

**TOWARDS SUSTAINABLE OUTCOMES? AN EVALUATION OF ALTERNATIVE
WATER GOVERNANCE ARRANGEMENTS IN BRITISH COLUMBIA**

by

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Abstract

In response to a need for enhanced water governance, water institution reforms are taking place around the world. Common among these reforms is a shift from monocentric to polycentric governance systems, bridging multiple scales of stakeholders through a mix of institutional arrangements. Benefits of a polycentric approach are commonly associated with higher performance in diverse contexts through better adaptation to changing conditions, customized rules that meet local needs and a sense of trust amongst stakeholders. However, even though water reforms identify probable benefits from a polycentric approach, the ability to predict which type of institutional arrangement is likely to yield desired outcomes remains a challenge. This study applies the institutional resource regime framework and transaction cost economics to evaluate the current water regime in British Columbia and identify if an alternative water governance arrangement can promote sustainable outcomes through minimized transaction costs. First, I perform an assessment of the water regime in British Columbia from 1859 to 2016 to identify how and why institutions have changed over time. Second, I compare the perception of transaction costs associated with a watershed agency and a regional district alternative arrangement to the current system to identify if an alternative arrangement can improve coherence through more efficient organizational structures. Third, I assess the perceived transaction costs for a watershed arrangement from respondents in the Okanagan region compared the rest of the province. Data were collected through document analysis and 36 surveys and 5 semi-structured interviews with government officials. Results confirm a complex water regime in British Columbia. Transaction costs under both watershed agency and regional district alternative arrangements were perceived higher compared to the current system, in contrast to what the literature would suggest. In addition, perceived transaction costs do not

significantly differ between respondents in the Okanagan region compared to the rest of the province suggesting no additional coherence associated with a watershed agency arrangement in the Okanagan basin. I conclude that the current system is evolving towards integration, but remains complex due to incomplete Aboriginal rights and title to water, jurisdictional and organizational fragmentation and undefined water yield quotas and water quotas.

Lay Summary

This study examines how the Water Sustainability Act can contribute to sustainable water governance and management in British Columbia. The research occurs in three phases. First, I assess the water regime in British Columbia from 1859 to 2016 to develop a trend in reform. Second, I look at whether alternative governance arrangements can improve coherence of the regime by reducing transaction costs. Third, I look at a comparison in the Okanagan to see if perceptions of a watershed agency from respondents in the Okanagan region differ from the rest of the province. Results show that the water regime is evolving towards integration, however, remains complex. In addition, both a regional district arrangement and a watershed arrangement would result in lower coherence due to additional coordination requirements. Even in the Okanagan, with the presence of the OBWB, alternative arrangements are not expected to improve coherence of the water regime.

Preface

This research is my independent, original work. I identified the research problem, designed the research program, gathered and analyzed the data and wrote all chapters. My advisory committee provided valuable feedback on my research program, analysis and writings.

All research was conducted with approval from the UBC Behavioural Research Ethics Board (UBC BREB #H18-00212 project title “WSA TC evaluation”).

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List of Abbreviations

BC	British Columbia
BCWWA	BC Water and Wastewater Association
CVRD	Cowichan Valley Regional District
CWRA	Canadian Water Resource Association
DR	Disposition rights
EMBC	Emergency Management British Columbia
ENV	Environment and Climate Change Strategy
FITFIR	First in time, first in right
FLNRORD	Forests, Lands, Natural Resource Operations and Rural Development
IE	Institutional Environment
IJC	U.S. - Canada International Joint Commission
IRR	Institutional Resource Regime
LOA	Land Ordinance Act
MH	Much higher
mH	Moderately higher
ML	Much lower
mL	Moderately lower
N	Neutral
NIE	New Institutional Economics
OBWB	Okanagan Basin Water Board
OECD	Organization for Economic Co-operation and Development

OR	Ownership rights
SA	Strongly agree
sA	Somewhat agree
SD	Strongly disagree
sD	Somewhat disagree
SIOE	Society for Institutional and Organizational Economics
TC	Transaction Cost
TCE	Transaction Cost Economics
UR	Use rights
WSA	Water Sustainability Act

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Dedication

To Landon

Chapter 1: Introduction

1.1 Problem Statement

In response to scarcity, greater competition for rights of access and over-exploitation of resources, reforms to water institutional regimes are taking place around the world. These reforms include changes to governance structures, increased involvement of non-state actors and the introduction of water markets. Of these reforms, a shift from monocentric to polycentric water governance regimes, bridging multiple scales of stakeholders through a mix of institutional arrangements, has become popularized through the works of Ostrom and Pahl-Wostl. Benefits of a polycentric approach are commonly associated with higher performance in diverse contexts through better adaption to changing conditions, customized rules that meet local needs and a sense of trust amongst stakeholders.

In British Columbia, these findings are recognized in the province's new Water Sustainability Act (2014) which offers the opportunity for alternative governance approaches that could better respond to the unique challenges and needs at more local levels. But what these new institutional arrangements will look like remains up for debate. Questions around appropriate scales, hierarchy of powers and responsibilities, and where funding will come from are being asked with many state and non-state actors assuming and promoting the delegation of governance to the local level at the watershed scale. Although this trend follows other provinces in Canada (i.e. Alberta, Saskatchewan, Ontario, Quebec, and Nova Scotia) who have undergone water reform and adopted watershed management and governance approaches, they have not been as successful as anticipated due to lack of actual delegation of decision making authority, uneven water protection and management, demographic concerns, lack of organizational capacity, and

lack of policy and procedural coherence (Cohen, 2011). Pahl-Wostl and Knieper (2014) have also drawn correlation between a lack of coordination between centers of decision making and failure to produce adaptive capacity. There is also limited systematic evidence about the impacts of polycentric governance (Baldwin et al., 2018; Carlisle & Gruby, 2018). As such, a major challenge facing decision makers in British Columbia is how to apply knowledge on institutional reform to determine what institutional design can deliver on the commitment made by the Ministry of Environment (2013b) to “ensure that B.C.’s supply of fresh, clean water is sustainable – not just to meet our needs today, but for generations to come” (p. vii).

This study builds on the notion that we can craft and adjust existing regimes to improve performance and that over time our knowledge on how to develop and refine institutional design will guide us through a wide range of specific cases (Young, 2008a). Unfortunately, the ability to identify which types of institutional design is likely to yield the desired outcomes remains a challenge (Delmas, 2009; Eaton, 1972; March & Olsen, 1989; North, 1990; Ostrom, 2005; Zucker, 1988). As a result, a common approach to institutional change in the public sector is the donor-promoted reform (Baimyrzaeva, 2012). This occurs when a successful reform is promoted with the assumption that the same success will occur in the newly applied context. As one might expect, this is not always the case and has resulted in researchers focusing efforts on identifying “*winning attributes*” through comparative analysis of case studies from around the world (Pahl-Wostl, 2009; Saleth & Dinar, 2004). Although valuable information has resulted from this process, it still does not address *why* reforms succeed and it fails to provide insight on which reform is best suited to meet intended outcomes.

One method, which remains largely underutilized, is the application of transaction cost economics to examine the costs associated with organizing and coordinating human and institutional interactions. Transaction cost economics, along with new institutional economics, which examines the rules and incentives in how institutions are organized, are considered fundamental in the study of why some governance institutions succeed and others fail. New institutional economics highlights the importance of how rules influence the distribution of rights and responsibilities and how that might affect incentives and the behavior of different organizations, while Williamson's work on transaction cost economics suggests that institutions that minimize transaction costs within and across situations optimize decision-making (Williamson, 2009). Transaction costs are also an indication of incoherencies in the institutional resource regime (Bolognesi & Pfliefer, 2019; Marshall, 2013; Ostrom, 2005). The less coherent the regime, the higher the transaction costs (Biesbroek et al., 2011; Vatn, 2005). Coherence relates to the connection and content of institutions, including property rights, public policies and organizations, and is considered vital to integrated governance and the possibility for sustainable outcomes due to improved coordination efficiency (Bolognesi, 2014; Bolognesi & Pfliefer, 2019). Both coherence and extent, which relates to the different goods and services of a resource that are regulated, are used in the institutional resource regime framework to analyze and inform the regime's contribution to sustainable resource use (Varone et al., 2002). Therefore, both the institutional resource regime framework and transaction cost economics can be used to analyze and inform British Columbia's water regime and if alternative arrangements will contribute to further integration and promote sustainable outcomes.

Overall, to understand if water governance and management in British Columbia supports sustainability, this study seeks to look beyond the Water Sustainability Act and evaluate British Columbia's water regime as a whole, including property rights and public policies. It also aims to understand if an alternative arrangement, either a regional district or watershed agency, can promote sustainable outcomes through improved coherence.

1.2 Defining the research

To develop knowledge on how to refine institutional design here in British Columbia to achieve sustainability, this study applies the institutional resource regime framework and transaction cost economics to evaluate the current water regime in British Columbia and identify if an alternative water governance arrangement can promote sustainable outcomes through improved coherence. It draws on a variety of disciplines, including property rights, policy analysis, transaction cost economics, new institutional economics, and organizational theory. First, I examine the water regime in British Columbia from 1859 to 2016 to identify if the regime typology is headed towards integration and associated sustainable outcomes. Second, I compare the perception of transaction costs associated with a regional district and watershed agency alternative arrangement to the current arrangement to identify if an alternative arrangement can improve coherence through more efficient organizational structures. Third, I assess the results of perceived transaction costs for a watershed arrangement to identify if there is a significant difference between respondents in the Okanagan region compared to the rest of the province.

It is the goal of this study to add to the literature on institutional reform and to help policy analysts and decision makers develop and refine existing institutional regimes in British

Columbia to improve coherence and contribute to the Province's commitment to water sustainability.

1.3 Research Questions

The research presented in this dissertation seeks to answer the following question: How does the current water regime in British Columbia support sustainability and how can alternative governance arrangements help? This question is broken down into six questions:

1. Why and how have water institutions changed in British Columbia?
2. How efficient is the current arrangement?
3. How effective are alternative arrangements perceived compared to the current arrangement?
4. Why and how are transaction costs perceived to change under an alternative governance arrangement?
5. Do these perceptions influence why alternative governance arrangements have not been implemented?
6. How do the perceived transaction costs under a watershed arrangement in the Okanagan basin compare to the rest of the province?

1.4 Approach to the research

This study was carried out using a case study research method. Case studies are considered an appropriate method for descriptive, exploratory or explanatory research (Yin, 2014). Yin (2014) notes that “case studies are the preferred strategy when: 1) the main research questions are “how” or “why” questions; 2) a researcher has little or no control over behavioral events; and 3)

when the focus of study is a contemporary (as opposed to entirely historical) phenomenon” (abstract). As such, they are particularly appropriate for the analysis of processes and context involving policy implementation (Robson, 1993; Stake, 1994) and are frequently used by institutional theorists (Goodstein & Velamuri, 2009; Greenwood & Suddaby, 2006). They are also appropriate for the identification of causal relationships and multiple influences (George & Bennett, 2005). Given the goals of this dissertation, a case study approach is considered the best fit to carry out the research.

In addition to identifying the appropriateness of a case study method, it is important to note that results from case studies are subject to limitations. First, the amount of data derived from case study research can result in important observations being omitted and, in addition, can make the analysis difficult to summarize, especially when the situation being examined is complex (Hodkinson & Hodkinson, 2001). Second, numeric representation of qualitative case study research can be difficult due to a lack of precision (Hodkinson & Hodkinson, 2001). Still, many researchers attempt to quantify their results which can lead to undermining of the phenomenon under examination. Third, samples tend to be “small and idiosyncratic, and because data is predominantly non-numerical, there is no way to establish the probability that data is representative of some larger population” (Hodkinson & Hodkinson, 2001, p. 10). The final limitation of case study research relates to the researcher and how they make judgements about the research including the formulation of questions and what to observe (Hodkinson & Hodkinson, 2001). As such, “researcher expertise, knowledge and intuition is a vital part of the case study approach” (Hodkinson & Hodkinson, 2001, p. 10).

Despite these limitations, “a major strength of case study data collection is the opportunity to use many different sources of evidence” (Yin, 2014, p. 119). Moreover, multiple sources of evidence help strengthen the case study conclusion through data triangulation (Yin, 2014). Therefore, a multiple source of evidence approach was chosen to answer the research question to protect the research against bias from a single data source and small sample size and to increase the depth of findings (Silverman, 2006). Specifically, this study employs documentation and archival record research, survey, and in-depth interviews to develop evidence and strengthen the construct validity of the case study (Yin, 2014). These are illustrated in research was performed in phases identified in figure 1.1.

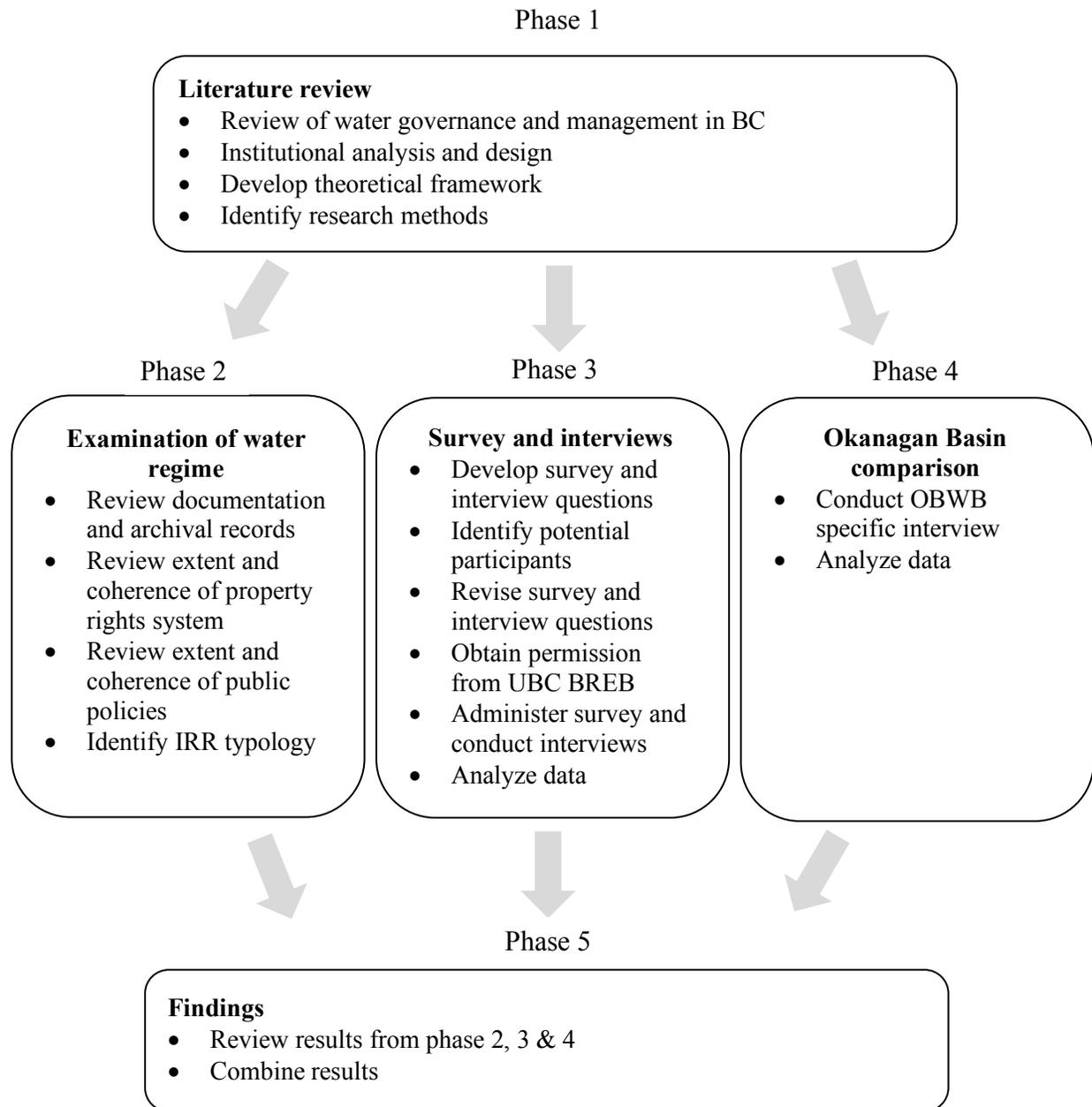


Figure 1.1 Approach to research

In the first phase I performed a high-level literature review on water governance and management in British Columbia and opportunities for alternative arrangements in the Water Sustainability Act. This review highlighted gaps in current literature on water reform in British

Columbia which focused on individual water institutions and fail to consider the broader water regime (property rights, policies and organizational structure) and the institutional environment it operates in. I then performed a literature review on institutional theory and institutional analysis with a focus on transaction cost economics to develop the theoretical framework.

Phase 2 of the research provided an in-depth examination of the water institutional resource regime from 1859 to 2016 using an expanded institutional resource regime framework. Data was collected through documentation and archival record research to identify why and how water institutions have changed in British Columbia. This review revealed four distinct phases of regime typology in British Columbia transitioning from simple to complex. It also helped inform the interview and survey questions.

Phase 3 of the research involved the collection and analysis of data through documentation, survey and interview sources. A draft survey was developed to identify: 1) efficiency of the current arrangement; 2) support and limitations to institutional change; 3) the perception of transaction costs in comparison to the current arrangement for a regional district and watershed agency alternative arrangement; and 4) reasons for differences in transaction costs. The survey was subject to two rounds of pilot testing before being distributed using the University of British Columbia's Qualtrics online survey tool. Participants included government officials working in water science and information (hydrologists, water information technologists, groundwater technicians), decision-making (water managers, engineers, authorization specialists, authorization technicians) and enforcement (compliance and enforcement managers, natural resource officers, natural resource officer investigators). Descriptive statistics were used to

identify efficiency of the current arrangement, limitations and the perception of transaction costs compare to the current arrangement. In depth interviews with key informants and free-form questions in the survey revealed additional information on the determinants of transaction costs.

Phase 4 of the research focused on further analysis of data obtained in phase 3 and the collection of additional data through documentation, archival records and an in-depth interview with a key informant from the Okanagan Basin Water Board. Once coding of data obtained in phase 3 was complete, independence of regions was tested using non-parametric and parametric methods depending on the normality of the variables: 1) transaction cost variables; and 2) limitation variables.

Phase 5 of the research combined results from phases 2, 3 and 4 to evaluate and inform why and how the current water regime and the opportunity for alternative arrangements, specifically a regional district and watershed agency arrangement, can achieve the provinces commitment to water sustainability.

In addition to the methods mentioned above (documentation, archival records, survey, and interviews), participant observation at meetings contributed to the shaping of this research. I attended a wide range of meetings with government officials, First Nations and watershed agencies which provided me with an understanding of various actors' perspective on water governance and management in British Columbia and the Water Sustainability Act (2014). At one of the meetings, the CWRA National Conference (2018), I presented my research proposal

as an oral presentation and sought feedback from government officials present. A list of meeting is provided in table 1.1.

Date	Meeting
May 2014	CWRA meeting and presentation on BC’s proposed water sustainability act
July 2014	CVRD task force meeting on alternative governance arrangements
July 2014	Metro Vancouver workshop on on-site stormwater management baseline
September 2014	CVRD task force meeting on alternative governance arrangements
February 2016	WWF Canada and POLIS project on Ecological Governance forum on environmental flow needs in British Columbia*
November 2016	CWRA BC Conference
October 2017	Meeting with City of Penticton
February 2018	Meeting with Tsleil’Watuth Nation
May 2018	BCWWA Conference presentation
May 2018	CWRA National Conference presentation
June 2018	SIOE Conference poster presentation
August 2019	Meeting with Provincial government
* Designated note taker	

Table 1.1 Water governance meetings attended

1.5 Dissertation structure

The chapters that make up this dissertation are structured around the phased approach to the research previously outlined in figure 1.1. The study is organized as follows.

Chapter 2 provides a high-level outline of water governance and management in British Columbia and an overview of literature on institutional reform and analysis. It identifies the regulations that govern water in British Columbia and challenges with managing a resource that is related to other resources both directly and indirectly. It also provides an overview of the changes brought forward under the new Water Sustainability Act and opportunities for alternative governance arrangements. It then examines institutional change and analysis from various academic disciplines and the application of transaction cost economics. Finally, the

chapter concludes by proposing a framework for assessing the sustainability of British Columbia's water regime and the ability of alternative governance arrangements to promote sustainable resource use through improved coherence.

Chapter 3 examines why and how the water regime in British Columbia has changed between 1859 to 2016 to identify if changes are heading in a direction that enables integrated resource governance and in turn the promotion of sustainable resource use. It examines these changes using the institutional resource regime framework that considers both the extent and coherence of the property rights system and public policies. An expansion of the framework is identified to include factors from the institutional environment such as related resources. The analysis identifies the transition of regime typology from simple to complex over four distinct phases. Limitations in achieving an integrated regime typology were identified and attributed to: 1) incomplete Aboriginal water rights and title; 2) jurisdictional and organizational fragmentation; and 3) undefined water yield quotas and water quotas. These findings contribute to the understanding of how the current water regime supports water sustainability. However, limitations from jurisdictional and organizational fragmentation are not explicit. Specifically, the effectiveness of the current arrangement and efficiency of organizational structure required further analysis to understand if misalignments exist.

