment
    v. Rights impact assessment
    vi. Socio-economic impact assessment
    vii. Archaeological or heritage studies
    viii. Health studies
    ix. Harvest and food security studies
    x. Ecological studies
b) Collaborative Assessment – An Indigenous Nation is working in a formalized partnership with either the proponent (industry, company) or the Impact Assessment Agency through the course of the impact assessment.
c) Indigenous-led Assessment – Indigenous Nation is leading its own assessment in parallel with another assessment process and reaching its own separate conclusions.

From First Nations Major Projects Coalition 2020

Monitoring Program

1. What elements from the holistic and water rights monitoring approaches do you think would be useful for FHQTC Member First Nations of FHQ Tribal Council in protecting the waterways?

2. What would a monitoring program look like?

a) What key relationships to water would you consider?
b) Where would sampling be done?
c) Who would be involved? Would the youth council work with the Elders?
d) When would sampling be done? May-September, every month?
e) How long would this sampling program continue for?
f) How would the information be used to influence management (water levels, discharge, water quality)?

Impact Assessment and Monitoring Program

1. How do you think the monitoring program we are developing could support FHQTC Member First Nations or FHQTC's impact assessment and project review process? Reflect, as a group, on how pre-developed monitoring programs can feed into the impact assessment process.

Larger Workshop

Return to the larger workshop and discuss key themes that emerged related to a project review process and supportive monitoring program.

Appendix C: Codebooks

Chapter 3

Codebook 3.1. Environmental and cultural water definitions.

Term	Definition
Environmental Flows/Water	"The quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems" - Brisbane Declaration (2007), Global Action Agenda (2018, p. 2)
Environmental-Social Flows/Water	"The quantity, timing, and quality of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods, and well-being." – Updated Brisbane Declaration and Global Action Agenda (2018, p. 4) Hydro-social-ecological relationships (Anderson et al. 2019; Douglas et al. 2019), excluding water rights and entitlements (Murray Lower Darling Rivers Indigenous Nations and Northern Basin Aboriginal Nations 2007).
Cultural Flows/Water	"…water entitlements that are legally and beneficially owned by the Indigenous Nations of a sufficient and adequate quantity and quality to improve the spiritual, cultural, environmental, social and economic conditions of those Indigenous Nations." – Echuca Declaration (2007, p. 2)

Codebook 3.2. Governance – centralized and decentralized.

Term	**Definition**
Water/Environmental Governance	"The set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes" (Lemos and Agrawal 2006, p. 298).
Centralized/Top-Down Governance	Control by country (Bourceret et al. 2021)
Multi-National Governance	Control by multiple countries (Bourceret et al. 2021)
Polycentric Governance	Multiple semi-autonomous decision-making centres (Bourceret et al. 2021)
Co-Governance	Shared authority and collaborative decision-making (Bourceret et al. 2021)
Public-Private Governance	Facilitation between state and private sector (Bourceret et al. 2021)
Decentralized Governance	Co-governance, polycentric, public-private, or community-based governance (Bourceret et al. 2021)

Codebook 3.3. Institutional forms of governance and management.

Form	**Definition**
Water Use Strategy	General protection of water resources for future use.
Dam and Energy production strategy	Production of energy from hydropower and operation or re-operation of dams.
Integrated Water Resource Management	"…a process that promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." - UNEP
Environmental Impact Assessment	"…a planning and decision-making tool used to assess the potential positive and negative effects of proposed projects. Impact assessments consider a wide range of factors and propose measures to mitigate projects' adverse effects." – Impact Assessment Agency of Canada

Codebook 3.4. OECD Water Governance Principles.

Principle	Definition
Principle 1 – Roles and Responsibilities in policy	Clearly allocate and distinguish roles and responsibilities for water policymaking, policy implementation, operational management and regulation, and foster co-ordination across these responsible authorities.
Principle 2 - Scale	Manage water at the appropriate scale(s) within integrated basin governance systems to reflect local conditions, and foster co-ordination between the different scales.
Principle 3 – Policy coordination	Encourage policy coherence through effective cross-sectoral co-ordination, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning and land use
Principle 4 – Capacity	Adapt the level of capacity of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties
Principle 5 – Data and information	Produce, update, and share timely, consistent, comparable and policy-relevant water and water-related data and information, and use it to guide, assess and improve water policy
Principle 6 – Finance	Ensure that governance arrangements help mobilise water finance and allocate financial resources in an efficient, transparent and timely manner
Principle 7 – Regulation (legal, administrative, and regulatory frameworks)	Ensure that sound water management regulatory frameworks are effectively implemented and enforced in pursuit of the public interest
Principle 8 - Innovation	Promote the adoption and implementation of innovative water governance practices across responsible authorities, levels of government and relevant stakeholders
Principle 9 - Transparency	Mainstream integrity and transparency practices across water policies, water institutions and water governance frameworks for greater accountability and trust in decision-making

Principle 10 – Engagement/Partnership	Promote stakeholder engagement for informed and outcome-oriented contributions to water policy design and implementation
Principle 11 – Trade-offs	Encourage water governance frameworks that help manage trade-offs across water users, rural and urban areas, and generations
Principle 12 – Monitoring or evaluation of policy	Promote regular monitoring and evaluation of water policy and governance where appropriate; share the results with the public and make adjustments when needed

Codebook 3.5. Environmental and cultural water governance strategies.