Chapter 4 examines the water regime in relation to water authorizations along with opportunities for alternative governance arrangements to understand how they impact coherence within the water rights system. Specifically, this chapter identified participant perceptions on the efficiency of the current arrangement, effectiveness of the current arrangement and alternative

arrangements, limitations to change, and transaction costs of alternative arrangements.

Alternative arrangements included: 1) a regional district arrangement; and 2) a watershed agency arrangement under two scenarios. The first scenario involved the delegation of information, decision making and enforcement activities. The second scenario involved the delegation of only decision making activities. The chapter revealed that under each scenario, both alternative arrangements are considered less efficient than the current arrangement. Specifically, the watershed agency arrangement under scenario two (delegation of decision making activities) is considered the most efficient of alternative arrangements analyzed. Limitations from satisfying level of efficiency are not considered significant, however, limitations around organizational readiness for change were identified from socio-political pressures and lack of staff capacity. The analysis revealed that an alternative arrangement is not perceived to provide efficiency benefits and would not contribute to the integration of British Columbia's water regime through improved coherence.

Building on the results of chapter 4, chapter 5 provides a comparative analysis in the Okanagan basin to examine how the perception of transaction costs of a watershed arrangement compare between respondents in the Okanagan region to the rest of the province. The Okanagan basin is often referred to by both government officials and researchers as an opportunity for the implementation of a delegated approach at the watershed scale¹. The setting in the Okanagan

¹ Nowlan and Bakker, 2007 state "The Okanagan provides another example. If surface water in the Okanagan Basin is closed to further surface water allocations, a local level body such as the Okanagan Basin Water Board may be best situated to make decisions on licence trades and transfers and conversion of land use with water use implications, in conjunction with the Agricultural Land Commission" (p.82).

basin is characterized by a history of water quality issues and high water demands and receives support from the Okanagan Basin Water Board to identify and resolve water issues. The chapter identified that participants from the Okanagan ranked similar to participants from other regions in British Columbia with regard to perceived inefficiencies of a watershed agency compared to the current arrangement. It also revealed that the delegation of decision making activities to the Okanagan Basin Water Board could have negative impacts on transparency, trust and effective collaboration.

The final chapter, chapter 6, provides a discussion of the overall results. The chapter summarizes the findings from this study including why and how the current water regime has changed over time and the opportunity for alternative arrangements. Specifically, both a regional district and watershed agency arrangement fall short in promoting the provinces commitment to water sustainability through improved coherence. The chapter then discusses both the practical benefits of this study to inform the Ministry of Environment and Climate Change Strategy and Ministry of Forests, Lands, Natural Resource Operations and Rural Development and other scholars about the empirical application of institutional resource regime framework and transaction cost economics. Finally, the chapter comments on the limitations of this study and future works.

1.6 Positionality

My motivation to engage in the research has been driven by my professional and volunteer experience. As a member of the Squamish climate action network, I led the water group looking at ways to improve water management in the Town of Squamish. We printed flyers and distributed them to homeowners promoting water conserving technologies and practices. We

reviewed local planning initiatives and provided feedback to encourage water protection. We campaigned to eliminate the sale and purchase of bottled water at municipally owned buildings, recreation facilities and parks and promote the installation of water fountains (“take back the tap” campaign was successful in September, 2010). We also reviewed provincial Water Act modernization reports and provided formal feedback to the Ministry of Environment. Yet, as an engineer, I would find myself designing developments and municipal systems that were in contradiction to the ideals I had been promoting as a volunteer. I was being pulled in two directions and could relate to both perspectives. Trying to find balance between these two objectives (environmental protection and conservation and human development) was complex and involved an evaluation from many sides. In addition, although I relied on government regulations for environmental protection, I was often told by both managers and clients to ignore regulations during design and let the approving authorities require strict compliance. I decided to explore other career opportunities and while at one interview, the interviewer noted that the position had been filled internally but that he wanted to talk. Curious, but also mildly frustrated for having taken the time for what I thought would be an interview, I sat back and began a great talk that quickly landed me in a book store with a pile of books and a new perspective.

It was during this time that I began to challenge my understanding of water governance and management and reflect on the impact that I was having. Although I still found value participating in community action, rules became the centerfold of my career. I was interested in how rules can best achieve intended outcomes, particularly in regards to my experience as an engineer working in development. I also became interested in science-based policy and how information can be best managed to inform policy and decision making.

“Do not listen to those who say there is nothing you can do to the very real and large social and environmental issues of our time” (Maude Barlow, 2012)

Working as section manager of engineering planning and design at a local municipality in British Columbia, all three of these interests were in constant play. First, lack of coordination and communication of water science and information resulted in the overlap of duties and uninformed decision making. Data was being collected by multiple departments and stored in different information systems. Although the municipality had a GIS department dedicated to developing solutions, departments struggled to work together towards a single database for climate, hydrometric and water quality data. Coordination with other organizations also proved difficult as the regional district failed to support the sharing of data between municipalities within the region and the province who were looking for more climate and hydrometric data. As a result, municipalities in the region worked together to share data in a single information management system for use by other organizations. Unfortunately, the cost of using the same system as the regional district and provincial government was too high resulting in the use of a system not acceptable to the province due to limited transparency over quality assurance and quality control. Second, policy options were typically limited to donor reform options that had already been adopted in British Columbia. This meant that policy instruments were limited to what other regions had adopted whether or not the issues we faced locally would be resolved. Third, those writing the rules were not aware of the different types of policy instruments or analytical frameworks available to assess options. So, even when other municipalities had adopted different instruments, the evaluation of alternative options was limited and often based on past experiences.

As an engineer, my approach to this research differs from other assessments of water management and governance in British Columbia. My experience as a development design engineer has shaped my understanding on the application of protection policies and importance of compliance monitoring and enforcement, while my experience with the day to day activities of water governance and management at the local level have shaped my view around the complexity of institutional analysis and design and organizational constraints. In addition, my volunteer experience has shaped my view around the importance of water for human health and happiness. All of these have played a role in the direction of my research and even more specifically, around the attention to the efficiency of alternative governance arrangements.

Chapter 2: Background and theoretical framework

In this chapter I undertake three tasks. First, I provide a high-level outline of water governance and management in British Columbia up until 2016. I identify the regulations that govern water in British Columbia and the challenges with managing a resource that is related to other resources both directly and indirectly. I also provide an overview of the changes brought forward under the new Water Sustainability Act and opportunities for alternative governance arrangements. Second, I provide a review of institutional change and analysis from various academic disciplines and the application of transaction cost economics. Third, I propose a framework for assessing the sustainability of British Columbia's water regime and the influence of alternative governance arrangements on sustainability outcomes.

2.1 Background

Under the Canadian *Constitution Act*, primary responsibility of water governance and management is held at the provincial and territorial level. In British Columbia, both ground and surface water are vested in the Crown and subject to the rules established by a myriad of regulations administered at the provincial and federal levels as shown in Figure 2.1.

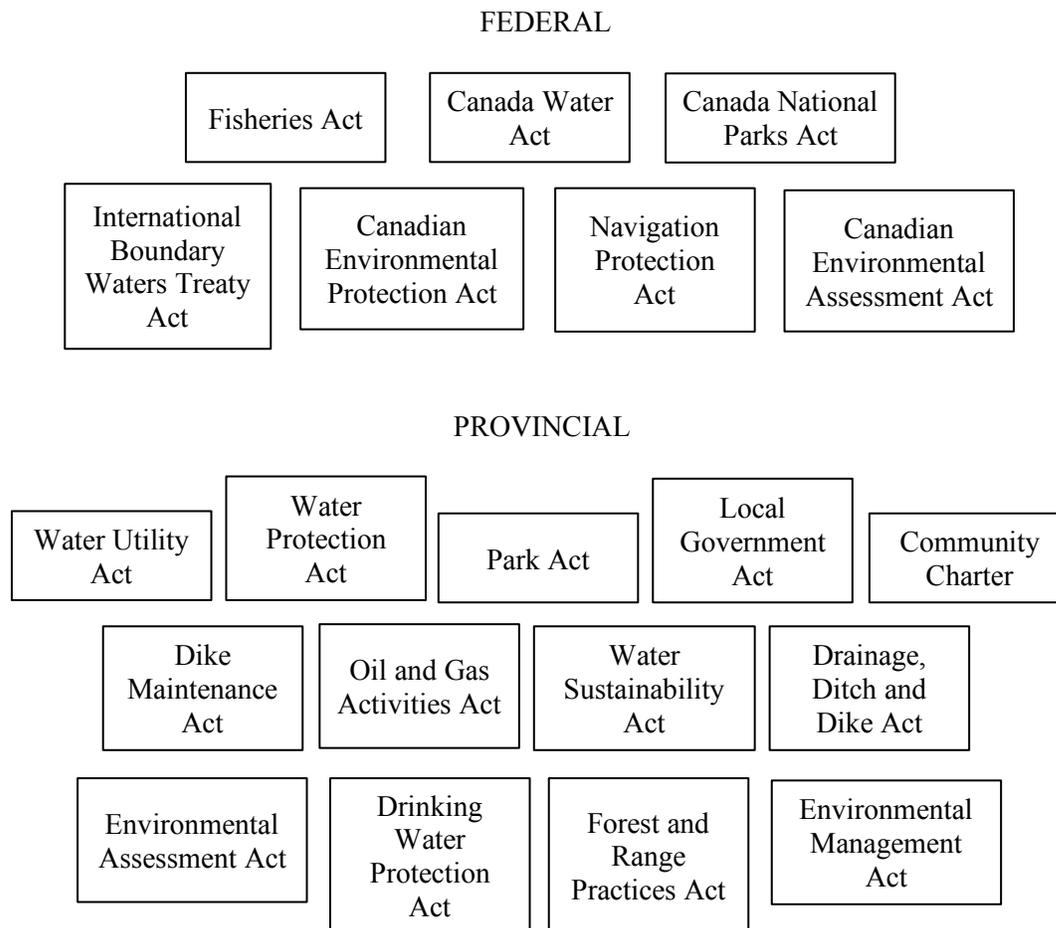


Figure 2.1 Institutions related to water in British Columbia

The Water Sustainability Act is the primary act for the establishment of water use rights in British Columbia, however, all of the regulations identified in figure 2.1 contribute to the overall governance of water from water allocation and infrastructure requirements to water quality protection. Given the abundance of regulations involved, a simple way to look at them is in regard to the number of legislative acts by area, water protection (quality and quantity) and water use (rights and infrastructure) as shown in Table 2.1. By doing so, it highlights the distribution of regulations, which are more heavily weighted to protection measures.

Water Protection		Water Use	
Quality	Quantity	Rights	Infrastructure
<i>Canada Water Act</i>	<i>Fisheries Act</i>	<i>International Boundaries Act</i>	<i>Canada National Parks Act</i>
<i>Fisheries Act</i>	<i>Canadian Environmental Assessment Act</i>	<i>Water Sustainability Act</i>	<i>Water Utility Act</i>
<i>Canadian Environmental Protection Act</i>	<i>Navigation Protection Act</i>	<i>Industrial Development Act</i>	<i>Park Act</i>
<i>Canadian Environmental Assessment Act</i>	<i>International Boundary Waters Treaty Act</i>		<i>Local Government Act</i>
<i>Navigation Protection Act</i>	<i>Water Protection Act</i>		<i>Community Charter</i>
<i>Fish Protection Act</i>	<i>Water Sustainability Act</i>		<i>Local Government Grants Act</i>
<i>Drinking Water Protection Act</i>	<i>Environmental Assessment Act</i>		<i>Drainage Ditch and Dike Act</i>
<i>Riparian Areas Protection Act</i>			<i>Dike Maintenance Act</i>
<i>Forest and Range Practices Act</i>			<i>Water Users' Communities Act</i>
<i>Environmental Management Act</i>			<i>Public Health Act</i>
<i>Environmental Assessment Act</i>			

Table 2.1 Water institutions in relation to protection and use

Protection measures are an important aspect of the water regime as without the protection of water, water may not be available for its intended use. For example, the Water Protection Act (1996) protects water exploitation by restricting bulk water transfers from one watershed to another and the removal of water outside of British Columbia. And the Water Sustainability Act (2014), through the identification of “environmental flow needs” (s. 15), aims to ensure sufficient water quantities in sensitive streams to protect the proper function of aquatic ecosystems. However, the distribution of jurisdictional power over environmental protection

between the federal government and provincial government results in not only a large number of regulations, but also a large number of organizations involved in the governance and management of water. The resulting organization of regulations and organizations is highly fragmented creating a poorly coordinated approach to achieve water policy goals (de Loë, 2017). In addition, water protection regulations in British Columbia fail to extend beyond the protection of water quality and quantity to include the protection of water availability. I propose the term availability in addition to water quantity to differentiate between the protection of water resources (water yield quotas) and water authorizations (water quotas). The protection of water availability includes measures to ensure water throughout the hydrological cycle. This includes measures aimed at ensuring source protection and the sufficient movement of water movement to recharge streams and aquifers, whereas the protection of water quantity aims to ensure water quotas are attainable through the control of water within the stream or aquifer or prioritized during water shortages.

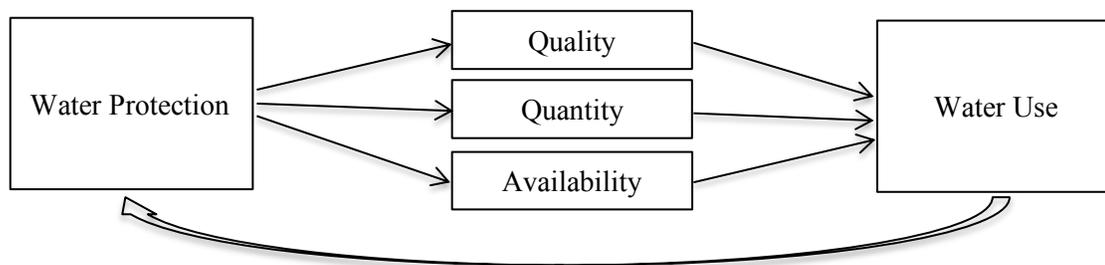


Figure 2.2 Interaction between water protection and water use

This gap around the protection of water availability can be attributed to several reasons. First, as stated by the former British Columbia comptroller of water rights, Jim Mattison, “the water allocation system is – and always has been – about the orderly distribution of water for economic

development” (in Brandes & Curran, 2017, p. 46). As a result, water protection regulations have traditionally been developed outside of the water rights system and have focused on environmental protection.

Second, a history of governing related resources within their individual institutional regime “spheres” has resulted in a lack of integration between related resource regimes to manage cumulative effects (Office of the Auditor General, 2015). Related resources, sometimes referred to as interconnected resources, are resources that interact with one another in a way that can impact their resource stocks and in turn the goods and services they provide. Land and water are recognized as being highly related and have promoted the call for integration within both governance and management around the world (Klumper & Theesfeld, 2017; Daniell & Barreteau, 2014). The former British Columbia auditor general noted in 1999 “A central recommendation is to ensure that the interests of drinking-water users are meaningfully represented in integrated land and resource decision making process” (p. 131). However, cumulative impacts extend beyond water quality and include alterations to the availability of water for use. This can be critical in areas where water users rely on annual precipitation run-off as land use decisions can have drastic impacts on water availability, particularly during the summer when precipitation is low and water use demand is high. To improve integration, the provincial government initiated the cumulative effects framework in 2010 and have introduced water objectives in the new Water Sustainability Act (2014) to mitigate risks from land use decisions on water quality, quantity and availability (Office of the Auditor General, 2015). Nevertheless, the consideration of cumulative effects from related resources remains limited to

the protection of water quantity for ecosystem function and water quality for drinking water sources (see Office of the Auditor General, 2016; Simms & Brandes, 2018).

Given the importance of the connection between water protection and use, coherence between regulations, organizations and related resources would seem to be a top priority to ensure the sustainability of water (quality, quantity and availability). However, to achieve water sustainability, the provincial government points to the new Water Sustainability Act (2014) to “ensure a sustainable supply of fresh, clean water that meets the needs of B.C. residents today and in the future” (Ministry of Environment, 2016). This focus on the Water Sustainability Act fails to acknowledge the complex water regime at play and has resulted in research in British Columbia on water governance focused on the Water Sustainability Act and its regulations (see Nowlan & Bakker, 2010; Simms & Brandes, 2016; Curran & Brandes, 2019). Furthermore, actors responsible for water authorizations have recently been re-organized under the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD). This integration of actors for related resources is seen by some as inviting the opportunity to shift provincial regimes to a more ecologically based paradigm and promote water sustainability (Baltutis, Brandes & O’Riordan, 2012). However, actors will still be limited by the regulations that govern them. Therefore, in order to understand the sustainability of a resource such as water, I proposed to look beyond the Water Sustainability Act and consider the arrangement of all regulations, property rights and protection policies, and factors outside of the water regime such as related resource regimes. Such an analysis follows an institutional approach that considers both the institutional regime and the institutional environment. This will be explored further in section 2.2, however, first I review in more detail opportunities under the Water Sustainability

Act (2014). This includes the opportunity for alternative governance arrangements and how these changes may influence the integration of the water regime.

2.1.1 Opportunities under the Water Sustainability Act

The Water Sustainability Act (2014) is a recent update to British Columbia’s outdated Water Act (1909 to 1996) and is administered by the Water Sustainability Division in the Ministry of Forests, Lands, Natural Resource Operations and Rural Development. It was developed by the Ministry of Environment (now Ministry of Environment and Climate Change Strategy) with what the province describes as “extensive public engagement” and included seven policy themes:

1. Protect stream health and aquatic environments (environmental flows, significant water shortages and prohibition on introducing foreign matter);
2. Consideration of water in land use decisions (water objectives);
3. Regulate groundwater use;
4. Regulate during scarcity (first in time-first in right, and temporary protection);
5. Improved security, water use efficiency and conservation (reviews, water sustainability plans);
6. Measurement and reporting; and
7. Enable a range of governance approaches.

A description of these themes and what they mean for British Columbians is described in table

2.2. However, regulations to support these policies have yet to be developed with prioritization being placed on groundwater use and environmental flows. Nevertheless, support for alternative

governance arrangements remain high for some regions (see CVRD, 2014; Town of Gibson, 2018).

Theme	WSA
Protect stream health and aquatic environments	Consideration of flows needed in a stream for environmental uses when making decisions for licences, authorizations and permits (<i>s. 15</i>) and during times of water shortages (<i>ss. 86-88</i>)
Consideration of water in land use decisions	Water objective regulations may be developed by the province for a designated watershed, stream, aquifer or area for the protection of water quality, quantity and water availability by requiring a public officer, regional district, municipality, local trust committee or prescribed person to consider water objectives when making decisions that relate to the watershed, stream, aquifer or area (restrictions on land use) (<i>s. 43</i>) Advisory boards may be established to provide expert advice (<i>s. 115</i>)
Regulate groundwater use	Introduction of groundwater authorizations and requirements for drilling and maintenance of wells (<i>s. 6</i>)
Regulate during scarcity	Water for domestic and environmental flows can be prioritized above all other uses during a declared significant water shortage (FITFIR still remains in place for all other uses) (<i>ss. 86-88</i>)
Improved security, water use efficiency and conservation	Water sustainability plan may be developed for an area to assist with conflicts between water users, water users and environmental flow needs, risks to water quality, or risks to aquatic ecosystems (<i>ss. 64-85</i>) Terms for power purposes limited to 40 years (<i>s. 19</i>) Terms and conditions of water licences are subject to a review after 30 years and alterations can be made to promote efficient water use and conservation (<i>s. 23</i>) Water reservations for unreserved water (<i>s. 39</i>)
Measurement and reporting	Improved monitoring and reporting requirements for water extraction and diversion (<i>s. 116</i>)
Enable a range of governance approaches	Delegation of powers and duties to another person or entity (<i>s. 126</i>)

Table 2.2 Water Sustainability Act (2014) themes

The enabling of a range of governance approaches is not new and were actually included in the Water Act of 1996 through amendments in 2004. Water governance frameworks presented by the Ministry of Environment (2009) in the water act modernization discussion paper included three options for the delegation of operational management functions: 1) centralized approach; 2)

shared approach; and 3) delegated approach. A centralized approach would be similar to the current arrangement with planning and decision making staying at the provincial level. A shared approach would allow for the development of a partnership in planning and decision making. Other shared approaches have taken place in the province including in the forest sector through the Haida Management Council which is composed of two members of the Haida Nation and two members of the provincial government. The Haida Management Council makes decisions around the use and management of land including the annual allowable cut. A delegated approach would allow for planning and decision making delegated to another organization. It is important to note that all of these options are limited to planning and decision making and do not include data collection, rule-making or enforcement. A summary of these approaches is illustrated in figure 2.3.

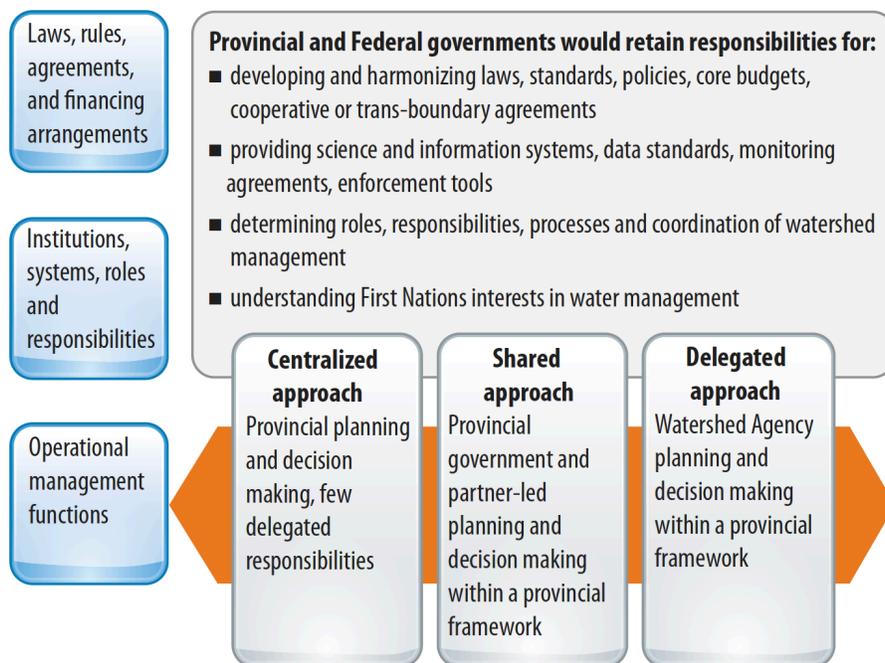


Figure 2.3 Alternative governance options (source: Ministry of Environment, 2009, p. 16)

Researchers on water governance in British Columbia have proposed alternative arrangements that are in line with the provincial options and include enhanced provincial arrangement, watershed agency and regional district leadership (Nowland & Bakker, 2007; Brandes & Curran, 2009; Cohen & Davidson, 2011). Enhanced provincial arrangement would continue with the current centralized provincial government decision making structure, but could potentially promote the integration of government organizations, particularly those of related resources. The development of a watershed agency or regional district leadership on the other hand would represent a delegated approach with decentralized decision making. A watershed agency would require the identification of watershed units which may cross multiple jurisdictional and resource units creating additional coordination efforts amongst organizations in different sectors to optimize outcomes and address cumulative effects. A regional district could also encounter coordination challenges from being located within several watershed units along with accountability concerns from different priorities within each region. Furthermore, researchers identified opportunities for alternative arrangements to establish institutions that better reflect values at the local level while still maintaining provincial priorities (Nowlan & Bakker, 2007; Robins, 2007). However, as mentioned earlier, the province has been clear that alternative arrangements do not include the delegation of rule-making. The only rules that can be developed outside of the provincial government are water protection regulations through the development of Water Sustainability Plans to address conflict between uses (Water Sustainability Act, 2014). Therefore, any delegated arrangement would be restricted to operating within the current water rights system.

Much of the research on alternative governance arrangements has focused on themes around collaborative governance, polycentric governance, adaptive governance, and good governance (see Joe, Bakker & Harris, 2017; Brandes et al., 2016; Brandes & O’Riordan, 2014; Nowlan & Bakker, 2010; Nowlan & Bakker, 2007). One method, which remains largely underutilized, is the application of transaction cost economics to examine the costs associated with organizing and coordinating human and institutional interactions. Transaction cost economics, along with institutional economics, which examines the rules and incentives in how institutions are organized, are considered fundamental in the study of why some governance institutions succeed and others fail. Williamson’s work on transaction cost economics suggests that institutions that minimize transaction costs within and across situations optimize decision-making.

In relation to natural resource governance and management, Allen (1991) provides a definition of transaction costs that is well suited for this study: “Transaction costs are the resources used to establish and maintain property rights. They include the resources used to protect and capture (appropriate without permission) property rights, plus any deadweight costs that result from potential or real protecting and capturing” (p. 3). In the context of alternative governance arrangements, these transaction costs are composed of costs associated with information, decision making and enforcement. And although Allen (1991) does not explicitly identify information costs in his definition, I would argue that it is considered an element of “resources used to establish and maintain a property right”. Understanding these costs are important for several reasons. First, governments are under constant pressure to spend less, however, as competition for resources increases, there is always need for additional resources to continue establishing and maintaining property rights. Therefore, there is a constant need and pressure to

improve efficiency. Second, the current arrangement of organizations involved in water planning and decision making in British Columbia is complex. Specifically, water entitlements are established and influenced within both federal and provincial institutions by actors from several organizations. Institutions related to water entitlements through quotas, allocations and re-allocations are limited to the International Boundary Waters Treaty Act, Canadian Environmental Assessment Act, Fisheries Act, Water Sustainability Act, and the Environmental Assessment Act, which results in vertical and horizontal interplay between federal and provincial regulations. These regulations and actors are identified in figure 2.4 along with their ability to either establish or influence statutory decisions. By unpacking all these interactions and identifying the associated transaction costs, decisionmakers can better understand where opportunities lie and constraints come from in order to improve efficiency.

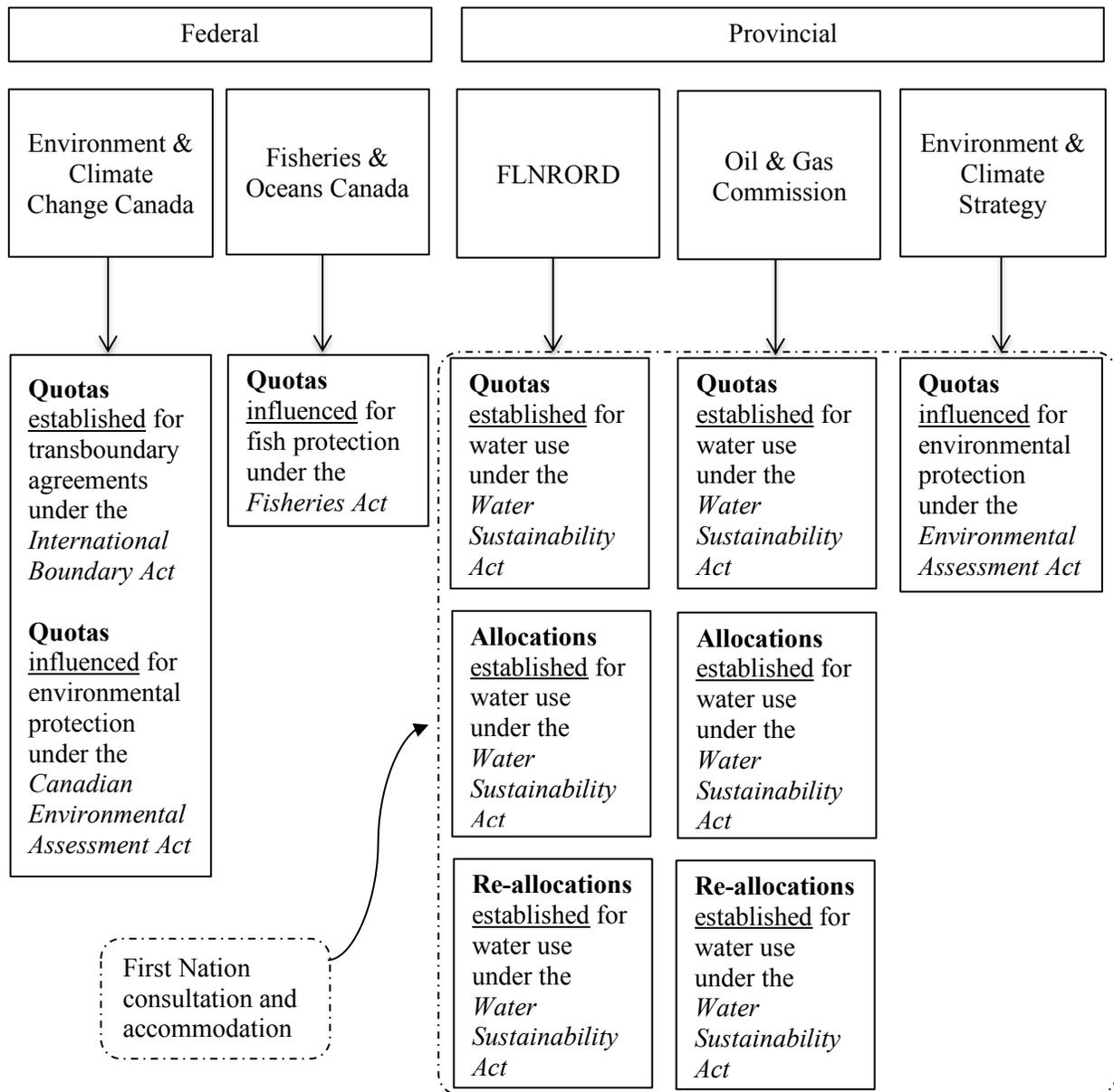


Figure 2.4 Institutions and organizations involved in water quotas, allocations and re-allocations

Third, transaction costs are an indication of incoherencies in the institutional resource regime (Marshall, 2013; Bolognesi & Pfliefer, 2019). The less coherent the regime, the higher the transaction costs (Biesbroek et al., 2011; Vatn, 2005). Therefore, transaction costs are one

indicator as to whether alternative arrangements, designed to contribute to further integration of the resource regime, will promote sustainable outcomes.

Overall, to understand if water governance and management in British Columbia supports sustainability, this study seeks to look beyond the Water Sustainability Act (2014) and evaluate British Columbia's water regime as a whole, including property rights and public policies. It also aims to understand if an alternative arrangement, either a regional district or watershed agency, can promote sustainable outcomes through improved coherence.

The next section of this chapter provides a review of literature around institutional change and the application of institutional theory and transaction cost economics to this study. It then provides an overview of common frameworks used to analyze resource governance and management and proposed a combined framework to assess the sustainability of water in British Columbia and opportunities under the Water Sustainability Act.

2.2 Theoretical perspectives

The analysis of how we use our natural environment to achieve intended outcomes has been studied by many disciplines in social science including sociology, economics, political science, and public administration. As a result, a variety of definitions are used to describe institutions.

In economics, the term institution refers to the humanly devised rules of behavior that shape human interaction (North, 1990). When resources are scarce or values conflicting, it is institutions that provide the set of rules for competition and cooperation. They are made up of

formal constraints (rules and laws), informal constraints (norms of behavior and self-imposed codes of conduct), and the enforcement characteristics of both (North, 1994). Other disciplines in the social sciences use different definitions of institutions that include organizations². Because this study includes both the institutional structure and institutional environment of the water regime, organizations are considered central to the analysis. As such, I include organizations within the definition of institutions. Therefore, institutions are defined here as: 1) formal and informal rules; 2) formal and informal organizations; and 3) the interaction between rules and organizations through regulatory structure, organizational structure and their systems. This follows other research in institutional analysis which include organizations in the analysis of the water regime, sometimes referred to as administration or administrative structure (see Baimyrzaeva, 2012; Saleth & Dinar, 2004; Williamson, 2000).

Frameworks, theories and models are sometimes used interchangeably. However, Ostrom (2011) identifies how they can be used together as a succinct way to analyze institutions and test our understanding of institutional design. To start, frameworks compose the broadest set of variables used to examine a diverse institutional setting. They can also be used to then compare theories. A specific theory then specifies which working parts of a framework are considered useful to explain diverse outcomes and how they relate to one another (i.e. transaction cost theory). Models then build off these theories as the precise assumptions about a limited number of

² Hodgson (2006) suggests North “has been insufficiently clear” and that his definition of institutions includes organizations.

variables in a theory that scholars use to examine the formal consequences of these specific assumptions about the motivation of actors and the structure of the institution they face.

The following sections will provide an overview of different contributions to institutional theory and frameworks that have been developed to study institutions. The terminology provided is specific to the discipline and individual providing the insight. However, I do my best to identify confusing concepts, particularly when concepts are combined but use different terminology, or the same terminology for different concepts.

2.2.1 Institutional change

Theories around institutionalism can be described in terms of the reason behind why institutions change. Collective choice theories explore the origins of property rights and treat institutional change as a centralized, collective choice processes. In evolutionary theories, there are no central mechanisms to create a coordinated shift in rules. Rather, new rules or behaviors are both randomly and/or deliberately generated from uncoordinated choices of many individuals (decentralized) with efficient institutions lasting and inefficient institutions fading out (Williamson, 2000). In contrast to these, equilibrium theories are founded not on the rules that govern behavior, but rather the shared expectations or the behavior itself. So, rather than changing the rule itself, change manifests through a changed expectation which realize equilibrium. These theories all provide meaningful insight into understanding institutional casuistry and design and continue to inform institutional change models and analysis frameworks. This section will describe each theory in more detail before looking at frameworks.

2.2.1.1 Collective choice theories

Throughout history, governments and communities have created institutions to confer property rights over scarce resources. These rights provide an entitlement to impose costs on a third party and are justified by different means. According to Bromley (1989), these means include first occupancy, labor theory, utility theory, political theory and moral enhancement. Raymond (2003), adds four perspectives on the norms underlying property rights theory including the possessory theory, intrinsic theory, instrumental theory, and egalitarian theory. Although this research will not attempt to investigate the normative basis of property rights, these theories provide insight on the conceptualization of formal rights and how quotas, allocations and re-allocations have been shaped over time. They also provide insight on the ideological principles that Hayek (1973) argues should be used to guide the design of institutions, as formal rules that do not follow consistent ideologies will become rules-in-form and will not have any effect.

In addition to the means of property rights, property scholars have identified different concepts around the characteristics of property rights. Characteristics include the bundle of rights beyond simply ownership title and have been used to compare property rights structures (Galik and Jagger, 2015). Honore (1961) identifies eleven characteristics: possession; use; management; benefit; capital; security; transferability; duration; appropriation and residuary character. Scott (1989) on the other hand, recognizes that in most cases these rights are incomplete and proposes six characteristics: quality of title; transferability; duration; flexibility; divisibility; and exclusivity. Schlager and Ostrom (1992) identify five characteristics: access; withdrawal; management; exclusion; and alienation. However, analysis of property rights based on property right characteristics only provides a generic distinction between property right holders and all

other parties when in reality there may be more than one entity holding the rights. These entities form a system of nested institutions (Ostrom, 1990) and may have unique objectives that lead to different types of decision-making.

To assess the institutional structure, the classification of property right regimes can be reviewed at the various levels of decision-making entities. These classifications include state property, private property, open access, and common property and enable the identification of interconnections between institutions and how decisions are made. It is important to highlight that identifying vertical interplay within institutions is an important aspect of understanding horizontal interplay. This supports Challen's (2000) identification of a lack of empirical studies that apply this approach resulting in the identification of improper regimes for analysis.

In addition to property right aspect of institutions, Challen (2000) proposes a need to identify other aspects of property right rules relating to the manner in which entitlements to the resource are defined and allocated to the holders of property rights. These aspects include systems of entitlements, mechanisms of initial allocation of entitlement and mechanisms for re-allocation of entitlements at each level of the vertical hierarchy. An example of these aspects applied to the current institutional design of water use in British Columbia was provided in section 2.1.1. in figure 2.2. This figure highlighted the number of players involved in the authorization of water use rights in relation to quotas (entitlements), allocation and re-allocation here in British Columbia.

Different configurations of property rights entail different distributional consequences resulting in bargaining, lobbying and political action between individuals and groups to try and change the rules for their own benefit (Libecap, 1989). Libecap refers to this rule-changing activity as contracting and sees institutional change as path-dependent as past institutions create the framework for responding to proposed changes. Understanding who makes decisions (or cluster of decision makers) and the responsibilities of all actors is an important aspect of institutional reform and particularly in trying to understand if reform will bring about desired change.

However, collective-choice theories have failed to identify why some rules are followed and others not. And it is this challenge, that if some rules are not followed, which has led theorist to look beyond institutional design and also consider the implications of institutional evolution.

2.2.1.2 Evolutionary theories

Institutional evolution theorists view institutional change as an evolutionary process. This evolutionary process considers new rules and behavior patterns to be developed through uncoordinated choices of many individuals rather than a single, collective choice political process. Transaction cost economics is an example of an evolutionary theory in which certain rules are able to govern transactions more efficiently than alternatives. Transaction cost economics assumes that efficient institutional forms will weed out inefficient forms as the efficient institutions are rewarded with positive feedback. Williamson (2000) describes the transaction cost approach as an “empirical success story” (p. 607), however, it has failed to be recognized in achieving local targets due to its application in a global setting (Kingston & Caballero, 2009).

Other forms of evolutionary theories include the notion of habits, in which the fittest habits of thought prevail similarly to natural selection (Veblen, 1899). Habits can be adaptable to the changing environment and as Aristotle identifies, habits produce a character and indicate how to act, but we can always act against habit (in Lord, 2013). Knudsen (2007) identifies organizational routines, which change when they become unsatisfactory. Successful routines may be copied from other firms, but they will rarely be perfect due to the need for coordinated habit change from several people resulting in a need for variation in routines to be explored. And, as Sugden (1989) notes, efficient institutions may not always prevail due to our inherent attraction to adopt rules that are similar to rules which we are already familiar with (recall path-dependency described by Libecap). Veblen (1899) also agrees that efficient institutions may not always prevail, but not because we become stuck in sub-optimal equilibrium, rather because individuals are not able to change at the same rate as their changing environment.

2.2.1.3 Equilibria theories

Equilibria theories attempt to bridge these links by shifting the focus from the rules that govern the behavior to the behavior that governs the rules. In essence, institutions are identified as equilibrium patterns of behavior rather than the rules which induce the behavior. Shared expectations are the fundamental source of order. As such, new rules that fail to change individual expectation will not have any effect (Aoki, 2001) and because expectations are shared, enforcement becomes endogenous.

In equilibrium, players are constrained by both exogenous physical constraints and endogenous rules (both formal and informal). There may be many equilibria but it is the interactions within and between both exogenous and endogenous constraints that shape the evolution of institutions. Hayek (1973) considers the co-evolution of institutions with individual mind, arguing that “mind is as much the product of the social environment in which it has grown up, as something that has in turn acted upon and altered these institutions. It is the result of man having developed in society and having acquired those habits and practices that increased the chances of persistence of the group in which he lived” (p. 17).

2.2.1.4 Combined theories

Although it is the institutions that shape our use of natural resources, North (1990) identifies the evolution of institutions as being shaped by the interactions between both institutions and organizations. According to North (1990) organizations include political bodies, economic bodies, social bodies and educational bodies that are bound together by a common purpose to achieve certain objectives. Within organizations, it is the individual actors and entrepreneurs that modify institutions through the choices they make. These choices are in turn influenced by the rate of learning and perception of pay-offs, or costs and benefits. North (1990) identifies a conceptual model for the process of institutional change based on the actions of private entrepreneurs and collectives, political entrepreneurs and collectives, and their influencing environments including relative scarcity, tastes and preferences and technology.

An important aspect of the model is the identification of relationships that exists between private and political entrepreneurs and their influence on the ability to bring about institutional change.

North's model gives formal rules (collective choice) a central role in institutional change. These changes are considered deliberate and based on both endogenous and exogenous environmental changes.

North also combines collective-choice theory with the theory that informal rules evolve gradually alongside formal rules resulting in a new equilibrium that is far less revolutionary (1990). This theory is based on the notion that when formal rules change, informal rules, which have "evolved as extensions of previous formal rules", survive the change and result in the restructuring of overall constraints (North, 1990, p. 91). Brousseau and Raynaud (2006) along with Bowles and Naidu (2006), also highlight the possibility that changes in informal rules can gradually climb the hierarchical ladder and become formalized. This relationship between formal and informal rules is also attributed to institutional change when inconsistencies are apparent (Dovers, 2001; Gooding, 1996). Complimentary formal and informal institutions, on the other hand, are attributed to successful institutional arrangements (Keefer & Shirley, 2000). In research conducted by Ensminger (2000), it was found that the design of formal institutions has the ability to influence some of the barriers to institutional performance. Particularly, Ensminger found that many characteristics that support generalized trust in society are significantly affected by formal institutional arrangements rather than informal institutional arrangements. Research also shows that informal organizations can substitute for formal institutions successfully under certain circumstances (Ensminger, 2000; North, 1990).

2.2.1.5 Summary

These approaches provide meaningful insight for institutional analysis and this study. First, collective choice theories identify a need to identify other aspects of property right rules relating to the manner in which entitlements to the resource are defined and allocated to the holders of property rights. Second, evolutionary theories identify that efficient institutional forms will weed out inefficient forms as the efficient institutions are rewarded with positive feedback. Third, equilibria theories identify that institutions reflect shared expectations and as such influence behavior through self-enforcement. Finally, combined theories bring together aspects each of these theories to identify the numerous exogenous and endogenous factors that have all shaped the development of institutional theory and our understanding of institutions.