Strategies	Definitions
Decision Support Tools	Multidisciplinary participatory models and tools to support decision-making and policy options. - (Xue et al. 2016)
Water Use Caps	1) Cap on Consumptive Water Use "Limit on the total volume of licenses issued and/or the extraction/abstraction of water against these licenses." 2) License Conditions for Water Abstractors "Conditions listed on the license of individual water users that restrict the volume and/or timing of extractions." 3) Conditions on Storage Operators or Water Resource Managers "Conditions on a storage operator prescribing releases from storage for downstream ecological needs." - (Horne et al., 2017, p. 363)
Event Space Management	A unique event that alters how people interact, thereby potentially altering the rules and norms of traditional management. - (Bark et al. 2016)
Development Space	**"**the difference between current conditions in the basin and the furthest level of water-resource development found acceptable to stakeholders through consideration of the scenarios" - King and Brown (2010, p. 135-136) This category also includes incorporating regional water visions into strategic planning.
Water Markets and Trade	"a decentralized approach for allocating water and water rights that have been touted as part of the future of water policy for decades." - (Garrick et al., 2023, p. 1) "a system of marketable rights to water would induce water users to consider the full opportunity cost of water, including its value in alternative uses, thus providing incentives to efficiently use water and to gain additional income through the sale of saved water." - (Rosegrant and Binswanger, 1994, p. 1615)
Indigenous Rights and Laws through Water Justice	"Water and its multi-faceted connections to Indigenous Peoples' self-determination – more precisely, to the socioeconomic, cultural, and political dimensions associated with Indigenous Peoples' exercise of the right to self-determination." - (Robison et al., 2018, p. 841)
Water (Ecological and Aboriginal) Reserves and Trusts	"Legally establishes environmental water as a prior right to consumptive water use."- (Horne et al., 2017, p. 363)
Legal Rights and Personhood	Direct "Giving rivers legal rights means the law can see the river itself as a legal person, and the river can take legal action to enforce those rights. Legal personhood confers legal standing (often described as the ability to sue and be sued), which enables rivers to go to court to protect their rights." - (O'Donnell 2019, p. 1) Indirect "Environmental water managers (EWMs) are organisations with legal personhood, which have been created to acquire and manage water for the aquatic environment." - (O'Donnell, 2017, p. 503)

Chapter 4

Codebook 4.1. Descriptions of demographic indicators for contributors' positionality.

Demographic Indicator	Definition
Background	
Environmental or Cultural Flow/Water	Experience working in the field of environmental and cultural flow/water as a practitioner, policy-maker, or researcher.
Impact Assessment	Experience as a practitioner, regulator, policy-maker, or researcher within water-related impact assessment.
Expertise	
Hydrogeomorphological	Engineers and modellers working on water allocation and hydrology and the relationships to geology and river/lake morphology.
Biophysical	Freshwater and estuarine biologists working on fish, habitat, contaminant transport, invertebrates, and algae and cyanobacteria and relationships to water allocation and hydrology.
Socio-Cultural-Economic	Social scientists with experience in qualitative investigation of people's experiences with water allocation and hydrology.
Social-Ecological	Natural and social scientists offering systems perspectives on water quantity, quality, and socio-economic perspectives.
Rights-Based	Experts in rights-based analysis and forms of assessment related to how water allocation and hydrology affect the practice of Inherent and Treaty Rights.
Assessment Experience	
Project-level	Those involved in project-level assessments for individual developments.
Regional-Strategic	Those involved in or who have experience in evaluating regional-strategic assessments.
Policy and Reviewer	Those designing policies or reviewing policies and projects for their organization.
Law and Regulatory	Legal experts or regulators for governmental organizations.
Researcher on Theory and Practice	Scholars researching impact assessment, environmental and cultural flows, or water sustainability more broadly.
Practitioner	Consultants carrying out part of a water-related impact assessment.
Supporting or Representing Communities	Individuals that are part of or are supporting Indigenous Nations in assessment or water management matters.
Part of Land Management Board	Individuals who sit on Land Management Boards in the Territories

Codebook 4.2. Descriptions of emergent thematic codes corresponding to figure 4.1 – issues in impact assessment that require positive action. Themes emerged from conversations with contributors but were also inspired, in part, by impact assessment literature in the references section (e.g., Blakley et al. 2020).

Inductive thematic code	Description
Capacity and funding	Not enough monetary support or a lack of process in impact assessment and engagement to include regional and downstream rightsholders and stakeholders.
Data gaps	Lacking regional watershed information and data or a process to collate and synthesize natural and social science information and data.
Disciplinary siloes	Compartmentalization of impact assessment disciplines (physical, biophysical, socio-economic) with effort to coordinate but difficulties in practice.
Governance negotiation	The need to negotiate governance goals for watersheds ahead of impact assessments to identify if projects interfere with the ability to govern by rightsholders.
Scoping disagreements	Contention over chosen spatial, temporal, and contextual (institutions/organizations to include) scales to determine impacts on valued components.
Limited regulatory oversight	No legislation to protect environmental and cultural flows and water or broader water goals in impact assessment.
Political bias	Regional political agendas and economic motivations interfering with proper assessment of proposed projects or dictating which projects require assessments.
Screening projects	Determining which projects require assessments based on their perceived risk.
Unclear jurisdictional authority	Multiple jurisdictions with overlapping authority to trigger assessment, regulate assessment components (the Fisheries Act, the Navigable Water Acts, etc.), or influence decisions that are independent of assessments but influence cumulative stressors.
No existing thresholds	No consensus on limits for water levels, flow, withdrawal, or quality within a region.
Unclear assessment triggers	Criteria that trigger assessments allow projects to move ahead if they are able to circumvent requirements.
Unsatisfactory engagement	Engagement processes that inform communities rather than create mutually beneficial partnerships.
Inattention to cumulative effects	Minimal consideration of broader cumulative of multiple project developments within a region.

Codebook 4.3. A description of emergent thematic codes related to the application of environmental and cultural flows planning in impact assessments. Themes emerged from conversations with contributors, but the generation of themes was also informed by existing literature.

Thematic code	Description	Inspiration Source
Knowledge sharing	The ability to exchange knowledge about water in a generative way through proactive sharing spaces ahead of assessment.	E.g., Jimmy et al. 2019
Water standards	Developing water standards based on evaluating the sensitivity, importance, and sacredness of water bodies.	E.g., WWF-Canada 2017
Cumulative effects	Examining the cumulative effects of water abstraction, drainage, and pollution for assessment designated and undesignated projects ahead of new development.	E.g., Blakley and Russell 2021
Early collaboration	Building up the pre-planning phase of impact assessments for greater appreciation of sustainability, strategic, and regional considerations.	E.g., Gibson et al. 2020
Baseline	Understanding hydro-social-ecological information needed to centre a project development within the watershed.	E.g., Douglas et al. 2019
Inclusive scoping	Broadening the temporal, spatial, and contextual/institutional scales of impacts assessments based on water cycles and transboundary relationships.	E.g., Sultana 2018
Rights and culture	Appreciating impacts to rights and culture for those downstream of development decisions.	E.g., Morgan 2012
Screening projects	Determining what projects should undergo assessments and be approved based on the creation of a water development space.	E.g., King and Brown 2018
Systems thinking	Including greater appreciation of social-ecological systems and related frameworks in assessments in watersheds.	E.g., Ostrom 2009
Tiering	Setting goals at the regional/watershed level, using that information to inform plans, programs, policies, and projects, and then testing success on the ground and informing water supply and allocation strategies at a higher level.	E.g., Arts et al. 2011
Water Relationships	Understanding how communities relate to and steward water systems, both through tangible and intangible expressions.	E.g., Craft and King 2021

Chapter 5

Codebook 5.1. Barriers to the water regulatory and impact assessment model.