This study applies insights from these theories to evaluate and identify the sustainability of the current water regime in British Columbia and opportunity for alternative governance arrangements. Specifically, collective choice theories and evolutionary theories highlight the need to include configurations of property rights and the broader institutional environment to understand institutional forms and their interactions when evaluating regimes. Evolutionary theories also identify opportunities from efficient institutional forms as they outlast inefficient institutional forms as a result of lower transaction costs. Transaction costs are, therefore, an important aspect of this study as they provide a means to evaluate if alternative governance arrangements can improve coherence.

2.2.2 Institutional analysis and design

Despite research advancements in institutional theory, when it comes to public sector institutional change, decision makers struggle with identifying *how* to change to achieve intended outcomes.

A common approach to institutional change is the donor-promoted reform. This occurs when a successful reform is promoted with the assumption that the same success will occur in the newly applied context. Unfortunately, as one might expect, this isn't always the case and has resulted in researchers focusing efforts on identifying governance elements through comparative analysis of case studies from around the world. For instance, Christensen, Laegreid, Roones, and Rovik (2007) note that while "it is difficult to identify one uniform nucleus, it is possible to filter out a number of traditions and perspectives that are built on partly complementary, partly competing theoretical rudiments and observations" (p. 2). To identify these attributes, analysts have developed frameworks to examine diverse institutional settings and provide a basis for assessing change options.

The following section will provide a review of frameworks used in institutional analysis and design that are applicable to this study. These include the institutional analysis and development framework, the institutional resource regime and the institutional diagnostic and analysis framework.

2.2.3 The “winning attributes” framework

To help decision makers design improved water regimes, researchers have identified attributes or principles associated with reform benefits such as multi-level, participatory, adaptability, trust, resiliency, efficiency, and transparency. Specifically, the Integrated Water Resource Management framework highlights the importance of coordinated management in connection with economic efficiency, environmental sustainability and social equity (Biswas, 2004; Powell et al., 2017) while the Organization for Economic Co-operation and Development framework guides the development of reform based on twelve principles related to trust and engagement, effectiveness and efficiency (OECD, 2018). One example of the winning attributes approach in British Columbia is in the Blueprint for Watershed Governance in British Columbia where Brandes, O’Riodan, O’Riodan, and Brandes (2014) identify guiding governance principles and winning conditions for “effectively managing and governing fresh water in the context of functioning and healthy watershed” (p. vii). However, the blueprint fails to identify how watershed governance reform compares to other options and assumes benefits associated with watershed-based approaches in the British Columbia context.

To assist practitioners in identifying “*winning attributes*” best suited to address specific situations, Young (2008b) has developed the diagnostic method. Young’s (2008b) diagnostic approach to institutional design focuses on solving specific problems by looking into the nature of the problem, the overarching political setting, character of the players and prevailing practices. Understanding these major factors can then provide insight into:

1. The scope of the biophysical system to be addressed by the institutions;

2. The appropriate goal(s) and its/their nature-environmental and/or behavioral-to set for an institution;
3. The rights to be conferred by the institution;
4. The rules to be implemented;
5. The decision-making procedures to be followed;
6. Key agencies responsible for implementation of the institution;
7. Bodies with which the institution needs to be in communication; and
8. The hierarchy of administration in which the institution will operate.

Young's diagnostic method was developed with a focus on environmental change, however, it encompasses many of the components of North's model identified earlier. In addition, Young (2008a) identifies analytical themes including scale, fit and interplay between both biophysical and governance systems to help understand issues as they relate to institutional design, performance and causality. In particular, I consider institutional interplay an important element in understanding how British Columbia will ensure the supply, or availability, of water into the future given the number of organizations at hand. However, the method is rather vague and fails to provide a detailed method for interpreting how these factors interact or relate to one another and thereby it is difficult, if not impossible, to derive theories or models from the framework. This is a common drawback of the "*winning attributes*" approach where the factors assessed are more anecdotal or check box like. Specifically, they provide no scale or relationship to be assessed between options.

2.2.3.1 Institutional analysis and development framework

One of the most recognized frameworks in comparative institutional analysis of common pool resources is the use of the Institutional Analysis and Development (IAD) framework (Kiser & Ostrom, 1982; Ostrom et al., 1994; Ostrom, 2005).

The IAD framework can be used to help frame policy research by examining the performance of institutions based on four criteria: efficiency; equity; accountability; and adaptability. In addition to the IAD framework, Ostrom and her colleagues have developed the Social Ecological System (SES) framework to overcome IAD constraints around variables for analyzing ecological systems. Both frameworks have provided meaningful developments to institutional analysis, however, not all elements of the frameworks are yet sufficiently well-developed resulting in an incomplete application and analysis (Cole, 2017). One of the main challenges in applying the IAD and SES evolves around the efficiency criteria. However, as North (1990) and other economists suggest, efficiency can be measured by applying economic principles such as transaction cost economics.

Transaction costs include the static costs of operating in an institutional regime and the dynamic costs during and because of change in an institutional environment. Static costs consist of the transaction costs of information, decision making and enforcement. Dynamic costs consist of transition costs associated with both changing institutional arrangements and intertemporal transaction costs associated with costs a reform may have on future transitions due to path dependencies (North, 1990). However, the empirical application of transaction cost economics

has run into problems resulting in few studies undertaking its framework. Benham and Benham (2000) attribute this to:

- Lack of standard terminology defining transaction costs;
- Estimation problems because production and transaction costs are jointly determined;
- An understanding of the opportunity costs of the full range of alternatives that determines choices of individuals is difficult when many kinds of transaction do not take place in the open market; and
- The law of one price does not apply, with different individuals facing very different transaction costs.

Of these, the main critique with transaction cost economics is the difficulty in identifying and measuring costs. Williamson (1985), however, suggests that the direct measurement of transaction costs is not needed but rather it is the difference between them that matters: “instead, the question is whether organizational relations (contracting practices; governance structures) line up with the attributes of transactions as predicted by transaction cost reasoning or not” (p. 22). Marshall (2003) offers a similar perspective and proposes the use of inductive approaches.

Nevertheless, most studies have failed to identify a structural model or framework to institutional choice that has gained wide use (Challen, 2000; McCann et al., 2005). For example, in Challen’s (2000) framework, the cost-effectiveness of alternative institutional arrangements in achieving intended outcomes is the main focus along with the inclusion of transformation costs. Marshall’s (2003) framework builds on the work of Challen to include abatement costs to account for the effect that institutions have on technology in environmental policy, while Pagan’s (2009)

framework considers both the transaction and transformation costs of alternatives to evaluate the transaction costs of five institutional features: clear objectives; interconnections between formal and informal institutions; adaptability; appropriateness of scale; and compliance capacity.

Finally, McCann, Colby, Easter, Kasterine, and Kuperan, (2005) have developed a method for measuring transaction costs to evaluate environmental policies. Rather than focusing on the factors that affect the degree of transaction costs, they identify approaches to measure the different types of transaction costs associated with public policies. Specifically, methods for measuring transaction costs include surveys, interviews, other studies, government reports, financial accounts and proposed budgets (McCann et al., 2005). From there, a comparative approach can be applied to evaluate alternative choices based on each type of transaction cost. This approach is in line with the goals of this study where I am interested in comparing two alternative arrangements to the current arrangement to identify if either alternative can improve efficiency. Given that no alternative arrangement exists and current operating scales do not follow either watershed or regional district scales, the use of other studies and existing government reports, financial reports or proposed budgets is not a valid option. Budgets can also be misleading if activities are not separated out to obtain a clear understanding on exact costs for each type of transaction cost. As such, implicit surveys and interviews are considered the most appropriate tool for measuring administrative transaction costs for this study although they can be time consuming and costly (McCann et al., 2005).

It should also be noted that implicit surveys and interviews can vary in their application in regard to transaction costs measurement. A number of researchers have applied implicit surveys to

estimate transaction costs based on staff time for various activities (Edgell, 1998; Fang et al. 2005; Kuperan et al. 1998; McCann & Easter, 1999), while others have applied the perception of transaction costs from informed persons who are familiar with transaction cost trends and sources (Lawson, 2009; Brown & Potoski, 2005). Lawson (2009) notes “clearly, it is futile to attempt any detailed measurement of net transaction costs per dollar of aid. Nevertheless, there is probably some value in assessing the perceptions of transaction costs across different resource persons and triangulating these observations in order to get a sense of overall trends” (p. 17). Thus, one must, again, consider the context of the analysis and information available to identify the appropriate approach to estimate the transaction costs. Given the difference in scales between alternative arrangements and the current arrangement, an estimate of staff time is not considered realistic. Therefore, the perception of costs from informed persons is considered the appropriate method for this study.

Given the challenges noted above, much of the literature around water reform has focused around the influence of organizational structure (Schluter & Pahl-Wostl, 2007) and there is minimal use of comparative analysis of transaction costs to better understand and predict successful water institutional reform (McCann et al., 2005). In Canada, other than Kennett’s (1992) analysis on minimizing organizational costs as a framework for allocating powers in federalism and water resource management, no other application of transaction cost economics in water reform has taken place.

2.2.4 Institutional resource regime framework

The institutional resource regime (IRR) framework developed by Kissling-Naf, Knoepfel, Varone and their colleagues in the early 2000's offers a way to assess the integration of a resource regime. Because integration is often associated with sustainability, researchers have applied the institutional resource regime as a way to assess the potential sustainability of a resource (Bressers et al., 2004; Gerber et al., 2009; Knoepfel et al., 2007; Renou & Bolognesi, 2019).

This analytical framework offers a way of combining public policy analysis and institutional economics in one analytical framework. It consists of formal property (ownership), disposition and use rights in conjunction with public policies (protection regulations), along with their respective dimensions (resources, users, interventions, etc.). By combining the two approaches, the IRR framework is able to identify the interactions within the institutions (protection policies have the ability to impact property rights) and between the institutions, users and the natural resource (Gerber et al., 2009; Kissling-Naf & kuks, 2004; Varone & Nahrath, 2014). The inclusion of both property rights and public policy is considered to offer a more complete analysis of heterogenous resources with multiple user groups since the range of regulations can be complementary and balancing (Knoepfel et al., 2007).

To analyze the overall integration of a resource regime, the regime is defined by a typology based on the extent and coherence of the property rights system and public policies. The analysis is performed over time to identify phases of key changes in the institutional regime including drivers and outcomes. In turn, this historical account of typology can be used to identify if the

resource regime is heading in a direction of integration and, therefore, as some infer, sustainability (Knoepfel et al., 2001). This approach is in line with the goals of this study where I am interested in looking beyond the Water Sustainability Act to assess the overall water regime. In addition, by including historical perspectives, the framework is able to provide a sharper understanding of the current arrangement through its evolution (Lawrence, 1984). However, the framework does not include factors outside of the water regime such as related resource regimes. Specifically, it is focused on the property rights system and public policies related to goods and services of the resource regime at hand. As such, it provides a starting framework for the study, but requires additional development to include factors outside the water regime.

2.2.4.1 Institutional decomposition and analysis framework

Similar to the IRR framework, Saleth and Dinar (2004) propose an institutional decomposition and analysis framework (IDA) that combines water law, water policy and water administration in what they refer to as the water institution. In addition, the IDA framework includes interactions between the water institution and exogenous influences from the water sector, public system, legal system, demography, economic development policies, and resources and environment (Saleth & Dinar, 2004). By including exogenous aspects, the framework enables the combination of endogenous and exogenous factors in the analysis of the water institutional regime. Also, the framework aims to highlight sources of transaction costs from within the water institution and influences from synergies and constraints in the institutional environment. However, the framework is focused on the operational aspects of water management and, as such, fails to consider broader water governance implications. For example, in the IDA, water policy is made up of aspects related to use priority, project selection, water transfers, cost recovery,

decentralization, and technology. It does not consider protection regulations outside of the property rights system. In addition, in Boyer et al. (2011) apply the IDA framework to assess aspects of the water institution and institutional environment to identify the strengths and weaknesses of different community-based water management schemes in Haiti. However, the focus of the analysis is on project management, such as project development and implementation, and omits broader governance aspects.

Nevertheless, the IDA framework does offer contributions to this study. Specifically, the linkages between the water institution and the institutional environment including factors that influence transaction costs through synergies and constraints were not something considered prior to this literature review. Also, included in the framework are resources and environment outside of the water institution that are missing in the IRR. This inclusion aligns with the goal of this study to include related resources in the assessment of the water regime in British Columbia.

2.3 Theoretical Framework

In British Columbia, the assertion that the re-working of the Water Act with the implementation of the Water Sustainability Act, including the provision for alternative water governance arrangements, will result in improved outcomes and sustainable water availability for today and in the future remains unknown. First, the Water Sustainability Act is only one of many water regulations in the province. Although it is the primary act for the establishment of water use rights, it works together with all the other regulations to ensure the protection of quality, quantity and availability of water for all uses. Second, the protection of water availability remains unregulated. This includes related resources such as forestry and land development where

activities alter the natural hydrology. Third, the notion of “sustainable water availability” implies that we are able to somehow control water availability when in reality we are not. Water is in constant motion and where it falls and in what form (snow, rain, fog) is out of our control³. To claim we can ensure sustainable water is a nirvana concept. It sounds good, however, in reality we will never be able to dissolve all of our water problems or ensure optimal trade-offs are achieved. Nevertheless, water sustainability or sustainable water governance and management remains a popular requirement of researchers and governments to address complex water challenges as competition for water continues to grow (Pahl-Wostl, 2016). To identify sustainable resource use, researchers often assess the integration, adaptability or coherence of a resource regime, although neither of these have proven to ensure water sustainability (Vairavamorthy et al., 2015). Rather, these attributes are better viewed as an indicator of potential sustainability (Bolognesi, 2014). As such, to understand if alternative governance arrangements will promote sustainability, this study aims to first assess the extent and coherence of the current water regime and second, identify whether alternative arrangements are viewed as potentially more or less efficient.

Before an assessment of alternative arrangements can take place, it is important to understand the coherence of the current water regime so comparisons can be made. Furthermore, a historical perspective provides information on why water institutions have changed over time and additional insight. Therefore, the IRR framework is a suitable framework to apply to understand

³ Water supply is impacted by climate change. Therefore, we do have some control over water availability, although not directly.

the current water regime. To broaden the analysis to include related resources, I combine factors from the institutional environment of the IDA framework with the IRR framework. This combined framework is used to address the first research question:

1. Why and how have water institutions changed in British Columbia?

Once the current water regime typology is identified, further analysis on the water regime within the water rights system can take place along with a detailed analysis of alternative governance arrangements through documentation, survey and interview sources. Further analysis on the water regime is focused on the efficiency of the current arrangement, effectiveness of the current and alternative arrangements and readiness and limitation to change. This addresses the second and third research questions:

2. How efficient is the current arrangement?
3. How effective are alternative arrangements perceived compared to the current arrangement?

Because alternative water arrangements are restricted in their powers to only water use decisions, the analytical approach is limited to the coherence of the organizational structure as defined by the coordination between actors for all activities related to decision making. As noted by Thompson et al. (1991) “without coordination, these agents and agencies might all have different and potentially conflicting objectives resulting in chaos and inefficiency” (p. 3). To identify prospects for institutional change, and more specifically whether an alternative governance

arrangement can contribute to the coherence of the water regime, I evaluate the efficiency of two alternative governance arrangements using a transaction cost economics approach. The two alternative arrangements assessed in this analysis include a regional district and a watershed agency. Because the province has restricted the delegation of powers of alternative arrangements to operational management (strictly decision making, no responsibility for information and enforcement activities), opportunities for improved coherence are considered limited given the complexity of actors involved in water authorizations. Specifically, the division of responsibilities related to water information, decision making and enforcement activities between three provincial organizations is considered fragmented. Therefore, this study will assess a regional district and watershed agency arrangement under two different scenarios to identify if there are additional efficiencies associated with the integration of all activities under the alternative arrangement. The first scenario assumes all activities related to information, decision making and enforcement are relinquished to the regional district or watershed agency. The second scenario assumes only activities related to decision making are relinquished to the regional district or watershed agency. This transaction cost economics analysis forms the basis for the fourth research question and together with the previous analysis forms the basis for the fifth and sixth research questions:

4. Why and how are transaction costs perceived to change under an alternative governance arrangement?
5. Do these perceptions influence why alternative governance arrangements have not been implemented?

6. How do the perceived transaction costs under a watershed arrangement in the Okanagan basin compare to the rest of the province?

Chapter 3: An examination of water governance reform in British Columbia

This chapter addresses the first research question: Why and how have water institutions changed in BC? It supports the idea that by understanding how rules regulate the use of a resource and the reason behind their changes, we can characterize governance regimes over time to identify if changes are heading in a direction that enables integrated resource governance and in turn the promotion of sustainable resource use.

3.1 Introduction

Water is an important resource. We depend on it in many aspects of life including economic development, energy production, agriculture, recreation, ecosystems, and human health.

However, it is a resource in constant motion and there can often be a mismatch between the hydrologic cycle and where and when water is needed. As such, a great deal of effort has been dedicated to the management of water to ensure its sustainability. It is widely assumed that to achieve sustainability, an integrated approach is needed (see Vairavamoorthy et al., 2015).

Integrated water management is not a new concept and has been promoted since the 1950's with the realization that challenges faced by water management were becoming more interconnected with environmental and economic development-related factors (Biswas, 2004).

“Integrated water management is a process which promotes the co-ordinated development and management of water, land, and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems”

(Global Water Partnership, 2000 p22).

A key part of successful integrated management is the implementation of governance regimes that are coherent and organizational structures that support knowledge sharing, communication, and compromise (Allan et al. 1999; OECD, 2018; Sandstrom et al., 2019). As such, integration has become a prominent element in the analysis of environmental governance and policy and includes input from many disciplines resulting in a range of themes including joined-up government, silos, horizontal governance, holistic governance, and policy coherence (Tosun and Lang, 2017). However, most frameworks are limited and focus on either governance scope or governance coherence or fail to capture the complete spectrum of interactions when combined (Weitz et al., 2017). The institutional resource regime (IRR) framework developed by Knoepfel, Kissling-Naf, Varone and their colleagues in the early 2000's and advanced by others including Gerber, Knoepfel, Nahrath and Varone (2009) offers a way to link together the extent and coherence of resource regimes by looking at both property rights and public policy design over time. The inclusion of both property rights and public policy offers a more complete analysis of heterogenous resources with multiple user groups since the range of regulations can be complementary and balancing (Knoepfel et al. 2007). Moreover, the range of regulations, through extent and coherence, are then used to understand how the resource regime ensures the sustainability of a resource by identifying its reproductive capacity and how users are influenced to limit quota allocations within the resource yield.

In British Columbia, increasing competition among water uses is causing greater concern for already full or over-allocated surface water sources (Simms & Brandes, 2016). To identify why

and how water institutions have changed, and if these changes promote sustainable outcomes, I apply a modified IRR framework to water governance in British Columbia from 1858 to 2016.

3.2 The IRR framework

The IRR framework combines public policy analysis and institutional economics in one analytical framework. It consists of formal property (ownership), disposition and use rights in conjunction with public policies (protection regulations), along with their respective dimensions (resources, users, interventions, etc.). By combining the two approaches, the IRR framework is able to identify the interactions within the institutions (protection policies have the ability to impact property rights) and between the institutions, users and the natural resource (Knoepfel et al., 2007).

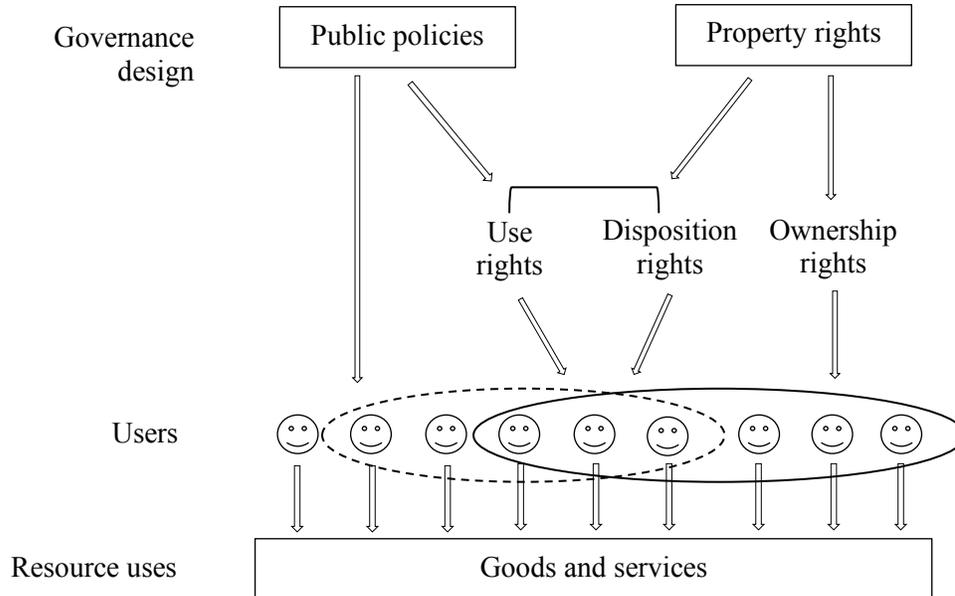


Figure 3.1 Interactions within the IRR framework (adapted from Gerber et al., 2009)

Property rights that impact use and disposition rights include modifications to the property institution such as introducing regulations for groundwater uses. Property rights that modify the structure of the distribution of property titles consist of major interventions such as expropriation and the privatization or nationalization of resources. In addition to the modification of property rights, other policy tools include the provision of information, regulation and the use of economic instruments such as fines, subsidies and tax relief. More recently there has been an encouragement of voluntary approaches to change people's or firm's behaviour that can draw on a mix of tools. This may be accomplished through information campaigns, certifications, unilateral commitments, and negotiated agreements. Voluntary approaches have become a popular approach to address problems quickly (OECD, 2003). However, their effectiveness is considered weak (Harrison, 2001; Lyon & Maxwell, 2003; de Vries et al. 2012) and by accommodating business opposition to regulation, they can risk undermining the development of mandatory approaches (Harrison, 2001; Braathen, 2005; Fleckinger & Glachant, 2011). Public policies that have repercussions on use and disposition rights include regulatory instruments aimed at clarifications (restrictions) on pollutant concentration limits or extraction volumes. Therefore, it is the combination of public policies and property rights that impact the users and in turn the uses of a resource. Implicit in the idea of governing the resource in a sustainable manner is that its stock is not impacted by the overall use and thereby enables a continued supply of goods and services into the future.

To identify the overall sustainability of a resource regime, the regime is defined by a typology based on the extent and coherence of the property rights system and public policies. The regime typology implies the existence of a relationship between the sustainability of a resource use and

its reproductive capacity, and the regime type and regulatory capacity. This analysis can be performed over time to identify phases of key changes in the systems including drivers and outcomes. In turn, this historical account of typology can be used to identify if the resource regime is heading in a direction of sustainability.

Empirical application of the institutional resource regime analysis framework is defined by Knoepfel et al. (2007) as being based on an analysis of resource uses. This includes the identification of: 1) resource uses; 2) resource uses regulated; and 3) resource use right quotas and yield quotas. Through its application, the researcher is able to identify relationships between the property rights system and public policies to identify if relationships exist between regime characteristics, resource reproductive capacity and the regime's effect on resource use (Gerber et al., 2009; Knoepfel et al., 2007).

3.2.1 Property rights and public policies

A property rights system includes all the formal property rights along with disposition and use rights. The content of the use and disposal rights are dependent on the type of property rights system. Bromley (1991) identifies four types of property rights systems: no property, common property, state property and private property. In the case of water in British Columbia, water is considered state property owned by the people of British Columbia but governed and managed by the Crown. Formal property rights include ownership title, rights of disposal (including the right to sell, gift and rent) and use rights (including the right to construct, deposit, use, destroy, and protect). It is the property rights system that undergoes changes when rights are considered out of line with expectations, too costly to administer or simply ineffective. Compared to policy,

changes to the property rights system are considered more stable, long lasting and predictable (Kissling-Naf et al., 2001).

The public policies that make up the IRR include all of the regulations that impact the management of a resource which is perceived in need of protection. Elements of the public policy design include not only the protection regulations themselves, but also the definition of the collective problem, forming causal models, target groups, instruments, outputs, and administrative arrangements (Kissling-Naf et al., 2001).

Together, the property rights system and public policies coordinate the resource owners and users for public benefit. Including both along with their elements, shown in table 3.1, in the analysis of a resource regime allows for a more encompassing understanding of how water is governed and managed (Gerber et al., 2009; Bolognesi & Nahrath, 2017; Kissling-Naf et al., 2001).

Property rights system	Public policies
Ownership rights Disposition rights Use rights	Protection regulations Political aims Causal models Target groups Instruments Outputs Administrative arrangements

Table 3.1 Elements of property rights and public policy design

3.2.2 Extent and coherence

Knoepfel, P., Nahrath, S., and Varone, F., (2007) note that the identification of gaps and incoherencies of a resource regime can help explain empirical evaluations of over-exploitation of a resource. As such, the extent and coherence of a resource regime can help identify if a regime will contribute to sustainable use of a resource (Bolognesi, 2014; Gerber et al., 2009).

Extent relates to the scope of the different goods and services of a resource that are regulated.

Extent includes two complementary elements: 1) absolute extent; and 2) relative extent. Absolute extent takes into consideration historical changes around the good and services regulated. This allows for the identification of changes in the range of goods and services regulated over time.

Relative extent assesses the number of goods and services regulated to the number of goods and services used. This ratio is used to identify if there are unregulated rivalries that can lead to over-exploitation or over-regulation that can result in inefficient allocation.

Coherence relates to the clarity and consistency of the regulations. Coherence includes three elements: 1) internal coherence of the property rights system; 2) internal coherence of the policy design; and 3) external coherence of the IRR. Internal coherence of the property rights system considers the clarity of property rights and use rights and specifically the alignment between property rights or use rights and the available resource units. Internal coherence of policy design considers the coordination between policies. External coherence of an IRR considers the connection between the property rights system and the policy design. This can be expressed as policies aimed at the wrong target group or policies that lack the power to achieve change. An

example of this would be environmental flow protection policy that is not able to limit water extraction from water use rights holders.

3.2.3 Regime typology

Based on extent and coherence of a regime, four typologies of institutional regimes can be defined which form the basis of the regime analysis and inform the regime's contribution to sustainable resource use (Bolognesi, 2014; Gerber et al., 2009; Varone et al., 2002). A non-existent regime occurs when there are no property rights or policies associated with a resource. In a non-existent regime, both coherence and extent are low. Non-existent regimes in the water sector are rare today, but can be discovered when reviewing the history of a resource regime (Knoepfel et al., 2007). A simple regime occurs when some of the goods and services are regulated in a coordinated manner. In a simple regime, coherence is high, however, because not all goods and services are regulated, extent is low. Simple regimes are commonly a result of the introduction of regulations following rivalries between a limited number of resource users. As such, regulations are developed in relation to the uses in competition and may not anticipate all rivalries. A complex regime occurs when most of the goods and services of a resource are regulated but in an uncoordinated way. In a complex regime, coherence is low and extent is high. Complex regimes are common as resources are developed and regulations are implemented to manage rivalries, prevent exploitation and promote conservation. An integrated regime occurs when all the goods and services of a regime are regulated in a coherent manner. In an integrated regime, both coherence and extent are high. Integrated regimes are not common due to the complexity of coordinating regulations and challenges around measuring stocks (particularly in water regimes), but are noted by Knoepfel et al. (2007) as existing predominately where

resources are publicly owned or under collective action such as self-governing common pool resources. Regime typologies are summarized in table 3.2 in relation to extent and coherence.

	High coherence	Low coherence
High extent	Integrated regime	Complex regime
Low extent	Simple regime	Non-existent regime

Table 3.2 Institutional resource regime typologies (adapted from Knoepfel et al., 2007)

3.2.4 Expansion of the IRR framework

In the IRR framework, the scope of a regime is bound by the extension of human interventions through property rights and public policies as they relate to the goods and services provided by a resource. However, by limiting the assessment of the regime scope to the goods and services derived from water, the analysis fails to capture influencing factors in the broader institutional environment. In relation to extent, goods and services can be described as direct goods and services (water), indirect goods and services (water that supports fisheries) and non-use goods and services. Specifically, by omitting related resource regimes (sometimes referred to as intersectoral or interconnected resource regimes), exogenous factors within the institutional environment that can impact the availability of resource goods and services are overlooked. For example, forestry is related to water as forest activities can impact the quality and quantity of water available for use. In this analysis, I expand the scale of extent to include related resource regimes.

In relation to coherence, property rights and public policies within the regime can also be influenced by factors outside of the institutional resource regime (Bressers et al. 2004). These

exogenous factors consist of broader political, social, economic and resource related factors (Easter et al., 1998; Meinzen-Dick & Nkonya, 2007; North, 1990; Saleth & Dinar, 2004). Specifically, Saleth and Dinar (2004) identify that the political system, legal system, economic development, demography, and related resources can have both positive and negative impacts on the coherence of the regime through synergies and constraints. Non-government organizations are another exogenous factor that can influence the institutional regime (Delmas & Toffel, 2004; Hoffman 2001). Specifically, organizations have been shown to assist in the promotion of collaboration between actors and, therefore, may have the ability to influence coherence (Schoon et al. 2017; Abrams et al., 2017). In this analysis I include exogenous factors in the assessment of coherence.

In addition, administrative arrangements, although identified as an element of public policies, are often excluded from assessments of coherence of the institutional resource regime.

Administrative arrangements, or management structures as described by Kissling-Naf et al. (2001), are considered important components of the institutional regime (Saleth and Dinar, 2004). In this examination I use the term organizational structure rather than administrative arrangements or management structures and include organizations within the property rights system and public policies of the governance design. The expanded framework with all of these factors is illustrated in figure 3.2.

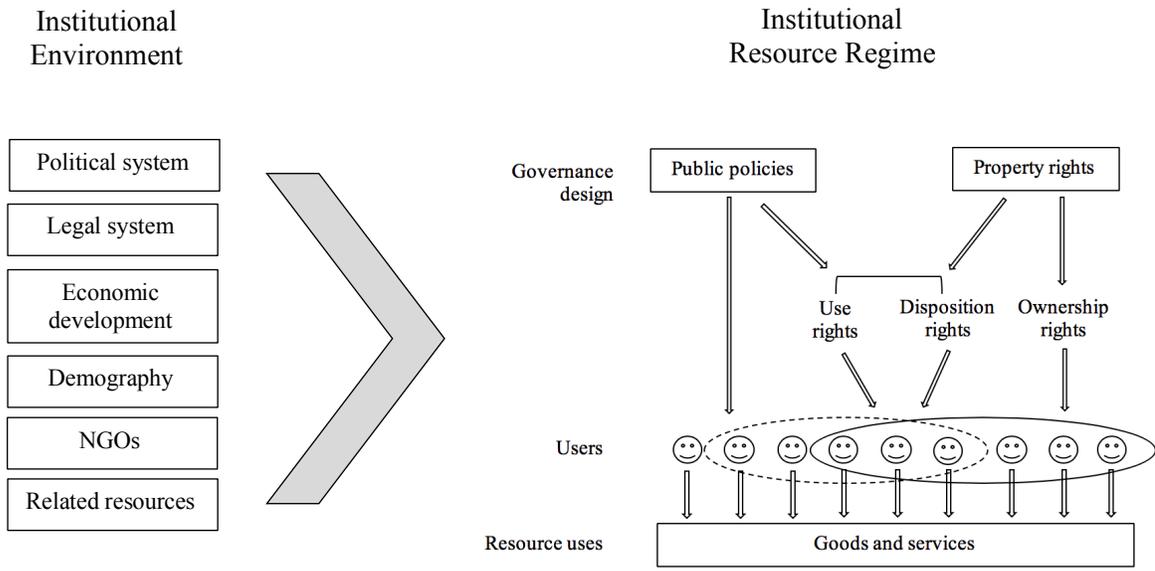


Figure 3.2 Interactions within and between the IRR and the IE

3.3 Methods

To carry out this examination, I researched documentation and archival records including legal databases, minutes of meetings, formal studies, organizational records, maps, and survey data produced by others. I also attended four meetings on the proposed Water Sustainability Act and held discussions with government officials at three conferences to identify focal points of water reform in British Columbia since 1859. First, the political system and actor powers and responsibilities related to water governance in British Columbia were identified. Second, goods and services derived from water and related resources were identified. These first two steps help set up the examination of the property rights system and public policies by identifying actors and water uses. Third, characteristics of federal and provincial legislation (policies, acts and regulations) related to water governance and management in British Columbia between 1859 and 2016 were described. This examination was broken into two sections to differentiate between the

water rights system and public policies. Phases were identified throughout the period of analysis to highlight issues and key changes. Through the identification of issues, I was able to gain insight into reasons behind why legislation proposals and changes were made including influences from the institutional environment. Finally, the extent and coherence of the water regime was reviewed to identify regime typologies from 1859 to 2016.

3.4 Results

A summary of institutional regimes for water management in British Columbia is provided in this section through the application of the expanded IRR framework.

3.4.1 Political system and water governance in British Columbia

Under the Canadian Constitution Act, 1982 jurisdiction over subject matters related to water governance and management is shared between the federal, provincial and territorial governments and, in some areas, Aboriginal governments under self-government agreements (s. 35). The distribution of legislative powers was first established in the Constitution Act of 1867 with few changes brought forward in the Constitution Act of 1982 most notably in relation to the recognition of Aboriginal and treaty rights (s. 35) and delegation of exclusive jurisdiction over non-renewable natural resources to provincial governments (s. 92A). Overall, ownership of public lands and natural resources is vested in the provincial or territory Crown with the exception of Aboriginal rights and title claims, all of which have not been finalized (Brandes & Curran, 2008). As such, both federal and British Columbia governments are able to create and enforce regulations related to water property rights and public policies. Under the Canadian Constitution Act (1982), subject matters that grant federal jurisdiction over water include

federally owned property (s. 91(1A)), navigation and shipping (s. 91(10)), sea coast and inland fisheries (s. 91(12)), Indians and lands reserved for Indians (s. 91(24)), criminal law (s. 91(27)), and boundary waters (s. 132). Subject matters that grant the provincial jurisdiction over water include management and sale of the public lands belonging to the province and of the timber and wood thereon (s. 92(5)), municipal institutions in the province (s. 92(8)) property and civil rights in the province (s. 92(13)), and all matter of a merely local or private nature in the province (s. 92(16)). The provincial government has also delegated powers to municipalities and regional districts through the Local Government Act (2015) and Community Charter (2003) relating to planning and service provisions. Operating within their jurisdiction, federal, provincial and local levels of governments have developed a range of regulations related to water for efficient and effective governance and management. These levels and their responsibilities are summarized in table 3.3.

Federal government	Provincial government	Local government
Drinking water quality guidelines on First Nation Reserves	Authorization of water permits, licenses and approvals	Drinking water and waste water services
Drinking water and waste water services on First Nation Reserves	Authorization of discharge permits	Protection of the natural environment and public health
Water protection and conservation	Water protection and conservation	Riparian protection
Navigation and shipping	Drinking water quality guidelines	Flood protection
Transboundary water agreements	Riparian protection	Land use planning
	Flood protection	Compliance and enforcement of municipal bylaws

Federal government	Provincial government	Local government
Sea coast and inland fisheries protection and conservation	Land use planning	
Environmental protection and conservation	Environmental protection and conservation	
Compliance and enforcement of federal laws	Compliance and enforcement of provincial laws	

Table 3.3 Responsibilities related to water across levels of government

As powers are distributed between levels of government, within each level of government implementation responsibilities are also divided between organizations, resulting in a diverse range of organizational structures. To leverage these powers, a large number of regulations exist that govern the use, conservation and protection of water. These regulations were identified in Chapter 2 along with the diversity of organizations (actors) in water authorizations.

Overall, water governance and management in British Columbia faces several challenges including: 1) varying water availability; 2) water quality protection from polluters and land use change; 3) protection from natural hazards related to water (floods, debris flows); 4) water for ecological function; 5) understanding water stock and use quantities; 6) understanding related resources; and 7) Aboriginal rights and title to water (Morris & Brandes, 2013; Simms & Brandes, 2016). In addition, not all of these problems are experienced throughout the entire province, and some areas may have varying degrees of intensity (limited water availability is a greater concern in semi-arid regions or in rivers where water has been overallocated). This variability in conditions around the province coupled with standard rules that apply across the province creates additional challenges for water actors in British Columbia.

3.4.2 Goods and services derived from water in British Columbia

Goods and services derived from water in British Columbia are classified by looking at the total economic value of a resource. This includes use values that are direct, indirect and optional (or future optional), and non-use values related to bequest and existence. These goods and services can be derived from both surface water and groundwater sources and are summarized in table 3.4.

Type	Sub-type	Goods and Services
Use		
Direct Use	Marketed benefits	Irrigation Power production Mining Oil & gas Industrial Private waterworks Public waterworks Mineral water Recreation
	Unpriced benefits	Waste absorption Consumption (domestic) Fire suppression Storage (flood control) Recreation Transportation Land improvement Cultural Ecological function (habitat, consumption) Views
Indirect	Functional benefits	Ecological function (habitat, consumption) Waste absorption Transportation Recreation
Optional	Future direct & indirect benefits	Conservation (diversion, retention, ecological function)

Type	Sub-type	Goods and Services
Non-Use		
Bequest	Benefits	Ecological function (habitat, consumption) Irreversible damages Views
Existence	Personal continued existence benefits	Ecological function (habitat, consumption)

Table 3.4 Goods and services derived from water in British Columbia

In British Columbia, water use authorizations are identified for twelve water use purposes under the Water Sustainability Act, 2014⁴, and include: conservation diversion, retention or use for fish or wildlife; domestic use (drinking water, food preparation, sanitation, fire, house animals and pets, garden irrigation); industrial use (camp and public facilities, commercial enterprise, cooling, crop harvesting and processing, fish hatcheries, ice and snow making, livestock and animals, pond and aquaculture, processing and manufacturing, pulp mills, etc.); irrigation use; land improvement diversion or impoundment (general, industrial rehabilitation or remediation); mineralized water use (bottling and commercial distribution of water, commercial bathing pools); mining use (hydraulic, placer, processing ore, washing coal); oil and gas use (drilling, oil field injection, hydraulic fracturing); power use (commercial, general - owned by a public utility - residential); storage uses (stream non-power, stream power, aquifer non-power, aquifer power); and waterworks (water sales, other, water delivery, local provider) (s. 2). However, the Water Sustainability Act (2014) does not govern waste absorption uses. Rather, waste discharge

⁴ Licences may also be issued under the Industrial Development Act, 1996, for hydropower purposes used for aluminum smelting, specifically the Rio Tinto Alcan power production projects around Kitimat, BC.

authorizations are issued under the Environmental Management Act (2003) through registrations, notifications, permits, approvals, water management plans, and operational certificates.

In addition to the goods and services derived from water, related resources with the ability to impact water availability are included in the analysis. These include land use change activities that alter the natural water balance (evaporation, runoff and groundwater recharge rates) such as municipal development, mining, oil and gas, agriculture, and forestry.

3.4.3 Evolution of water rights system

As noted earlier, all water in British Columbia is state property governed by the Crown.

Therefore, there are no private water rights holders and all rights to water are issued as use rights by the provincial government under the Water Sustainability Act of 2014 (former Water Act).

However, this was not always the case. Throughout the period of analysis from 1858 to 2016, the evolution of the water rights system in British Columbia can be divided into *four* distinct phases.

These phases are characterized by major changes in interventions, including the range of goods and services regulated and actors involved, and are used to inform the regime typology in section 3.4.5. Each phase is described below followed by a summary provided in table 3.5.