Barrier	Definition
Assessment Triggers and Standardized Process	***Assessment Triggers*** Criteria that result in development projects being designated or not being designated for impact assessments. – IAAC, 2019; Noble, 2021a Saskatchewan Environmental Assessment has six qualitative criteria: • "have an effect on any unique, rare or endangered feature of the environment; • substantially utilize any provincial resource, and in doing so, preempt the use, or potential use of that resource for any other purpose; • cause the emission of any pollutants or create by-products, residual or waste products which require handling and disposal in a manner that is not regulated by any other Act or regulation; • cause widespread public concern because of potential environmental changes; • involve a new technology that is concerned with resource utilization and that may induce significant environmental change; or • have a significant impact on the environment or necessitate a further development, which is likely to have a significant impact on the environment." - Government of Saskatchewan, 2014, p. 4 ***Assessment Standardization*** Having a standardized impact assessment process that may not leave room for creativity and innovation in pursuing sustainability. – Gibson et al., 2005
Project and Impact Splitting	***Project Splitting*** "Project splitting involves proponents seeking approvals for parts of a larger project separately, to avoid more rigorous EIA for the total project." - Ehrlich, 2021, p. 6 ***Impact Splitting*** "Impact splitting involves considering significance determinations of individual impacts separately, to avoid a finding of significant adverse impact for the total effects of a project. Both involve flying below the impact assessment radar." - Ehrlich, 2021, p. 6
Limited Regulation or Self-Regulation	***Limited Regulation*** A lack of regulatory enforcement because of no enabling legislation or discretion by regulatory bodies. – Sheelanere et al. 2013 ***Self-Regulation and Regulatory Capture*** When proponents or licence holders have the power to influence the regulatory process, and, in these cases, the regulator may represent the proponent or license holder rather than the public. – Edwards, 2021
Weak Effort to Meet Duty to Consult	***Duty to Consult*** The Crown has a legislated duty to "consult and accommodate" Indigenous communities to protect "existing aboriginal and treaty rights." – Canadian Constitution Act, 1982, section 35 ***Engagement*** Governments, proponents and practitioners include Indigenous communities' knowledge and stakeholder perspectives. - Government of Canada, 2019 ***Range of Duty to Consult*** When consultation occurs, the Crown (or proponents charged with part of the duty to consult) determines the degree of consultation necessary based on the level of Indigenous interest, seriousness of impairment, and the strength of the Indigenous land claim. – Wright, 2020 *Consultation* At one end of the spectrum, consultation means giving notice of conduct, sharing relevant information, and discussing issues brought up from the notice – Wright, 2020 *Deep Consultation and Engagement* "The opportunity to make submissions; formal participation in the decision-making process; and, the provision of written reasons to show that Indigenous concerns were considered and how those concerns were factored into the decision." – Wright, 2020, p. 14

Codebook 5.2. Explanation of barriers and opportunities for regulatory change.

Themes and Opportunities	**Definition**
Regulatory Enforcement and Enabling Legislation	A lack of regulatory enforcement because of no enabling legislation or discretion by regulatory bodies. – Sheelanere et al. 2013
Watershed Planning/Management	"…a continuous and adaptive process of managing human activities in an ecosystem, within a defined watershed. Integrated watershed management involves the integration of environmental, social and economic decisions and activities through an inclusive decision making process to manage the protection, conservation, restoration and enhancement of aquatic and terrestrial ecosystem features, functions and linkages."- Canadian Council of Ministers of the Environment (CCME), 2016, p. 3
Wetland Protection Policy	"Saskatchewan requires policy to conserve, retain, and restore the province's wetlands, for the benefit of all Saskatchewan people, both current and future generations…" – Ritchie, 2023, p. 1
Baseline or Baseline Assessment	A regional reference condition to measure impacts against and determine the significance of those impacts. - Dubé, 2003; Jones, 2016
Regional Cumulative Effects Assessment	"An approach to assessment concerned with region-based environmental planning or development and assessing the impacts of area-specific plans and program initiatives." – Noble, 2021, p. 219
Indigenous-Led Assessment	"A process that is completed prior to any approvals or consent being provided for a proposed project, which is designed and conducted with meaningful input and an adequate degree of control by Indigenous parties — on their own terms and with their approval." – Gibson et al., 2018, p. 10

Chapter 6

Codebook 6.1. A set of generic sustainability criteria from Gibson et al. (2020, p. 27).

Sustainability Criteria	Definition
Life support	"Build human-ecological relations that establish and maintain the long-term integrity of socio-biophysical systems and protect the irreplaceable life support functions upon which human as well as ecological well-being depends."
Livelihood sufficiency and opportunity	"Ensure that everyone and every community has enough for a decent life and opportunities to seek improvements in ways that do not compromise future generations' possibilities for sufficiency and opportunity."
Intragenerational equity	"Ensure that sufficiency and effective choices for all are pursued in ways that reduce dangerous gaps in sufficiency and opportunity (and health, security, social recognition, political influence, etc.) between the rich and the poor."
Intergenerational Equity	"Favour present options and actions that are most likely to preserve or enhance the opportunities and capabilities of future generations to live sustainably."
Resource Maintenance and Efficiency	"Provide a larger base for ensuring sustainable livelihoods for all while reducing threats to the long-term integrity of socio-ecological systems by reducing extractive damage, avoiding waste and cutting overall material and energy use per unit of benefit."
Understanding, Commitment and Engagement	"Build the capacity, motivation and habitual inclination of individuals, communities and other collective decision-making bodies to apply sustainability principles through more open and better-informed deliberations, greater attention to fostering reciprocal awareness and collective responsibility, and more integrated use of administrative, market, customary, collective and personal decision-making practices."
Precaution and Adaptation	"Respect uncertainty, avoid even poorly understood risks of serious or irreversible damage to the foundations for sustainability, plan to learn, design for surprise and manage for adaptation."
Immediate and Long-Term Integration	"Attempt to meet all requirements for sustainability together as a set of interdependent parts, seeking mutually supportive benefits."

Codebook 6.2. Definitions of environmental, environmental-social, and cultural flow and water terms from various sources.

Flow/Water Term	Definition
Environmental Flows/Water	"The quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems" – Brisbane Declaration and Global Action Agenda (2007), Updated Brisbane Declaration and Global Action Agenda (2018, p. 2)
Environmental-Social Flows/Water	"The quantity, timing, and quality of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods, and well-being." Updated Brisbane Declaration and Global Action Agenda (2018, p. 4)
Cultural Flows/Water	"….water entitlements that are legally and beneficially owned by the Indigenous Nations of a sufficient and adequate quantity and quality to improve the spiritual, cultural, environmental, social and economic conditions of those Indigenous Nations." Echuca Declaration (2007, p. 2)

Chapter 7

Codebook 7.1. Key sustainability considerations.

Sustainability Consideration	Definition
Regional Vulnerabilities	Regional vulnerabilities are all potential risks and complexities that may further compromise the regional social-ecological system, resulting in system collapses, reorganization, and surprises with negative consequences for people and other life (Holling 2001).
Trade-Offs	Benefits and adverse effects, including perceived risks and foreclosed opportunities (Morrison-Saunders and Pope 2013). Perceived risks are hazards that may or may not occur but cause impacts to people's well-being because of an expectation of future consequences (Slovic 2016). Foreclosed opportunities refer to potentially valuable pathways and alternatives that will become unavailable or impractical if specified development trajectories are pursued (Gibson et al. 2005b).
Alternatives	Alternatives of development may include no development, conditions on development, and other development trajectories to determine the most beneficial trajectory (Gibson et al. 2005b).

Codebook 7.2. Flow- and place-based sustainability criteria categories and their indicators derived in Chapter 6.

Sustainability Criteria Categories	Definition	Possible Indicators
Improvement of Water and Native Grasslands for Sufficient Quality and Quantity	Improve the long-term integrity of freshwater quality and quantity, wetlands, grasslands and native pastures, and dependent people and rights by avoiding pollution, unnecessary drainage, and protecting against drought and flood extremes.	- Water quality improvement (fish kills, toxic algae, nutrients) - Grassland and wetland retention and rehabilitation - Water level and low flows
Lasting Upstream-Downstream Livelihood Opportunities and Access	Ensure equal livelihood opportunities (market and rights-based) of upstream and downstream people and communities are supported in development trajectories and not limited in any way by impacts affecting the land and water.	- Rights-based plant harvesting and fishing - Public access - Small farmer revenue - Downstream recreation and tourism
Treaty-Informed Equity in Water and Land-Use Management	Support Treaty- and rights-informed democratic water management through a regional advisory council(s) that aims to reduce gaps (water quality, health, well-being, decision-making authority, and culture and rights practices) between upstream and downstream water and riparian users.	- Roles and responsibilities of managers and communities - Adaptive policy review - Relationship building - Involvement in regulatory frameworks and policy creation
Shared Watershed Identity Through Learning, Openness, and Transparency	Build the shared identity (understanding and commitment) of individuals, communities and Indigenous and provincial governments to apply sustainability principles to watersheds and grasslands through ongoing learning, openness, and transparency.	- Communication - Collective action/responsibility - Political will - Transparency
Respect Regional Climate and Water Uncertainty by Preparing to Mitigate and Adapt for Seven Generations	Mitigate and adapt for seven generations by favouring efficient prairie adaptation and water development trajectories for sufficient agricultural resilience and land and water quality and quantity that supports Saskatchewan residents and improves the spiritual, cultural, environmental, social and economic conditions of Indigenous Nations	- Climate extremes - Frequency and intensity of floods and droughts - Adaptation strategies - Precautionary principle
"Enough, For All, Forever" – All Place-Based Sustainability Criteria	Work to meet all the context-specific, interdependent sustainability requirements in the short and long term by respecting water and land and seeking mutual well-being and enjoyment forever.	- All

Chapter 8

Codebook 8.1. Regional planning and assessment options.

Regional Option	Definition
Watershed Planning/Management	"…a continuous and adaptive process of managing human activities in an ecosystem, within a defined watershed. Integrated watershed management involves the integration of environmental, social and economic decisions and activities through an inclusive decision making process to manage the protection, conservation, restoration and enhancement of aquatic and terrestrial ecosystem features, functions and linkages."- Canadian Council of Ministers of the Environment (CCME), 2016, p. 3
Regional Assessment	"An approach to assessment concerned with region-based environmental planning or development and assessing the impacts of area-specific plans and program initiatives." – Noble, 2021, p. 219
First Nation-Led Assessment Centred in Land-Use Plans	"A process that is completed prior to any approvals or consent being provided for a proposed project, which is designed and conducted with meaningful input and an adequate degree of control by Indigenous parties — on their own terms and with their approval." – Gibson et al., 2018, p. 10

Appendix D: Data Sharing Agreement

DATA SHARING AGREEMENT

THIS DATA SHARING AGREEMENT (the **"Agreement")** is made as of the 27 day of **June** _____,2023 (the **"Effective Date"),**

BETWEEN

UNIVERSITY OF WATERLOO

located at 200 University Avenue West, Waterloo ON N2L 3G1 (the **"UWaterloo")**

AND

FILE HILLS QU'APPELLE TRIBAL COUNCIL

located at 740 Sioux Avenue, Fort Qu'Appelle SK S0G 150 (the **"FHQTC"** or **"First Nations")**

AND

THE UNIVERSITY OF REGINA

located at 3737 Wascana Parkway, Regina, SK 545 0A2 (the **"UofR")**

WHEREAS:

A. The Parties wish to work together on a collaboration about how to create and implement a draft regional assessment in the Qu'Appelle River Watershed ("Study One"), as well as develop FHQTC's impact assessment policy and a supportive monitoring program based on cultural flows concepts ("Study Two")(collectively the **"Project").**