The *first* phase (1859-1892) is characterized by Colonial Proclamations and the introduction of provincial statutes related to the distribution of water use rights to miners and settlers during the gold rush. Following the end of the gold rush in California in the early 1850's, settlers began to make their way north to New Caledonia (present day British Columbia) bringing great change and as Barman (1991) noted "the status quo was irrevocably shattered" (p. 61). The Gold Field

Act was introduced in 1859 by the British Columbia Governor to provide security for water users and to settle disputes. An important feature of the Gold Field Act is that it followed the doctrine of prior appropriation. The Doctrine of Prior Appropriation stipulated that “the right to water did not depend on the ownership of riparian land but was gained by the person who first put water to beneficial use” (Percy, 1992, p. 278). This differs from eastern Canada and the United States where the Doctrine of Riparian Proprietorship had been adopted. However, riparian proprietorship was considered problematic for several reasons as described by Percy (1977):

“Most importantly, the limitation of water use to riparian land in the dry climate of the southern prairies obviously inhibited the development of land distant from good sources of water [...] Secondly, the development of even riparian lands was inhibited by supply problems under the common law doctrine. Major consumptive uses of water were clearly denied riparian owners [...] Finally, in dry years when there might not be sufficient water to satisfy the legitimate needs of riparians, no scale of priorities was available to apportion the scarce water to its most important uses. All riparians had equal claim to the resource.” (p. 143-144)

In addition, riparian proprietorship was considered problematic in western United States where many states had adopted prior appropriation (Hutchins, 1956). This included the arid region of Sierra Nevada, California where water was considered an important part of the economy, particularly for mining gold and irrigation, resulting in prior appropriative rights being upheld in the courts (Hutchins, 1956). In British Columbia, the allowance of water rights to non-riparian landowners enabled opportunities from semi-arid agricultural lands and, most importantly, placer

gold deposits. Provisions for water use were stipulated in the Rules and Regulations for the Working of Gold Mines (1859) under the Gold Field Act and included water use privileges to defined quantities of water (measurement questionable), restrictions on who could apply, water rates, rights-of-way for ditch works, penalties for any unused or wasted quantities, protection of water quality, and priority based on prior appropriation (now often referred to as first in time, first in right or FITFIR). In 1865, water use rights were transferred into the new Land Ordinance Act with added provisions to allow the diversion of water from a stream to be used for cultivating land with written authority (Ordinance 26). Amendments to the Land Ordinance Act in 1870 were carried out to specify that the transfer of pre-emption rights transfers water rights and that no person could acquire exclusive right to water except under statutory water record (s. 36). In addition, the Land Ordinance Amendment Act of 1972 introduced protection measures for water user rights by establishing the principle of beneficial use including reasonable water usage and compensation for excessive usage that resulted in damages to the rights of others (s. 1). After the Confederation of British Columbia and the Dominion of Canada in 1871, provisions were made by the federal government under the British Columbia Terms of Union for the province to maintain ownership of Crown lands (unceded territory) but to grant lands to the Dominion for the development of the railway (Railway Belt Lands) and the establishment of First Nation reserves (ss. 11 & 13). However, the jurisdiction over natural resources in transferred lands was not clear and began a long debate over who had the power over water, particularly water use rights to First Nation reserves (Matsui, 2009). In an effort to consolidate land and water ordinances and assert jurisdiction over water on all lands, the province established the Land Act of 1874. However, the Land Act restricted Aboriginal resource uses and rights (including water) resulting in push back from First Nation chiefs and the submission of

First Nation petitions to government officials at both the provincial and federal level (Matsui, 2009). In response, the province amended the Land Act to allow water use for First Nation agricultural purposes on reserve land in 1888 under section 1 (Matsui, 2009). Other changes to the Land Act throughout the 1880's brought about minor changes to the management of water, most notably around the opportunity to establish water districts by the Land Commissioner in 1884 (White, 1919), and the recognition of water as a valuable resource (Wilson, 1989). In addition, to help settle anticipated disputes over recorded water for irrigation, the provincial government enabled the election of a district water viewer under the Water Viewers Act of 1886 (c. 24). Unfortunately, as noted by White (1919) "this act was a move along good lines, but it was not much used, probably because of the lack of necessary collateral government agency by which to make the operation of its provisions effective" (p. 67).

The *second* phase (1892-1920) is distinguished by additional efforts by the province to further legitimize their jurisdiction over all water claims, the clarification of water rights and more comprehensive water legislation, particularly around irrigation use rights. The province continued its declaration to all Crown rights to water in the establishment of the Water Privileges Act of 1892 in which it stated "the right to the use of all water at any time in any river, watercourse, lake or stream not being a navigable river or otherwise under the exclusive jurisdiction of the Parliament of Canada, is hereby declared to be vested in the Crown in the right of the Province" (s. 2). This was the provinces first statute exclusively dealing with water and intended to provide stronger legal and administrative jurisdiction over water to the province - although the province had essentially acted this way by requiring an application for water. In addition, the extent of use rights was broadened beyond just miners and "bona fide"

agriculturalists to include approved companies to construct waterworks systems (s. 4) and power production. Then, in 1897, the Water Clauses Consolidation Act was passed reasserting the Crown's position over water ownership, including all unappropriated and unrecorded water, and providing more thorough regulation amongst expanding water users including mining, irrigation, domestic, waterworks systems, power production, industrial, and mechanical purposes (White, 1919). Specifically, the Water Clauses Consolidation Act (1897) repealed most clauses relating to water in other Provincial Acts, including the Water Viewers Act (s. 154), and reaffirmed the right of every owner of land to water through obtaining a record from the province:

“Every owner of land may secure the right to divert unrecorded water from any stream or lake for agricultural, domestic, or for mechanical or industrial purposes, and purposes incidental thereto, to an amount reasonably necessary therefore, upon obtaining a record thereof in manner hereinafter appointed”.

(s. 8)

The Water Clauses Consolidation Act (1897) also extended First Nation use rights on reserves to include domestic purposes (s. 35) and promoted water conservation and management to support economic opportunities throughout the province stating in its preamble “... and to provide means whereby such water and water-power may be made available to the fullest possible extent in aid of the industrial development and of the agricultural and mineral resources of the Province”.

Unfortunately, administrative support continued to fall short leaving new and cancelled records to pile up (White, 1919). Nevertheless, the dominion government continued to reject the provinces claim to water ownership rights over the Railway Belt and First Nation reserve lands where Indian Reserve Commissioners and dominion government continued to issue water use

rights under dominion authority (Matsui, 2009). This tension continued throughout the early 1900's with both authorities issuing water use rights. Water use rights were extended to municipalities under an amendment to the Water Clauses Consolidations Act in 1900 that included municipal water use rights for power production (c. 44). As competition for water uses continued to grow, the province began to receive pressure from the newly formed Western Canada Irrigation Association calling for dramatic change to water governance and management. Following their second annual conference in 1908, the Western Canada Irrigation Association noted to the province:

“Therefore, be it resolved that in the opinion of this convention, the most urgent need of the province to-day is the enactment of a simple and comprehensive law under which the sources of water supply for irrigation may be used to their fullest extent in extending irrigation development, and to that end the government in the proposed legislation enact provisions which will clear the streams of existing records that are not being used, provide for the careful and systematic gauging of all source of supply for the storage of flood water on a basis which will protect those constructing expensive works necessary to conserve this water, and provide the needed staff of competent government officials to administer the law after it is enacted.” (p.15)

Then, with much anticipation, in 1909 the province introduced the Water Act continuing to grant the province ownership of water in addition to further refinement of use rights for the diversion, storage and use of water through water licences, permits and short-term use approvals and the creation of Board of Investigation to transfer water record to licences (White, 1919).

Specifically, section 6 provided a standard for water measurement for both flow and quantity stating “the discharge of one cubic foot of water per second shall be the unit of measurement of flowing water, and the acre foot the unit of measurement of quantity”. Section 9 defined the powers of the Board of Investigation including the ability to collect data and examine old records to deal with streams that had been over allocated when transferring water records to water licences. These transfers were prioritized based on rankings specified in section 49 and completed as fast as the Board of Investigations could validate existing claims and water availability. Section 48 defined the creation of the Water Rights Branch within the Department of Lands and included the Chief Commissioner who was able to identify water districts as he felt fit. Section 250 continued the requirement of beneficial use. Section 287 defined the powers of the Water Commissioners to issue water licences located in each of the water districts. Overall, the Water Act sought to strengthen the provinces power over water and promote economic growth in the agricultural sector and power production to support community and industrial development. Difficulties with the administration of the Water Act were highlighted by the Board of Investigations as Water Commissioners continued to issue licences the Board of Investigations was trying to remove (White, 1919). This lack of coherence resulted in administrative inefficiencies and called for the chairman of the Board of Investigations, J.F. Armstrong, to recommend that all water licences be issued from a central office (White, 1919). Specifically, to improve coherence and efficiency, J.F. Armstrong proposed:

1. *Simplify the notices which were to be posted and published;*
2. *Give the applicant a short delay in which to file the information to which the public was entitled, and a longer delay in which to pay the*

fees and prove to the Department that the water could be beneficially used for the purpose stated;

- 3. Set a fixed time within which plans of the works be submitted to the public and to the Department, and a fixed time for the commencement and the completion of these works;*
- 4. Entrust to one official the issue of licences and permits and the granting of the other water privileges;*
- 5. Enable the Executive grant a certificate of the approval of its undertaking to a company or municipality before the plans of works have been completed;*
- 6. Entrust to the Comptroller of Water Rights the approval of the plans of the works to be constricted;*
- 7. Provide a summary procedure on complaints for illegal diversion of water and other offences by a licence; and*
- 8. Provide for the inspection of dams and other structures which are alleged to be dangerous.*

These suggestions were brought into force through the Water Act Amendment Act of 1912. However, in 1912, the Dominion Government responded to the provinces new Water Act Amendment Act and passed the Railway Belt Water Act of 1912 to assert power over water

authorizations on Railway Belt and First Nation reserve lands and validate water use rights issued by the Dominion. The province followed with the Water Act of 1914 to protect water use rights authorized by the dominion government in an attempt to bring them closer to full provincial administration (White, 1919). The amendment included further extension of the scope of water use rights and the redistribution of water districts that followed natural watershed boundaries rather than the former land district boundaries (Weston, n.d.). The province also introduced calculations to identify water quantities for allocation amounts based on cultivation area rather than random amounts guessed by the licence applicant which were often too large or too small (Wilson, 1989). The province also sought to secure water use for irrigation in the semi-arid Okanagan region of the province where private irrigation systems were supplying and selling water to farmers and causing concern from what Merrill (1912) referred to as the “capitalization of perpetual franchise” (p. 125). Types of companies who could apply for water licences were extended in the Water Act (1914) to include water user communities, mutual water companies, land and water companies and public irrigation communities (c. 81). In further efforts to protect the public and address concerns echoed by the Western Canada Irrigation Association, an amendment to the Water Act of 1914 was passed in 1918 allowing the province to create the Conservation Fund to secure moneys for the purchase of these private waterworks systems (c. 98, d. 5). The purchase of private waterworks systems was completed in 1920 limiting distribution use rights to municipalities and irrigation communities (Wilson, 1989).

During the *third* phase (1920-1979), the water rights system underwent few changes. Ownership and disposition rights remained stable and changes to water use rights legislation was restricted to licencing requirements for use rights to improve administrative efficiency. The main changes

were related to the allowance of unrecorded water and approvals for short term water use up to 6 months (extension to 12 months and then 24 months). The allowance for unrecorded water meant that water used for domestic (consumption and garden irrigation), fire suppression and prospect mining no longer required a licence.

The *fourth* phase (1980-2016) is characterized by major changes including the recognition of Aboriginal and treaty rights, delegation of authorizations, protection of water from exploitation, extension of use rights to include groundwater, and the extension of authorizations to the Oil and Gas Commission. In the first part of the phase (1980-2010), the Constitution Act of 1982 recognized and affirmed existing Aboriginal and treaty rights (s. 35), resulting in uncertainty around Provincial ownership of water resources. The first formal provisions to recognize Aboriginal and treaty rights in British Columbia were through the Environmental Assessment Act of 1994 which required First Nation involvement through consultation (ss. 7, 14, 17, 23 & 43). However, changes to the Environmental Assessment Act in 2002 limited First Nation inclusion resulting in challenges brought on by First Nations against the Crown through the courts. Following court cases (*Calder v. Attorney General of British Columbia*, 1973; *R. v. Sparrow*, 1990; *Delgamuukw v. British Columbia*, 1997; *Guerin v. The Queen*, 1984; *Haida Nation v. British Columbia (Minister of Forests)*, 2014; *Halfway River First Nation v. British Columbia*, 1998; *Nisga'a Nation v. British Columbia*, 1999; *R. v. Marshall*; *R. v. Bernard*, 2005; *Taku River Tlingit First Nation v. British Columbia (Project Assessment Director)*, 2004; and *Tsilhqot'in Nation v. British Columbia*, 2014) onus was placed on the Crown to ensure consultation and accommodation with First Nations before issuance of water use rights through licences, approvals and permits was reinforced. The Province responded recognizing that “the

province is legally obligated to consult and accommodate First Nations, where required, on land and resource decisions that could impact their Indigenous Interests” (Ministry of Environment and Climate Change Strategy, 2019). Nevertheless, outcomes of the provincial consultation and accommodation process remains unsatisfactory to many First Nations who call for more inclusion in British Columbia’s colonial water governance framework (BC First Nations Consultation and Accommodation Working Group, 2013; Simms et al., 2016; von der Porten & de Loë, 2014).

Major changes to the administration of water authorizations came in 1981 and 1982 when power for water approvals and licences were shared with newly established Regional Water Managers (Water Act, 1979). Regional Water Managers were located in Regional Operation Divisions throughout the province returning to the original organizational structure of authorizations throughout the province. Additional powers were delegated in 1992 to allow Regional Water Managers to cancel licences (Water Act, 1992). In response to an increase in private sector electricity production following the launch of the provincial 2002 Energy Plan (BC, 2002), the Water Act was amended in 2003 to restrict the duration of licences for power production (Water Act, 1996). Specifically, new licences for power production were limited to 40-year durations at which time they could be renewed (*s. 12*). In 2004, more changes were brought forward to extend the Water Act to cover groundwater (*s. 1*) and the introduction of alternative governance arrangements (*s. 62-67*). However, groundwater provisions were limited to drilling authorizations (no use rights granted) and no water management plans were ever approved by the minister (Fraser Basin Council, 2011).

The second part of the phase (2010-2016) saw authorization powers extended to the Oil and Gas Commission and the adoption of the highly anticipated Water Sustainability Act. The extension of powers began when the Oil and Gas Commission formalized water source well authorizations under Section 25 of the Oil and Gas Activities Act (2008). In addition, Section 17 of the Oil and Gas Activities Act (2008), designated a Regional Water Manager appointment in the Oil and Gas Commission to issue short term (24 month) surface water use or diversion approvals under Sections 8, 9 and 26 of the Water Act (1996). The extension of powers to the Oil and Gas Commission was to fulfill their “single-window regulatory agency” motto in order to promote continued effective and efficient oil and gas exploration and development (Oil and Gas Commission, 2013). In 2014, the new Water Sustainability Act brought many changes. Use rights were extended over groundwater uses through the requirement of an authorization for aquifer sources (*s. 6*). Ecosystem protection measures were introduced through environmental flow needs, sensitive stream designations and consideration of water for ecological function in the assessment of water authorizations (*s. 15*). Stronger quantitative protection measures enabled temporary protection orders for environmental flows needs restricting all water users (based on prior allocation) to ensure sufficient water for ecosystems (*s. 86-88*). These protection measures replaced regulations under the Fish Protection Act (1997) that were only used in very dry years and considered more reactive than preventative (Mattison, 2016). To enable conservation provisions and address increasing concerns regarding over allocation of water quotas, Section 23 introduced provisions for thirty-year review of existing license terms and conditions. Accompanying these re-evaluations were additional requirements for measuring and reporting (*s. 116*). Opportunities under the Water Sustainability Act (2014) include the establishment of advisory boards, water objective regulations, water sustainability plans, and alternative

governance approaches. Advisory boards may also provide expert advice in relation to water use right quotas and yield quotas (s. 115). They may also provide advice on establishing water objectives which may allow for the extension of regulations over related resource to protect water quality, quantity and availability (s. 43). Water sustainability plans may also be developed to assist with rivalries between water users and water users and environmental flow needs in order to promote the security of authorizations (ss. 64-85). Finally, the Water Sustainability Act (2014) continues to provide the opportunity for the development of regulations to formalize the delegation of administration and governance through alternative governance arrangements (s. 126).

Year	Intervention			Description of intervention	Range of goods and services regulated	Main actors
	OR	DR	UR			
<i>Phase 1</i>						
1859	X		X	<i>Gold Fields Act</i> provided exclusive water rights to defined quantities, cancellation for non-use and waste, water quality protection	Mining, engineering and animals	State: Provincial Actors: Provincial General, Gold field commissioner Appropriators: Miners, farmers End-users: Miners, farmers
1865			X	<i>Land Ordinance Act (LOA)</i> provided exclusive water rights to all land owners	Irrigation	State: Provincial Actors: Department of lands and works Appropriators: Farmers End-users: Farmers
1867	X			<i>Parliament of Great Britain Act</i> established federal Dominion with powers and jurisdiction over federal railway-belt and First Nation reserve lands		State: Federal Actors: Dominion Appropriators: Railway-belt lands, First Nations on reserves End-users: Railway-belt lands, First Nations on reserves
1870	X		X	<i>LOA</i> amendment removed preemptive water rights (no person could acquire an exclusive right except under statutory water record) and protection of use rights		State: Provincial Actors: Department of lands Appropriators: Water record holders End-users: Water record holders
1972			X	<i>LOA</i> amendment provided protection of use rights through “beneficial use”		State: Provincial Actors: Department of lands Appropriators: Water record holders End-users: Water record holders
1874	X		X	<i>Land Act</i> replaced the <i>LOA</i> consolidated land and water ordinances		State: Provincial Actors: Department of lands Appropriators: n/a End-users: Province

Year	Intervention			Description of intervention	Range of goods and services regulated	Main actors
	OR	DR	UR			
1886			X	<i>Water Viewers Act</i> intended to support resolution of water disputes		State: Provincial Actors: Department of lands, water viewer Appropriators: Water record holders End-users: Water record holders
1888			X	<i>Land Act</i> amendments allowed First Nation access to water use privileges for on reserve domestic and agricultural water use	Irrigation and consumption on First Nation reserves	State: Provincial Actors: Department of lands Appropriators: Farmers on First Nation reserves End-users: Farmers on First Nations reserves
<i>Phase 2</i>						
1892	X		X	<i>Water Privileges Act</i> declared all Crown rights to water and eliminated exclusive rights to water	Power production, private waterworks	State: Provincial Actors: Department of Lands Appropriators: Dominion water record holders, power producers End-users: Water record holders, power producers, Province
1897	X		X	<i>Water Clauses Consolidation Act</i> reasserted Crown ownership over water	Industrial, mechanical, FN domestic	State: Provincial Actors: Department of lands Appropriators: Dominion water record holders End-users: Province
1900			X	<i>Water Clauses Consolidation Act</i> amendment extended for municipal water use	Public waterworks (incl. power production)	State: Provincial Actors: Department of lands Appropriators: Municipalities End-users: Municipalities

Year	Intervention			Description of intervention	Range of goods and services regulated	Main actors
	OR	DR	UR			
1909	X		X	<i>Water Act</i> introduced water licences, approvals and permits, established the Board of Investigation, created Water Rights Branch	Storage (irrigation), storage (flood protection)	State: Provincial Actors: Department of Lands, board of investigation, water rights branch (water commissioner), water districts (engineers) Appropriators: All water users End-users: Farmers, property owners, general population
1909			X	<i>Boundary Waters Treaty</i> resolved water rights and quality standards between Canada and the US		State: Federal Actors: Foreign Affairs Canada Appropriators: All water users End-users: Provincial
1912	X		X	<i>Railway Belt Water Act</i> asserted ownership rights over the Railway Belt and First Nation reserve lands and validate water use rights issued by the Dominion		State: Federal Actors: Dominion Appropriators: Railway belt and First Nations on reserves End-users: Railway belt and First Nation reserves
1912	X		X	<i>Water Act Amendment Act</i> centralized water authorizations		State: Provincial Actors: Department of Lands, water commissioner Appropriators: n/a End-users: All water users
1914	X		X	<i>Water Act</i> recognized Dominion water use rights and secured water use for irrigation in the Okanagan region	Private waterworks	State: Provincial Actors: Department of Lands, water commissioner Appropriators: Dominion water rights holders, farmers End-users: Dominion water rights holders, farmers

Year	Intervention			Description of intervention	Range of goods and services regulated	Main actors
	OR	DR	UR			
<i>Phase 3</i>						
1925			X	<i>WA</i> amendment allowed unrecorded water for domestic purposes	Consumption	State: Provincial Actors: Department of Lands, Forests and Water Appropriators: General population End-users: General population
1949			X	<i>Industrial Development Act</i> issued water licences for hydropower purposes for Alcan (now Rio Tinto Alcan)	Power production (around Kitimat, BC)	State: Provincial Actors: Department of Lands and Forests Appropriators: Alcan End-users: Alcan
1951			X	<i>WA</i> amendment allowed unrecorded water to extinguish fires and prospect for mining purposes	Fire suppression, prospect for mining	State: Provincial Actors: Department of Lands and Forests Appropriators: Mining industry End-users: Mining industry
1960			X	<i>WA</i> amendment extended groundwater (never enacted) and introduced approvals short term water use	Short term water uses (6 months)	State: Provincial Actors: Department of Lands and Forests Appropriators: Groundwater users End-users: None
<i>Phase 4a</i>						
1982	X			<i>Constitution Act</i> recognized existing Aboriginal and treaty rights (provincial government duty to consult and accommodate with aboriginal peoples)		State: Federal Actors: Provincial government Appropriators: Provincial government End-users: Provincial government, Aboriginal peoples
1982			X	<i>WA</i> amendment delegated powers to regional water managers to issue licences, amend licences and transfer appurtenancy		State: Provincial Actors: Operational Divisions, regional water manager Appropriators: n/a End-users: n/a

Year	Intervention			Description of intervention	Range of goods and services regulated	Main actors
	OR	DR	UR			
1985			X	<i>International Boundary Waters Treaty Act</i> provided water rights to obstruct or divert boundary waters		State: Federal Actors: Foreign Affairs Canada Appropriators: All water users on boundary waters End-users: All water users on boundary waters
2003			X	<i>WA</i> amendment to expiry date for power purposes (40 years)	Power producers	State: Provincial Actors: Ministry of Water, Land and Air Appropriators: power producers End-users: power producers
2004				<i>WA</i> amendment enabled alternative governance arrangements (none approved)	All	State: Provincial Actors: Ministry of ENV Appropriators: n/a End-users: none to date
<i>Phase 4b</i>						
2010			X	<i>Oil and Gas Activities Act</i> provided water source well authorizations, allowed water to be acquired from landowners with groundwater wells	Oil and gas	State: Provincial Actors: Oil and Gas Commission Appropriators: Oil and gas industry End-users: Oil and gas industry
2014			X	<i>Water Sustainability Act</i> expanded scope to include extraction and use of groundwater, introduced environmental flow needs and conservation measures, and opportunities for advisory boards, water objectives, sustainability plans and alternative governance arrangements	All uses from groundwater sources with the exemption of domestic, geothermal and oil and gas use	State: Provincial Actors: Ministry of ENV and Ministry of FLNRORD Appropriators: Groundwater users End-users: All groundwater users with exemption for domestic, geothermal and oil and gas use

Table 3.5 Phasing of water property rights from 1859 to 2016

3.4.4 Evolution of policy design relating to water

Throughout the period of analysis (1858-2016), the evolution of public policies in British Columbia can be divided into *three* distinct phases. These phases are characterized by major changes in public policy instruments, including the range of goods and services regulated and actors involved, and are used to inform the regime typology in section 3.4.5. Each phase is described below followed by a summary provided in table 3.6.