B. UWaterloo, through its PhD Candidate, Nathanael Bergbusch (the **"Researcher"),** is conducting the Project. Nathanael Bergbusch is supervised by UWaterloo faculty member Dr. Simon Courtenay, UWaterloo's Faculty of Environment;

C. FHQTC is the political and service organization for the Qu'Appelle Agency and the File Hills Agency, delivering programs and services to the eleven First Nations in the Treaty Four Territory. The eleven sovereign Member First Nations include Nekaneet First Nation, Wood Mountain Lakota First Nation, Piapot First Nation, Muscowpetung Saulteaux Nation, Pasqua First Nation, Standing Buffalo Dakota Nation, Okanese First Nation, Star Blanket Cree Nation, Little Black Bear's Band of Cree & Assiniboine Nations, Peepeekisis Cree Nation, and Carry the Kettle Nakada Nation;

D. The Researcher has applied for and received approval from the University's appropriate Research Ethics Board **("REB")** for the Project, which approval is attached hereto as Schedule "A";

E. UWaterloo has indicated it wishes to acquire certain information or data in the custody and control of FHQTC and UofR for the purposes of the Project as specified in Schedule "B", attached hereto;

F. The data elements identified in Schedule "B" are Identifiable Data and therefore FHQTC and UofR require an agreement specifying the protection of such Identifiable Data as set forth in this Agreement;

G. The Parties wish to ensure that data is managed in a manner that meets applicable laws and standards regarding personal privacy and also meets the First Nations' expectations

and interpretation of First Nations' OCAP®of First Nations' data; and

H. FHQTC and UofR agree to provide the data elements to UWaterloo in accordance with the terms and conditions of this Agreement.

NOW THEREFORE, in consideration of the mutual covenants and obligations set forth in this Agreement, the receipt and sufficiency of which are hereby mutually acknowledged, the Parties hereto agree as follows:

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1. **SCHEDULES** The following schedules are attached to, and form an integral part of, this Agreement:

1.1.l. Schedule "A" - Project REB Approval; and

1.1.2. Schedule "B" - Data Elements

1.1.3. Schedule "C" - Work Plan

1.1.4. Schedule "D" - Cybersecurity

2. **DEFINITIONS**

2.1. For the purposes of this Agreement:

2.1.1. **"Aggregate Data"** means data presented in summary tables containing no personal information.

2.1.2. **"Arising Intellectual Property" or "Arising IP"** means Intellectual Property that was conceived, developed, improved or first reduced to practice in the carrying out of the Project by any Party.

2.1.3. **"Background Intellectual Property" or "Background IP"** means Intellectual Property that was conceived, developed, acquired, or first reduced to practice by any of the Parties prior to carrying out the Project or is developed independently of the Project.

2.1.4. **"Data"** means the data elements as specified in Schedule [11]8[11] attached hereto, being provided to the Researcher for the Project.

2.1.5. **"Data Steward"** means the Researcher (i.e., Nathanael Bergbusch) who will be responsible for receiving and maintaining the Data and First Nation Data shared under this Agreement;

2.1.6. **"De-identified Data"** means Data from which any information that may reasonably be expected to identify an Individual has been removed.

2.1.7. **"Disclosure"** occurs when the Researcher, or any employee or agent of the University authorized to perform the research, transmits or otherwise makes accessible Data to any other person who is not authorized to perform the research or access the Data.

2.1.8. **"First Nations Data"** means:

2.1.8.1. Any and all data shared by the First Nations under this Agreement;

2.1.8.2. Any data formed by linking one or more data sets with data provided by First Nations parties; and

2.1.8.3. Any data held by the Data Steward pursuant to this Agreement that is capable of identifying First Nation communities, First Nation membership, Indian status, or residence on an Indian Reserve;

2.1.9. **"FIPPA"** means the *Freedom of Information and Protection of Privacy Act* {Ontario) as such legislation might be amended, supplanted, or replaced from time to time.

2.1.10. **"Identifiable Data"** means Data that contains any identifiers allowing the individual to whom it relates to be identified and includes information that either by itself or when combined with other information available to the person who receives it allows the person receiving it to identify the individual being referred to in such information.

2.1.11. **"Identifiers"** means information pertaining to an Individual that could be used to identify the Individual and includes information that contains microdata or aggregates that allow for the indirect identification of, including but not limited to, an Individual, a household, a facility, a work unit.

2.1.12. **"LAFOIP"** means The Local Authority Freedom of Information and Protection of Privacy Act (Saskatchewan) as such legislation might be amended, supplanted, or replaced from time to time.

2.1.13. **"OCAP"** refers to First Nations principles of Ownership, Control, Access, and Permission, known as OCAP®, which represent the assertion of First Nations rights to govern information collected from and pertaining to First Nations. OCAP® mandates that First Nations control, why, how, and by whom information is collected, used, or shared. It respects community privacy rights in the same way that individual privacy rights are valued.

2.1.14. **"Party"** means either FHQTC and/or UWaterloo and/or UofR. **"Parties"** means all of them collectively.

2.1.15. **"Report"** means any document, analysis, review, summary, extraction or any other manipulation of any kind and in any form whatsoever of data;

2.1.16. **"Research Results"** means any data and Intellectual Property created in the performance of the Project. Without limiting the generality of the foregoing Research Results do not include:

2.1.16.1. Background Intellectual Property

2.1.16.2. Confidential information of the FHQTC and/or UofR, which is disclosed to the University to facilitate the Project;

2.1.16.3. Restatements of previously existing information by either the FHQTC and/or UofR; or

2.1.16.4. Methods, techniques, processes or computer codes utilized by the University for the conduct of the Project.

2.1.17. **"Term"** means the term of this Agreement as set out in section 9.

2.1.18. **"Thesis"** means a thesis or academic report of an Intern relating to the Research Project.

2.1.19. **"Use"** means any reference to or manipulation of the Data by any person authorized to access such Data, but does not include Disclosure.

3. PURPOSE

3.1. The Researcher is undertaking the Project as the basis of the Researcher's PhD program. The focus of this Agreement involves the analysis of certain Data within the custody and control of the FHQTC and UofR.

3.2. This Agreement is being entered into by the Parties to support the disclosure of the requested Data from FHQTC and UofR to UWaterloo for the Project. The Data will be used exclusively for:

3.2.1. Study One-To bring together perspectives on regional assessment, the Lake Diefenbaker irrigation expansion, and Indigenous knowledge/science about flow, water quality, and social relationships. These perspectives, long-term hydro-ecological data, and mapping information will inform the development of a draft regional assessment.

3.2.2. Study Two - Ensure FHQTC has protection over data collected from their councils during workshops and monitoring related to developing their own impact assessment policy and supportive cultural flows monitoring program.

4. DATA ELEMENTS

4.1. Data clements that will be disclosed by FHQTC and UofR to UWaterloo pursuant to this Agreement are described in Schedule "B" and will include transcripts from key informant interviews and workshops, as well as long-term lake and river hydro-ecological data for the Qu'Appelle River Watershed.

4.2. Data extraction will be completed by FHQTC and UofR. The Data will be linked including long-term lake data from the UofR, long-term river data from the Researcher's Master of Science thesis at the UofR, Landsat models from the UofR, and interview data from First Nation and non-First Nation informants. FHQTC and UofR will replace any identifying numbers with a randomly generated identifier, prior to providing Data to UWaterloo.

4.3. The Pnrties acknowledge that the Data, as provided to UWaterloo, is considered to be De-identified Data as defined under this Agreement.

4.4. FHQTC and UofR Data will be provided on a one-time basis. The data will not be used for future purposes or work that is outside the scope of the Project.

5. REPORTS

5.1. The Parties acknowledge that the Data will be used to produce a variety of reports, publications, presentations, or public disclosure of the results of the Project.

5.2. UWaterloo agrees that any report, publication, public disclosure, or presentation of the Data for only the purposes as outlined in this Agreement will be prepared using Aggregate or De-identified Data.

5.3. Any reports, publications, public disclosure or presentations that include data derived from FHQTC and UofR Data shall contain the following acknowledgement (or a significantly similar statement):

"Data used in this [report] were made available by the FHQTC and UofR. Any opinions expressed by the authors do not necessarily reflect the opinion of the FHQTC and UofR".

5.4. Quotes (anonymized or attributed data) from interviewees that are FHQTC Member Nations Citizens may be used in co-authored (with FHQTC) publications and presentations if consent is given by these

individuals and FHQTC. All transcripts, the final paper text, and presentation script and text will be verified by interviewed individuals and FHQTC before submission. The use of data cannot be expanded without individuals' and FHQTC's consent.

6. DATA PROTECTION PROTOCOLS

6.1. Data will be securely transferred as follows:

6.1.1. General:

6.1.1.1. Researcher attests that he has completed cybersecurity awareness training provided by the University of Waterloo.

6.1.1.2. Data will not be stored on portable storage media (e.g., USB sticks, portable drives) except for disaster recovery purposes. Backup media will be encrypted and stored in a physically secure location

6.1.1.3. Transfer of Data will occur through One Drive, part of Microsoft 365, following practices outlined in UWaterloo's Information Systems and Technology Department. Transfer of Data will be via electronic mail only if the email is encrypted. Use of email will be avoided.

6.1.2. For Study One:

6.1.2.1. Transcripts from interviews with First Nations informants will be sent to respective interviewees and FHQTC. Original copies will be stored in a password protected folder on the Researcher's password protected personal computer and in an encrypted folder in Microsoft 365 OneDrive, which requires multi-factor authentication. Analyzed results will be sent to First Nations informants, FHQTC, UofR, and UWaterloo through OneDrive. Analyzed results, as quotes

from interviews or figures, will be used in publications and presentations after consent is given by FHQTC and First Nations informants.

6.1.2.2. Transcripts from interviews with non-First Nation informants will be stored on the Researcher's password protected computer and in an encrypted folder in Microsoft 365 OneDrive. Results will be shared with FHQTC, UofR, and UWaterloo through OneDrive.

6.1.2.3. Geographic information related to developments will be on the Researcher's password protected computer and in an encrypted folder in Microsoft 365 OneDrive and outputs will be sent to FHQTC, UofR, UWaterloo, and used for data sharing and publication purposes.

6.1.2.4. Long-term data from the University of Regina will be stored on a shared Microsoft 365 online folder with UWaterloo. Outputs (figures, infographics and text) will be sent to FHQTC and the University of Regina for data sharing and publication purposes.

6.1.3. For Study Two:

6.1.3.1. Transcripts from group interviews with FHQTC councils Members will be sent to FHQTC. Original copies will be stored in a password protected folder on the Researcher's (UWaterloo's) password protected personal computer and in an encrypted folder in Microsoft 365 OneDrive. Transcripts and analyzed results will be sent to FHQTC through OneDrive.

6.1.3.2. Follow-up surveys, if completed, will be stored in a password protected folder on the Researcher's password protected personal computer and in an encrypted folder in Microsoft 365 OneDrive. Raw data and analyzed results will be sent to FHQTC and UWaterloo through OneDrive.

6.1.3.3. Monitoring data, if collected, will be stored in a password protected folder on the Researcher's password protected personal computer and in an encrypted folder in Microsoft 365 OneDrive. Raw data and analyzed results will be sent to FHQTC and UWaterloo through OneDrive.

6.2. It is expressly acknowledged that FHQTC is only prepared to provide UWaterloo with the requested Data pursuant to this Agreement if the requested Data are De-identified and are not Identifiable Data, as defined under this Agreement.

6.3. The Researcher and UWaterloo shall take reasonable steps to protect the security and confidentiality of the Data, including without limitation:

6.3.1. Protecting the Data to at least the same standards as the FHQTC and UofR protects data under their respective custody and control; and

6.3.2. To at least the same standards as UWaterloo protects delta under its custody and control.

6.4. The Parties will immediately advise the other if they:

6.4.1. Become aware of inaccuracies in the shared Data; or

6.4.2. Suspect the security of the Data may have been compromised; and

6.4.3. Suspect a breach of the requirements of this Agreement by one or more of the other Parties.

6.5. In further support of the provision of Data from FHQTC and UofR for the Project, copies of the Certificates of Approval for these studies from the University of Waterloo REB (REB 44463 and 44504) that were obtained are attached hereto as Schedule "A".

6.6. The Researcher and UWaterloo shall restrict access to the Data shared by FHQTC and UofR to members of the Project research team, as identified on the University of Waterloo REB application.