The *first* phase (1868-1970) spans over one hundred years and is marked by few developments due to the province's focus on economic development. Collective problems addressed were related to protecting fish resources, protecting property from flood events and protecting irrigation needs during droughts. With a strong economic dependence on fishery resources throughout Canada, the Dominion of Canada introduced the Fisheries Act of 1868 to deal with fisheries management, protection and conservation (Carrothers, 1941). Section 12 of the Fisheries Act (1868) required the construction of fishways to ensure fish passage around dams, slides and other obstructions in a stream and section 14 protected against pollution of rivers. The target groups of these measures were industries working in and around rivers (mining, gravel, coal), construction works that cross a river and industrial effluent. In 1953, the Canada Water Conservation Assistance Act provided funding to develop dams for the control and conservation of water to communities that could not afford these works on their own. This promoted the development of dams throughout Canada, many in violation of section 12 of the Fishery Act. Dams were seen as having additional benefits in areas that experienced both flooding in the spring and droughts in the summer as storage provided double benefits. The target groups of these measures were municipalities and farmers. Provincial jurisdiction over environmental

pollution began in 1956 with the introduction of the Pollution Control Act. This was a direct result of conflict between the City of Richmond who opposed the City of Vancouver's proposed sewage treatment plant on Iona Island. The Pollution Control Act (1956) introduced effluent discharge authorizations through the issuance of discharge permits with attached conditions relating to treatment from the Department of Municipal Affairs. Permits were limited to municipalities and municipal waste discharges until 1965 when pollution control was shifted to the Department of Lands, Forests and Water Resources and expanded the definition of "works" under section 2 to include industrial waste (Pollution Control Act, 1965). Two years later, additional changes were made to expand the definition of "pollution" beyond sanitation and public health to include impacts on the goods and services of land and water and to require permits for all waste discharge providing more comprehensive environmental protection around waste absorption (Pollution Control Act, 1967).

Following international environmentalism, water quality protection policies increased during the *second* phase (1970-1986) along with federal measures to support provincial and territory water science and management. Major changes at the federal level were driven by the formation of national environmental advocacy organizations and the establishment of Environment Canada and the Environmental Protection Service (Parson, 2001). In 1970, the Canada Water Act superseded the Canada Water Conservation Assistance Act to improve federal support to provinces and territories around water management. Specifically, the federal government committed itself to collect data (water monitoring for hydrometric flows and quality quality), research, planning around transboundary watersheds (consultation committees), conservation, and support for the implementation of holistic and participatory water management, including

planning at the watershed scale (Canada Water Act, 1970). Results from these measures continue today to support water science and decision making, although not as robust. In addition, the federal government advanced its commitment to legislative jurisdiction over sea coast and inland fisheries to manage, protect and preserve fisheries with amendments to the Fisheries Act (Constitution Act, 1867 s.91). The first change came in 1970 with the introduction of pollution prevention measures under section 34 along with the Pulp and Paper Effluent Regulations in 1971 to protect fish from harmful substances discharged from pulp and paper mills. The second change came in 1977 when then Fisheries Minister Romeo LeBlanc emphasized at the House of Commons Debates (2nd Session, vol. 6) the need for habitat protection. Specifically, Leblanc (1977) noted “Habitat protection will always remain a difficult battle because it runs against the energies of good people following their natural bent: developers, loggers, land reclaimers, and so on. The work of constant monitoring and restraint where necessary is hard, but the alternative prospect of forever losing stocks or species of fish is not acceptable” (p. 5668). The amendments strengthened pollution prevention measures and the addition of fish habitat protection measures (ss. 35-36). Specifically, Metal Mining Effluent Regulations (now Metal and Diamond Mining Effluent Regulations) were created to protect fish from “deleterious substances” (s. 36). Provincially, public environmental interests also soared and in 1972 the province elected, for the first time, the New Democratic Party bringing change from the “explore, exploit, export!” era (Hak, 2004). Forest activities began to be held accountable for pollution that was threatening drinking water sources and fisheries. In 1972, Coast Logging Guidelines were developed in the Ministry of Lands, Forests and Water Resources to protect fish from forest practices. Although water and land were shifted to the Ministry of Environment in 1975, the Ministry of Forest continued to develop protection policies throughout the 1980’s including the identification of

Community Watersheds recognizing water quantity, quality and timing of flow (Guidelines for Watershed Management of Crown Lands Used as Community Water Supplies, 1980). In 1975, the introduction of the Ecological Reserve Regulations restricted sewage discharge directly within the boundaries of an ecological reserve (s. 9). Today, there are 134 established ecological reserves in the province, 15 of which are marine. However, in 1982, the Auditor General noted that without water quality standards and an effective monitoring program, the ministry of Environment, Lands and Parks could not reliably assess the performance of the environmental protection measures (BC Office of the Auditor General, 1982). The province responded by developing provincial wide water quality guidelines and site-specific water quality objectives (Ministry of Environment, 2013). In addition, in 1982, the province replaced the Pollution Control Act with the Waste Management Act imposing stringent liability for waste discharge and expanding authorizations to include permits, approvals and orders (s. 3).

The *third* phase (1985-2016) is marked by continued increase in environmental protection policies directed at both water quality and quantity, increase involvement of non-state actors and opportunities for policies directed at water availability. The beginning of this phase is described by Harrison (1996) as the re-emergence of the federal role in Canadian environmental policy. The number of Canadians that perceived environmental issues as “very serious” began to rise in the late 1980’s and by 1989 the environment had become the public’s top priority (Gallup Canada, 1989). At the same time, the 1989 G-7 Summit in Paris and the Brundtland Commission called for sustainable development around the world and the 1992 Earth Summit in Rio. These international and local pressures resulted in further development of policies for both protection of resources supported by water and the protection of water use rights from pollution. Target

groups included foresters, industry (oil and gas, power producers), development projects, municipalities, and other effluent and sewer polluters. However, one of the main differences between this phase and the previous phase is in relation to public environmentalism. Specifically, environmental groups advanced from local voluntary groups to professional environmental associations and were included in consultation of environmental policy providing a voice for public environmental concerns by the late 1980's (Harrison, 1996). Environmental groups were also successful in holding the federal government accountable for environmental protection through the courts requiring environmental impact assessments for major federal projects (Harrison, 1996). Environmental impact assessments came into law in 1992 under the Canadian Environmental Assessment Act. The Environmental Assessment Act of 1992 sought to “achieve sustainable development by conserving and enhancing environmental quality and by encouraging and promoting economic development that conserves and enhances environmental quality” (preamble) and applied to all projects that required federal funding, permits or licencing. However, in 1996, the federal government cancelled the Flood Damage Reduction Program, a move that is questionable given the benefits associated with the program (de Loë & Wojtanowski, 2001). This resulted in the disbandment of British Columbia's Floodplain Mapping Branch (Day, 1999) and delegation of flood considerations to professional engineers (APEGBC, 2012). With a continued lack of consistent funding at the local level, in 2013 the Real Estate Foundation of British Columbia developed a Floodplain Maps Action Plan calling for provincial and federal government action to support and coordinate floodplain mapping. Threats to fish continued in this phase from increasing water extractions and changes to the natural water balance resulting in insufficient flows in streams for fish and other ecosystem functions. To ensure sufficient flows for fish, particularly during droughts, water quantity

protection measures were introduced in 1997 under the Fish Protect Act. These measures allowed short term restrictions on water use rights based on prior allocation (first in time, first in right). However, restrictions were limited to streams that were designated as a sensitive stream for the “protection of a population of fish whose sustainability is at risk because of inadequate flow of water within the stream or degradation of fish habitat” (s. 6) and considered reactive rather than preventative (Mattison, 2016). Protection measures against water exploitation were established in the Water Protection Act of 1996 prohibiting bulk water export from British Columbia and large-scale transfers between watersheds (ss. 4-8). Additional water quality protection measures were introduced for municipal sewage discharge through the adoption of the Municipal Sewage Regulation of 1996 (now Municipal Wastewater Regulation, 2012) under the Environmental Management Act (1996). Given the high standards of the Municipal Sewage Regulation (1996), municipalities were allowed to establish a schedule in order to meet the requirements established through the development of waste management plans. The opportunity for waste management plans remain in place under Section 24 of the Environmental Management Act with many municipalities having to create liquid management plans including the greater Vancouver sewerage & drainage district and member municipalities. In the Metro Vancouver Liquid Waste Management Plan, focus is on wastewater treatment, sewage overflows (combined systems), water conservation strategies, and development impacts on rainwater runoff for environmental protection (Metro Vancouver, 2010). Concerns relate to both the both water quantity and water quality and require the development of Integrated Stormwater Management Plans by each member municipality. Integrated Stormwater Management Plans are not a requirement of the Municipal Wastewater Regulation, but are tools to understand and regulate land use change to protect ecological function. I mention the greater Vancouver ILWRMP

because, although it is the intention of waste management plans to skirt under provincial standards when in non-compliance, they can also provide an opportunity for additional requirements under the direction of the Minister of Environment (now Minister of Environment and Climate Change Strategy). In 2004, water discharge authorizations were moved under the Environmental Management Act with different requirements for permits, approvals and registrations depending on sources (schedule 1 for unique, complex and variable technology industries and schedule 2 for industry and activities authorized by a code of practice). However, continued failure of provincial governments to protect the environment from municipal effluent resulted in the federal government asserting a stronger presence around wastewater jurisdiction and in 2006 proposed a Canada wide strategy for the management of municipal wastewater. By 2012, the federal government passed nation-wide baseline standards for municipal wastewater treatment and effluent discharge through the Wastewater Systems Effluent Regulations (SOR/12-139) under the Fisheries Act (1985). This was the first time the federal government introduced jurisdiction over municipal wastewater effluent bringing Canadian standards more in alignment with those in the United States and European Union where secondary treatment is required. The requirements allowed for transitional authorizations to meet the required secondary treatment by 2020 to 2040 depending on discharge points (ss. 24-33). In addition, if a province already has standards in place that met the standards in the federal Wastewater Systems Effluent Regulations, equivalency agreements could be established to annul the federal regulations. In 2014, protection measures that were previously under the Fish Protection Act (1997) were integrated into the Water Sustainability Act through environmental flow needs, sensitive stream designations and consideration of water for ecological function in the assessment of water authorizations (s. 15). In addition, protection measures enabled temporary protection orders for

environmental flows needs restricting all water users (based on prior allocation) to ensure sufficient water for ecosystems (ss. 86-88).

Year	Instrument description	Range of goods and services regulated	Main actors
<i>Phase 1</i>			
1868	<i>Fisheries Act</i> protected fish passage and water pollution	Resource extraction, hydro-electricity, flood protection	Actors of arrangement: Fisheries and Oceans Canada Target groups: Fishers, industries Pressure groups: Fishers, government End users: Fishers, industries
1873	<i>Better Protection of Navigable Streams and Rivers Act</i> protected navigable streams from mill waste	Waste absorption (mill waste)	Actors of arrangement: Dominion of Canada Target groups: Lumber mills Pressure groups: Government End users: Lumber mills
1903	<i>Water-courses Obstruction Act</i> prevent obstruction of lakes and watercourses from thrown waste	Industrial waste absorption	Actors of arrangement: Dominion of Canada Target groups: Industries (incl. lumber mills) Pressure groups: Fishers End users: Industries
1953	<i>Canada Water Conservation Assistance Act</i> (now <i>Canada Water Act</i>) assistance for the storage of water for flood control and conservation	Flood protection, conservation	Actors of arrangement: Environment Canada Target groups: Private waterworks, industry Pressure groups: Local government, industry, farmers End users: General population
1956	<i>Pollution Control Act</i> pollution prevention through permitting	Municipal waste absorption	Actors of arrangement: Department of Municipal Affairs, Pollution Control Board Target groups: Municipalities Pressure groups: City of Richmond End users: General population
1965	<i>Pollution Control Act</i> amended to include industrial pollution	Industrial waste absorption	Actors of arrangement: Department of Lands, Forests and Water Resources (now ENV) Target groups: Industries Pressure groups: Local government End users: General population

Year	Instrument description	Range of goods and services regulated	Main actors
<i>Phase 2</i>			
1970	<i>Canada Water Act</i> coordinated conservation, development and use of water between provinces and territories, protection against pollution of water	Coordination between provinces and territories	Actors of arrangement: Environment Canada Target groups: Provinces, territories Pressure groups: Federal government End users: Provinces, territories
1970	<i>Fisheries Act</i> amendments expanded protection of fish and pollution prevention	Ecological function, waste absorption	Actors of arrangement: Fisheries and Oceans Canada Target groups: Industry (metal mining, pulp and paper, wastewater effluent), vessels Pressure groups: Fishers End users: Fishers, recreation, general population
1975	<i>Ecological Reserve Regulations</i> introduced protection of ecological reserve areas from sewage discharge	Ecological function, waste absorption	Actors of arrangement: Department of Environment (now ENV) Target groups: Sewage discharge (incl. local government, pleasure crafts) Pressure groups: Environmentalists End users: General population, ecosystems, shellfish harvesters
1975	<i>Flood Damage Reduction Program</i> coordinated provincial and federal flood protection through a non-structural approach with floodplain mapping	Flood control	Actors of arrangement: Environment Canada Target groups: Provinces, local governments Pressure groups: Federal government End users: Provinces, local governments
1977	<i>Fisheries Act</i> amendments introduced protection of fish habitat from harmful alteration, disruption or destruction.	Ecological function (fish habitat)	Actors of arrangement: Fisheries and Oceans Canada Target groups: Development construction Pressure groups: Fishers, economy End users: Fishers, recreation, general population
1980	<i>Guidelines for Community Watersheds</i> (now <i>Forest and Range Practices Act</i>) introduced protection of water	Forestry	Actors of arrangement: Ministry of Forests (now FLNRORD) Target groups: Foresters

Year	Instrument description	Range of goods and services regulated	Main actors
	quantity, quality and timing of flows from forest activities		Pressure groups: Scientists, municipalities End users: Forest operators on unceded territory
1982	<i>Water Quality Guidelines & Water Quality Objectives</i> introduced protection to drinking water sources, ecological function, recreation, cultural purposes	Waste absorption	Actors of arrangement: Ministry of Environment (now ENV) Target groups: Foresters Pressure groups: Environmentalists, waterworks operators (municipalities) End users: Foresters, land developers
1982	<i>Waste Management Act</i> replaced <i>Pollution Control Act</i> required permit, approval or order for industrial waste	Industrial waste absorption	Actors of arrangement: Ministry of Environment (now ENV) Target groups: Industries Pressure groups: Environmentalists End users: Industries
<i>Phase 3</i>			
1988	<i>Canadian Environmental Protection Act</i> introduced protection measures around air and water pollution, acid rain, ocean dumping, toxic dumping, and ozone depletion	Waste absorption	Actors of arrangement: Environment Canada Target groups: Industrial polluters, power producers Pressure groups: environmentalists, scientists, fishers, recreation End users: General population, aquatic ecosystems, fishers
1988	<i>Land Act</i> introduced drinking watershed reserves to protect drinking water sources from commercial and industrial activities	Community waterworks	Actors of arrangement: Ministry of Forests and Lands (now FLNRORD) Target groups: Water providers (municipalities, irrigation districts) Pressure groups: General public, municipalities End users: Water providers (municipalities, irrigation districts)
1992	<i>Canadian Environmental Assessment Act</i> incorporated sustainable development and public participation in planning phase of projects prior to	Power production	Actors of arrangement: Environment Canada Target groups: Federal projects that require federal funding, permits or licencing Pressure groups: Environmentalists, international leadership

Year	Instrument description	Range of goods and services regulated	Main actors
	issuing of funding, permits and licences		End users: General population, ecosystems, Indigenous Nations
1996	<i>Water Protection Act</i> introduced to restrict existing and prohibit further bulk water removal from BC and large-scale transfers between nine major watersheds in BC	All	Actors of arrangement: Ministry of Environment, Lands and Parks (now ENV) Target groups: Power producers, commercial users, industries Pressure groups: Environmentalists, scientists End users: Power producers, municipalities, land owners, water sales
1996	<i>Land Act</i> amendment to lease area for watershed purposes (water source protection)	Community waterworks	Actors of arrangement: Ministry of Environment, Lands and Parks (now FLNRORD) Target groups: Water providers (municipalities, irrigation districts) Pressure groups: General public, municipalities End users: Water providers (municipalities, irrigation districts)
1997	<i>Fish Protection Act</i> provided protection of fish habitat and sufficient water for fish through streamflow protection licences and temporary reduction in water use rights	All (FITFIR)	Actors of arrangement: Ministry of Environment, Lands and Parks (now ENV) Target groups: Municipalities, water users Pressure groups: Environmentalists, fishers End users: Water use rights holders
1998	<i>Water Conservation Strategy BC</i> promoted water conservation through water use efficiency measures	Direct uses	Actors of arrangement: Ministry of Environment, Lands and Parks (now ENV) Target groups: Industry, general population Pressure groups: Environmentalists End users: Industries, general population
2001	<i>Drinking Water Protection Act</i> enabled drinking water protection plans to protect drinking water quality and availability	Community waterworks	Actors of arrangement: Ministry of Health; and Ministry of Ministry of Water, Land and Air Protection (now ENV and FLNRORD) Target groups: Water providers (municipalities, irrigation districts)

Year	Instrument description	Range of goods and services regulated	Main actors
			Pressure groups: Municipalities (water providers), environmentalists End users: Water providers (municipalities, irrigation districts)
2002	<i>Environmental Assessment Act</i> ensured major projects meet goals of environmental, economic and social sustainability, and specific regulations for large groundwater extraction projects (> 75 l/s)	All	Actors of arrangement: Environmental Assessment Office Target groups: Major projects Pressure groups: Environmentalists, local community groups End users: Major projects including power producers, oil and gas, mining, development
2003	<i>Environmental Management Act</i> (repealed <i>Waste Management Act</i>) pollution prevention from waste discharge	Waste absorption	Actors of arrangement: Ministry of Water, Land and Air Protection (now ENV) Target groups: Industries, municipalities Pressure groups: Environmentalists End users: Industries, municipalities
2012	<i>Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC</i> required consideration of climate change when developing flood assessment reports (including flood hazard and flood risk)	Flood control	Actors of arrangement: Association of Professional Engineers and Geoscientists of BC (now EGBC) Target groups: Professional engineers Pressure groups: Real estate foundation, government End users: Professional engineers, development projects that require development permits or sale or lease of unceded territory, municipalities
2012	<i>Environmental Assessment Act</i> amendment reduced “project” definition to require fewer assessments	All	Actors of arrangement: Environment Canada Target groups: Projects that require federal funding, permits or licencing Pressure groups: Commercial enterprises End users: Commercial enterprises (industries, power producers, oil and gas, mining)
2012	<i>Fisheries Act</i> amendments reduced the scope of fish habitat protection	Ecological function (fish habitat)	Actors of arrangement: Fisheries and Oceans Canada Target groups: Any works that can harm fish habitat

Year	Instrument description	Range of goods and services regulated	Main actors
			Pressure groups: Fishers, economy End users: Fishers, recreation, general population
2012	<i>Wastewater Systems Effluent Regulations</i> under the <i>Fisheries Act</i> introduced nation-wide baseline standards for municipal wastewater treatment and effluent discharge	Waste absorption (municipal)	Actors of arrangement: Fisheries and Oceans Canada Target groups: Municipalities Pressure groups: Federal government End users: Municipalities
2014	<i>Riparian Areas Protection Act</i> (repealed the <i>Fish Protection Act</i>) to provide streamside protection and enhancement	Ecosystem function	Actors of arrangement: Ministry of Environment Canada Target groups: Land owners, municipalities Pressure groups: Environmentalists End users: Land owners, municipalities
2014	<i>Water Sustainability Act</i> repealed parts of the <i>Fish Protection Act</i> and introduced protection policies in the water rights system	Ecosystem function	Actors of arrangement: Ministry of Environment and Ministry of Forests, Lands, Natural Resource Operations and Rural Development Target groups: Water use rights holders Pressure groups: Environmentalists, First Nations Fisheries Council, commercial enterprises End users: Water use rights holders

Table 3.6 Phasing of water policy design from 1859 to 2016

3.4.5 Regime typology

Throughout the period of analysis (1858-2016), the development of water governance regimes in British Columbia can be divided into *four* distinct phases. These phases are characterized by major changes in extent, internal coherence of the property rights system, internal coherence the policy design, and external coherence of the IRR, including the institutional environment. Each phase is described below and summarized in table 3.7.