6.7. The Researcher and UWaterloo acknowledge and agree that:

6.7.1. The provenance of the Data will be appropriately cited and recognized by the Resec:ircher and UWaterloo;

6.7.2. The Data will only be used for the purposes outlined in this Agreement; and

6.7.3. The Data will not be shared with any other third party or organization without the express prior written permission of FHQTC and/or UofR, as the case may be.

7. INDEMNIFICATION

7.1. The Parties acknowledge that the Data is being provided on an "as is, as available" basis. UWaterloo acknowledges that FHQTC and UofR are not responsible nor liable for any losses, expenses, or damages {of any kind and howsoever arising) that UWaterloo may suffer or incur relating to or arising out of the inaccuracy, incompleteness, corruption, deletion, or unavailability (whether temporary or permanent) of the Data.

7.2. UWaterloo shall indemnify and hold harmless the FHQTC and/or UofR and their directors, officers, faculty, staff, employees, and students from and against all fines, suits, proceedings, claims, demands, damages, judgments, awards, liability, costs, fees (including c1ll legal fees and disbursements on a solicitor and client basis), and actions of any kind or nature arising directly or indirectly, out of, or otherwise connected with any breach of this Agreement, or the unauthorized or improper use, disclosure, or dissemination of the Data (including the Protected Data), including but not limited to any use or disclosure contrary to the provisions of this Agreement.

7.3. UWaterloo acknowledges and agrees that any release of the Data by any manner or means, other than for the purposes expressly provided for in this Agreement, may cause the FHQTC and/or UofR immediate and irreparable harm. UWaterloo agrees that in the event of a breach or an impending breach by UWaterloo of its obligations hereunder, the FHQTC and/or UofR shall be entitled to seek all remedies available to them at law, and UWaterloo specifically acknowledges and agrees that an injunction is a fair and just remedy.

7.4. In no event shall the FHQTC and/or UofR be liable for any claims, damages, injuries, losses, or other liabilities of any kind, whether in tort, contract, or otherwise, arising by reason of, or in connection with this Agreement, except where they have been caused or contributed to by the FHQTC's and/or UofR's negligence or wilful misconduct.

8. GENERAL

8.1. Notwithstanding anything contained in this Agreement, the Parties acknowledge that this Agreement is subject to the provisions of LAFOIP and/or FIPPA.

8.2. The Parties agree to comply with all present and future laws respecting or applicable to their respective Use, handling, and Disclosure of the Data.

8.3. The obligations contained in this Agreement are intended to be complimentary to the obligations the Parties have pursuant to applicable law. In the event of any inconsistency between such obligations, the obligations imposed by law shall govern, provided that to the extent this Agreement imposes a higher confidentiality or security standard than the standard imposed by law, this Agreement shall govern.

8.4. This Agreement and its Schedules constitute the entire Agreement between the Parties with respect to the subject matter hereof. This Agreement supersedes all prior Agreements, oral or written, between the Parties with respect to the subject matter herein.

8.5. This Agreement shall be construed in accordance with the laws of the Province of Saskatchewan.

8.6. This Agreement is binding upon and enures to the benefit of the Parties and their respective successors and assigns.

9. TERM AND TERMINATION

9.1. This Agreement covers the sharing of Data from FHQTC and UofR to UWaterloo from the Effective Date until January 1, 2026, (the **"Term")** or earlier as provided herein.

9.2. The Parties agree and acknowledge that this Agreement must be amended if there are any changes to the data requirements or the Use of the Data.

9.3. This Agreement may be amended upon mutual written agreement of the Parties. Any Amendment contemplated under this Agreement must be executed with the same formality as this Agreement.

9.4. This Agreement may be terminated upon the mutual written agreement of the Parties.

9.5. Any Party may terminate this Agreement for cause if another party does not fulfill any of its duties or obligations as set out in this Agreement and fails to remedy such default within thirty (30) days after being advised of such default by another Party.

9.6. Terms and conditions relating to the following matters shall survive the termination of the Agreement relating to:

9.6.1. Use of the Data;

9.6.2. Confidentiality; and

9.6.3. Indemnification.

9.7. Upon expiry (seven years after thesis completion) or termination of this Agreement, the First Nations' data in UWaterloo's possession will be deleted and the Data Steward will notify the Parties confirming the destruction/return of data has been completed according to this section.

10. NOTICE

10.1. Any notice or other communication required or contemplated by this Agreement shall be in writing and will be effective if delivered by hand to an authorised representative of the other Party, or if sent by registered mail, or if sent by e-mail transmission to the other Parties at the address of such other Party as set out below:

If to the University of Waterloo:

For Contract and Financial Matters:

Research Office, University of Waterloo Leslie Coop

Director, Funding Agencies and Non-Profit Sponsors 200 University Avenue

West, Waterloo, ON, N2L 3Gl Email: lcopp@uwaterloo.ca

For Research Matters:

Dr. Simon Courtenay

Faculty of Environment, University of Waterloo

200 University Avenue West, Waterloo, ON, N2L 3Gl

Email: simon.courtenay@uwaterloo.ca

10.1.1. **If to the University of Regina:**

For Contract and Financial Matters:

Research Office, University of Regina

3737 Wascana Parkway, Regina, SK S4S 0A2 Attention: Contracts Staff

Email: research.office@uregina.ca

For Research Matters:

Dr. Peter Leavitt

Faculty of Science, University of Regina 3737 Wascana Parkway,

Regina, SK S4S 0A2 Email: Peter.Leavitt@uregina.ca

10.1.2. **If to the File Hills Qu'Appelle Tribal Council:**

For Contract and Financial Matters:

Shannon Thomson

Director of Lands, Resources, Environment, and Stewardship (LRES) at File Hills Qu' Appelle Tribal Council

482 Hoffer Drive, Regina, SK S4N 7Al

Shannon.Thomson@fhqtc.com

For Research Matters:

Dr. David Fortin

Environmental Scientist at File Hills Qu'Appelle Tribal Council, Department of LRES

482 Hoffer Drive, Regina, SK S4N 7Al

david.fortin@fhqtc.com

10.2. The address of any Party may be changed by notice in the manner as set out in section 10.1. Any notice, request, direction or other communication shall be deemed to have been given:

10.2.1. If by hand delivery, on the date of delivery; or

10.2.2. If by registered mail, two (2) Business Days after the sending thereof.

10.3. Any communication given by electronic communication is deemed to have been received on the date of its transmission. If the date of transmission is not a Business Day, or if it is not received within normal business hours, then it is deemed to have been received on the next Business Day following transmission. Any Party may change

particulars of its address at any time by providing written notice to the other Parties in accordance with this section.

11. Intellectual Property, Copyright, and Publication

11.1. All rights and title to the Arising Intellectual Property developed under this Agreement shall belong to UWaterloo or the Researcher.

11.2. Each Party shall remain the exclusive owner of its own Background IP. This Agreement does not imply or confer any license or technology transfer of the Background IP exchanged or shared by the Parties in the course of the Agreement.

11.3. Notwithstanding anything in this Article 11 and subject to the applicable terms of confidentiality for the Project, UWaterloo and the Researcher grants the FHQTC and UofR a non-exclusive, royalty-free, perpetual, and irrevocable license and right to use the Research Results for academic research, educational or other non-commercial purposes, and, subject to Article 12, publication.

12. PUBLICATION RIGHTS

12.1. The Parties recognize the importance of communicating scientific data (including the Research Results) and, therefore, encourage their publication in reputable scientific journals and at seminars or conferences. The Parties further recognize the value of academic collaboration and agree to seek opportunities to co-publish Research Results, when appropriate.

12.2. None of the Parties to this Agreement will be restricted from presenting the Research Results or any portion of the same at symposia, professional meetings, for academic evaluation, or by publishing theses, course reports, academic journals or other publications (each a **"Publication").**

12.3. To avoid improper disclosure of a Party's or Parties' Confidential Information or Background IP or loss of available protection of such information or the Research

Results through public disclosure, the Publishing Party will furnish the other Parties with a copy of any proposed Publication at least thirty {30} days in advance of such proposed Publication. During this thirty (30} day period the Parties receiving the Publication shall have the right to request that any Confidential Information or Background IP be deleted from the proposed Publication, or that portions thereof be rewritten so as to protect the intellectual property and/or confidentiality rights of the Party's or Parties' provided that the Publishing Party shall have final authority to determine the scope and content of any Publication, except with respect to the Party's or Parties' Confidential Information and Background IP.

12.4. In the event that a UWaterloo student works on the Project and the student completes a Thesis, the student will own the copyright in that Thesis. Notwithstanding anything else contained in this Agreement, a student shall not be delayed in his or her thesis examination or submission of an academic report. The Parties acknowledge and agree that:

12.4.1. Except as otherwise provided by this Agreement, this Agreement does not obligate the student participant to delay publication or disclosure of a Thesis; and

12.4.2. Nothing in this Agreement shall delay the defense of a student's Thesis.

13. COUNTERPART EXECUTION

13.1. This Agreement may be executed in counterparts. All counterparts shall be deemed originals and taken together shall constitute one and the same Agreement.

IN WITNESS WHEREOF, the duly authorized officers of the parties have executed this Agreement on the date first written above.

The University of Regina:

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Signature **Date:**

Print Name: Dr. Andrea Sterzuk

Title: Associate Vice-President (Research)

University of Waterloo:

UNIVERSITY OF WATERLOO Leslie Copp
Signed with ConsignO Cloud (2023/06/30)
Verify with verifio.com or Adobe Reader.

June 30, 2023

Signature **Date:**

Print Name: Leslie Copp

Title: Director, FANS, Office of Research

File Hills Qu'Appelle Tribal Council:

June 27, 2023

Signature Date:

Print Name: BRAD Johnson

Title: Executive Director of Finance and Administration

SCHEDULE "A"

RESEARCH ETHICS BOARD CERTIFICATE OF APPROVAL

SCHEDULE "B" DATA ELEMENTS

Study One:

1. Data to be disclosed by the First Nations Parties includes key informant interviews (with Elders, Knowledge Holders, Leadership, etc.).

2. Data to be disclosed by the University of Regina includes 25-30 year long-term hydro-ecological data (from both lake and river locations).

3. Data to be disclosed by the University of Waterloo includes research products from key informant interviews (non-First Nation), spatial and temporal geographic information related to industrial developments, and analysis of the long-term hydro-ecological data.

Study Two:

1. Data to be shared and disclosed between parties include workshop interviews and surveys, as well as future monitoring data.

For Study One and Study Two:

1. The Parties agree that the information shared in this Agreement may be collected, stored, disclosed, and used strictly for the limited purposes set out in this Agreement.

2. For greater certainty, any Party may allow a third party contractor to access the data described herein for the purpose of assisting the Party to comply with its obligations

under this Agreement, provided that the disclosing Party ensures, through contract with the third party, that:

a. Data, or any part or product thereof, provided to the contractor shall either be destroyed or returned to the disclosing Party upon the completion of any contract, including service contract; and

b. The contractor shall maintain in the strictest confidence all information made available by or acquired from the disclosing Party and shall not disclose to any third party, copy, or use any data except in performance of the contract with the Party; and

c. The contractor shall maintain the same privacy and security standards as required by the disclosing Party under this Agreement.

GLOSSARY OF NEW TERMS

Term	Meaning	Page Example
Environmental-social flows	"The quantity, timing, and quality of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods, and well-being." – Updated Brisbane Declaration and Global Action Agenda (2018, p. 4) Ecological and non-ecological needs and inclusive decision-making in the same political system.	29
Higher-level assessment	Impact assessment beyond the project level, including strategic, regional, and regional-strategic assessment and Indigenous-led assessment centred in land-use plans. Higher-level assessment may also be referred to as higher-order or higher-tiered assessment.	9
Regional readiness	A state of preparedness that those engaged in the governance of a watershed can reach for acting in the interests of human communities, ecosystems, and their interactions. This includes the ability to create a water development space ahead of developments based on agreed upon water visions for the future (King and Brown 2018).	80
Water change	Describe hydrologic alteration and water quality change through regional data, understandings, and relationships to water.	85
Water consensus	Build consensus on the cultural and ecological significance and sensitivity of water bodies to inform development and assessment processes.	86
Water councils	Create regional visions, objectives, and rules for ecosystem, culture, and rights-based needs with a dedicated advisory council.	85