The *first* phase (1858-1909) is identified as a simple regime. Although no unified water rights system existed until 1914 and the extent of goods and services regulated was low, the phase does not qualify as a non-existent regime. The Colonial Proclamation established rights to water for all (providing ownership regulation) and not just those whose property backed onto streams like riparian proprietorship in the east. Absolute extent saw the expansion of uses regulated from mining and animal use to include irrigation, fisheries, mill waste, power production, waterworks, industrial, and storage. However, relative extent remained low with waste absorption regulations limited to lumber mills and no use rights required for water from groundwater sources. The coherence of property rights was also low. On one hand the provincial government was issuing water use rights beginning in 1858 for gold mining and animal use, expanding to First Nation reserve land and other economic industries in 1875. While, on the other hand, the Federal government was issuing water use rights for activities on federal land (known as the Dominion Railway Belt) and First Nation reserve land (which transferred between the federal government to the provincial government and back to the federal government). Public policies were also limited to the protection of fisheries, and had little to no impact on the property rights system. In addition, overallocation of water resources resulted in implementation of the Water Viewers Act

(1886) to settle anticipated disputes. Overall, there was a regime in place, however, it was not a clear regime resulting in uncertainty around the legitimacy of licences and water availability.

The *second* phase (1909-1970) is qualified a simple regime. Even with the implementation of the Water Act of 1909 and 1914 bringing clarity and security to licences issued for water use rights, the scope of goods and services regulated continued to exclude groundwater sources. In relation to extent, absolute extent saw an expansion in uses regulated to include municipal waste, industrial and mining absorption and a reduction in regulations for unrecorded water for prospect mining and fire purposes and short term uses up to six months. Relative extent remained low with the reduction in regulations for unrecorded and short-term uses and continued unregulated groundwater uses. The coherence of property rights system improved during the beginning part of this phase with the centralization of water authorizations, re-allocation of use rights, the collection of water data, and the development of a stream database used to track possible water shortages in an attempt to better understand water resource quotas to provide security around water use rights. However, relaxations to the requirement of use rights for prospect mining purposes and short-term 6-month approvals to improve efficiency were contradictory to goals of the Water Act of 1909 and 1914. Coherence of public policies were also characterized by a low level of diversification even though the federal government provided funding to support the development of storage facilities for conservation and flood protection. The development of storage facilities contradicted fisheries regulations that aimed to reduce fish obstructions. In addition, waste absorption permissions were regulated through water discharge permits, however, these permits were not considered a formal “use right” as rights were never conferred in the Pollution Control Act (1967). Rather, permits were considered more a privilege and used

to allow the Director to require treatment or cease discharge to protect actual use rights and other goods and services from pollution. Therefore, the external coherence of the regime remained low.

The *third* phase (1970-2010) is qualified as complex. First, public policies developed around the protection of both water quality and quantity following international and local environmental pressures. This resulted in an increase in absolute extent from regulations around waste absorption and ecological function. However, relative extent remained low with continued unregulated groundwater uses. Second, the property rights system saw an increase in competition for uses creating pressure for the restriction of use rights. However, restrictions were limited to power production licences with a maximum duration of 40 years. Third, coordination between organizations became more complex with the decentralization of water authorizations to regional water managers and the affirmation of Aboriginal rights and title. The affirmation of Aboriginal rights and title required the government to consult and accommodate before issuing a licence, approval or permit introducing a new actor in the organizational structure. However, coordination improved between related resources through the promotion of integrate resource management plans developed at the regional level. The federal government also supported improved coordination between provinces and territories with shared watersheds. It also provided improved water science and information with the implementation of hydrometric monitoring and weather stations throughout the province providing information on resource yield quotas and flood hazards and risks (although floodplain mapping support was discontinued in 1996). Finally, a major shift in this phase came from policies that began to have an impact on the

water rights system through the opportunity for the restriction of use rights for fish protection and the implementation of water quality regulations in the related forestry regime.

The *fourth* phase (2010-2016) is also qualified as a complex regime. It is separated from the previous phase, but it is worth noting that the previous phase laid the ground work for many of the changes in this phase. The Water Sustainability Act of 2014 translated the growing necessity to integrate the qualitative and quantitative governance of water into one concrete legal basis. The absolute and relative extent of property rights became high with the realization of groundwater source regulations. Coherence within the property rights system increased with a shift in political commitment to consultation and accommodation with First Nations and the review of licences after 30 years. However, by expanding power of water authorizations to the Oil and Gas Commission, the organizational structure became further fragmented. Public policies continued to fall short around water availability and quality protection. However, although organizational fragmentation increased within public policies with the introduction of Wastewater System Effluent Regulations by the federal government, coherence at the provincial level between protection policies and water use rights improved with the introduction of the Water Sustainability Act (2014). Moreover, opportunities not yet developed under the Water Sustainability Act (2014) provide the start of an integrated regime. Specifically, additional coherence may be achieved through the development of advisory boards, water objectives, alternative governance arrangements, and water sustainability plans. In regard to the protection of water quantity and availability, the opportunity for water advisory boards can include expert advice on water science including a better understanding around water yield quotas and the identification of water quotas to define an extraction limit for surface and groundwater sources.

Overall, the water regime in British Columbia has developed from a simple regime (1858-1970) to a complex regime (1970-2010) to the start of an integrated regime in 2014 with opportunities available for continued integration as regulations are developed and alternative governance arrangements explored under the Water Sustainability Act, 2014.

Phases	Property rights system (PR)	Public policies (PP)	Institutional regime
<i>Phase 1</i> 1859-1909	Establishment of prior appropriation, however, no unified water rights system, and no water quantity and quality protection measures.	Federal fisheries policy to conserve fish resources including pollution protection.	Simple regime Low extent Low internal coherence of PR Low internal coherence of PP Low external coherence
<i>Phase 2</i> 1909-1970	Establishment of the provincial Crown jurisdiction over all water resources, centralization of authorizations, standard unit of measurement, re-allocation of use rights, increase in goods and services regulated, and alternative administrative processes for unrecorded water and short term uses.	Policies to promote water conservation, flood control and protection from drought at the federal level, and protection from water pollution at the provincial level.	Simple regime Low extent Medium internal coherence of PR Medium internal coherence of PP Low external coherence
<i>Phase 3</i> 1970-2010	Limitation of use rights through environmental and fish protection measures, decentralization of authorizations, restrictions to new power production licences, uncertain Aboriginal rights and title to water, and alternative governance arrangements.	Expansion of protection of water quality mainly through independent sector policies, promotion of integrated planning at the regional level, additional federal support for water science and coordination for transboundary watersheds, and the introduction and termination of flood damage reduction program.	Complex regime Medium extent Low internal coherence of PR Medium internal coherence of PP Medium external coherence
<i>Phase 4</i> 2010-2016	Increase in scope to include groundwater, authorizations extended to Oil and Gas Commission, restrictions on use rights for ecological function, commitment to consultation and accommodation, 30-year licence review, advisory boards, water objectives, area based regulations, and water sustainability plans.	Integration of fish protection policies into the Water Sustainability Act, federal policy to protect water quality from municipal effluent, reduction in federal environmental assessments, and climate change considerations in flood assessments.	Complex regime High extent Medium internal coherence of PR Medium internal coherence of PP Medium external coherence

Table 3.7 Typology of water resource regime from 1859 to 2016

3.5 Discussion

Results from this examination show that the water regime has progressed from simple to complex. In terms of the property rights system, I identified four distinct phases. In the first phase, water in British Columbia was declared owned by the Crown in 1859 shortly after British Columbia became a province. At that time, the province adopted prior appropriation allowing water use rights to non-riparian landowners enabling opportunities for semi-arid agricultural lands and placer gold deposits and issued water use licences through the Department of Lands. In the second phase, the province enacted the Water Act of 1909 followed by the Water Act of 1914 securing ownership over water and bringing more comprehensive water legislation around use rights. These changes also resulted in the transfer of water records to official licences, the creation of water districts that followed natural watershed boundaries and the introduction of a comptroller of water rights to dispose water use rights out of one central office for improved efficiency and coherence. The third phase saw little change other than the allowance of unrecorded water and approvals for short term water use. These changes were introduced to speed up licence processing time to support economic development throughout the province. In the fourth phase, major changes were brought about including the protection of water from exploitation, the recognition of Aboriginal rights and title to water (resulting in consultation and accommodation), the formalization of groundwater use rights, the decentralization of authorization powers to regional water managers, and the extension of authorization powers to the Oil and Gas Commission. Overall, property rights have developed over time to respond to increasing uses and competition over limited resources. To improve coherence of the property rights system, the government has restructured authorization powers from decentralized to centralized in 1914 and back to decentralized in 1982 followed by extension to the Oil and Gas

Commission in 2010. The opportunity for further delegation through alternative governance arrangements under the Water Sustainability Act (2014) to improve coherence remain unknown.

In terms of public policies, I identified three distinct phases. In the first phase, the federal government developed jurisdiction over ocean and inland fisheries to secure fish resources which were an important economic resource for the Country. The development of dams was encouraged and financially supported by the federal government to ensure protection from flooding and secure water during dry seasons. In the second phase, the federal government continued to support provincial governments and international environmentalism prompted the development of water quality protection measures. An important development during this phase was the federal government's commitment to improve water science, coordination and flood protection along with the recognition of fish habitat as an important aspect of fish protection and conservation. Pollution protection measures were also introduced at the provincial level to protect fish from deleterious substances. Forestry activities were also held accountable for impact on water quality through the development of Community Watersheds and water quality guidelines around the province. The third phase was initiated with an increase in public support for environmental protection resulting in further development of policies for both the protection of resources supported by water and the protection of water use rights from pollution. This phase also saw an increase in public participation in environmental concerns, federal measures for municipal wastewater and the opportunity for the development of water objectives to develop local regulations to protect water sources. Overall, policies have developed in four main areas: 1) protection against flooding; 2) protection against water exploitation; 3) protection against

pollution; and 4) protection and conservation of ecological function. However, the protection of water availability from related sources remains unknown.

Based on extent and coherence of the water regime, the analysis identified four distinct phases. The *first* phase is considered simple due to limited extent over water use rights and protection policies. In addition, jurisdiction over water was shared between the provincial and federal governments creating incoherencies in the properties rights system. The *second* phase is also considered simple due to continued low extent and low external coherence. However, during this phase, an increase in coherence within the property rights system and public policies provided clearer use rights and alignment between jurisdictions. Significant developments during this phase include provincial jurisdiction over water ownership, the establishment of a single central agency for water authorizations, the development of a standard unit of water measurement and revisions to use quotas based on data collected by the Board of Investigation when transferring records to licences. However, protection policies remained limited to pollution control and stream obstructions to protect fisheries. The *third* phase is considered complex due to an increase in competition over limited water resources, the affirmation of Aboriginal rights and title, decentralization of water authorizations, and major developments in public policies as environmental issues became paramount. Specifically, federal government provisions to improve water science and information provided resources to begin understanding resource yield quotas, although much of this support was disbanded by the beginning of 2000 and failed to be picked up by the provincial government. Nevertheless, these changes resulted in an increase in extent and coherence within public policies, but incoherencies within the property rights system. The *fourth* phase is also considered complex due to high extent from the expansion of water use

rights over groundwater sources and medium to high coherence. Specifically, the extension of water authorizations to the Oil and Gas Commission brought additional division to an already fragmented organizational structure resulting in lower coherence within the property rights system. However, opportunities under the Water Sustainability Act (2014) provided the start of an integrated regime with the introduction of environmental flow needs, sensitive stream designations, consideration of water for ecological function in the assessment of water authorizations, and provisions for thirty-year review of existing license terms and conditions resulting in greater extent of the water regime. Moreover, the Water Sustainability Act (2014) may provide additional extent and coherence of the water regime through the establishment of advisory boards to provide expert advice, the development of water objective to protect water resources (both quality and availability), alternative governance arrangements to share decision making powers and water sustainability plans to resolve conflicts.

Overall, the property rights system and public policies have both developed over time to expand the scope of the water regime to include most uses and to become more coherent. However, the main hinderance of becoming an integrated regime remain from gaps and incoherencies in water regulations from Aboriginal rights and title to water, jurisdictional and organizational fragmentation and the absence of a defined resource yield quota.

First, a major gap in the current water regime relates to Aboriginal rights and title to water. Warwick Sears (2013) notes “probably the biggest issue in B.C. is the fact that First Nations rights and title have not been resolved” (p. 20 in Morris & Brandes, 2013). However, following recent legal and legislative changes that have recognized and affirmed Aboriginal rights to title

and treaties, the Provincial government has committed to new relationships with First Nations when it comes to governing water (Simms et al., 2016). This not only includes consultation and accommodation, but also opportunities for collaborative governance (or collaborative consent). Collaborative consent involves a commitment by the province to engage with Indigenous governments, as equal partners, to achieve mutual consent on matters related to water governance (Phare et al., 2017). In 2018, the Provincial government signed a Nicola watershed pilot memorandum of understanding with the Nicola First Nations to “explore opportunities to engage governments and stakeholders in the management of water in the Nicola watershed” (Ministry of Environment and Climate Change Strategy, 2018). Support for collaborative governance was noted by George Heyman, Minister of Environment and Climate Change strategy, who stated “we know changes are happening in the Nicola watershed and there is a need to develop solutions together. The pilot will build on the work that has been ongoing in the watershed by communities and individuals for a number of years” (Ministry of Environment and Climate Change Strategy, 2018). Chief Lee Spahan of the Coldwater Indian Band also noted “water is of very high cultural importance to members of the Coldwater Indian Band. When it comes to decision-making, we need to be involved, because right now it’s decided by people who don’t live here, who don’t see the issues with water what we see. Through collaboration, we can prevent a lot of these issues” (Ministry of Environment and Climate Change Strategy, 2018). The Nicola watershed pilot memorandum of understanding provides an opportunity to overcome gaps in the water rights system, however, it is the only arrangement of its kind in relation to water co-governance in British Columbia. Moreover, the current process does not align with how Indigenous peoples refer to their rights. Specifically, Canada distinguishes Aboriginal rights when they are recognized by a government itself or a court (Phare, 2009). Whereas Indigenous

peoples understand their rights as inherent Indigenous rights, where colonial instruments are not sources of rights, but rather recognize Indigenous peoples' inherent rights (Phare, 2009).

Inherent indigenous rights are “given and limited by the Creator’s laws and responsibilities, including the laws of stewardship and reciprocity with nature. These principles cannot be altered or narrowed by other humans, their governments or their laws, and this includes all Canadian governments” (Phare, 2009, p. 36-37). This misalignment around the conceptualization of Indigenous rights means that Aboriginal rights and title to water remain unknown.

Second, the division of powers and responsibilities between and within both federal and provincial governments has created a complex arrangement of regulations and organizational structures. Specifically, the constitution does not explicitly assign jurisdiction over environmental matters to one actor and within the province, responsibility for water science and information, decision making, enforcement, and policy development are carried out by several organizations. This type of fragmentation lends itself to incoherencies from misalignment and additional coordination efforts. For example, regional water managers are typically located in the Ministry of Forests, Lands, Natural Resource Operations and Rural Development, however one regional water manager has been designated in the Oil and Gas Commission. The distribution of decision making to an organization with different priorities lends itself to risks from the decision maker focusing efforts on their own priorities, and in this case, efficient oil and gas exploration and development. As noted by Parfitt (2019), the Oil and Gas Commission is already at risk from unlicensed dams, contaminated water and disregard to cumulative impacts. This can create misalignment between decision makers. In relation to aligning regulations, efforts have been made within and between both property rights and public policies including shifting both

vertically between federal and provincial organizations and horizontally between provincial organizations. For example, minimum flows for fish and sensitive stream designations were originally under the provincial Fish Protection Act (1996). Under the Fish Protection Act (1996) fish protection was difficult to enforce due to lack of legal requirement to consider flows for fish and additional coordination between Ministries. Fish protection was subsequently moved under the Water Sustainability Act of 2014 providing legal requirement for the consideration of environmental. This type of fragmentation can also lend itself to regulatory gaps as organizations assume responsibilities lie with another organization. Although the Water Sustainability Act extends regulations over additional uses and resources, gaps remain around lack of regulations for recreational, cultural, conservation, views, and flood protection and exemptions from regulations for unrecorded water, exploration uses, short term uses, and deep well sources. In addition, interplay between the water institutional regime and relate resources to address cumulative impacts on water quality, quantity and availability will remain limited to water quality regulations for ecological function and water availability for drinking water sources until water objective regulations are developed. However, the division of powers can also provide an opportunity for a range of actors to support the bridging of gaps. For example, lack of provincial regulations around municipal wastewater effluent have resulted in the Federal government implementing the Wastewater Systems Effluent Regulations (2012) under the Fisheries Act (1985). Through the Canada Water Act (1985), the Federal government also provides support to provinces and territories around water management. A summary of water goods and services, associated regulations and gaps at the end of the analysis timeframe (2016) is provided in table 3.8.

Goods and Services	Regulations	Gaps
Surface water sources	Regulated under WSA	
Groundwater sources	Regulated under WSA	
Rainwater sources		Not regulated
Irrigation	Use authorization required under WSA	Water conservation not required
Power production	Use authorization required under WSA New licences limited to 40 years under WSA Water use plans protect shared uses downstream from reservoirs	
Mining	Use authorization required under WSA	Exploration water use purposes exempt from authorization
Oil & gas	Use authorization required under WSA Water source wells permits required under Oil and Gas Activities Act	Exploration and short term 24-month water uses do not require licence Water use reporting not required for oil and gas water source wells Deep groundwater wells exempt from licence requirement
Industrial	Use authorization required under WSA	
Private waterworks	No longer permitted	
Public waterworks	Use licence required under WSA	
Recreation	Water quality protection through provincial water quality objectives Additional protection may be developed through water objectives under WSA	Limited to policy direction, not enforceable - health authorities may sample water quality for public health risks and close beaches or issues public advisories
Mineral water	Use authorization required under WSA	
Waste absorption	Waste discharge authorization required under EMA Nation-wide baseline standards under Municipal Wastewater Effluent Regulations	Waste management plans allow lower level of standard
Consumption (domestic)	Use authorization required under WSA Community watersheds Drinking water protection plans protect water quality and quantity Additional protection may be developed through water objectives under WSA	Limited water quality protection to drinking water protection plans and existing Community watersheds
Fire suppression	No authorization required under WSA	
Storage (flood control)	Licence required under WSA	Professional reliance - flood assessment guidelines Limited floodplain mapping
Transportation & navigation	Protected under the Canadian Navigable Waters Act	
Land improvement	Authorization required under the WSA	

Goods and Services	Regulations	Gaps
	Restrictions on large-scale transfers under Water Protection Act	
Conservation	Water conservation guide and information Licence reviews (re-allocation) after 30 years under WSA Additional protection could be developed through water objectives under WSA	Water use conservation limited to local water restrictions (municipalities continue to have a decreasing block rate price structure) “Use it or lose it” through beneficial use requirement
Cultural	Water quality protection through provincial water quality objectives Additional protection may be developed through water objectives under WSA	Limited to policy direction, not enforceable
Views		No protection of water for aesthetic views
Ecological function (habitat, consumption)	Protected through environmental flows under the WSA, under local bylaws and environmentally sensitive development areas Additional protection may be developed through water objectives under WSA	Federal fish habitat protection limited to fish that are part of commercial, recreational or Aboriginal fishery
Storage (reserve)	Use authorization required under WSA	
Irreversible damages	Bulk water removal banned under the Water Protection Act Additional protection may be developed through water objectives under WSA	

Table 3.8 Gaps within the water regime

Finally, without a defined resource yield quota, or yield quotas in the event of climate change, the amount of water available for use remains unknown and individual use quotas will remain at risk to overallocation. Efforts made by the government to identify additional water allocation restrictions resulted in the development of a database of streams and aquifers with possible water shortages or that are fully recorded (Ministry of Environment, 2016). However, a review of several fully recorded streams revealed that licences continued to be issued after the streams were declared fully recorded. For example, Penticton Creek, located in the City of Penticton in the interior of British Columbia, was identified as being fully recorded in April 1941 (Ministry of

Environment, 2016). However, licence C014567 was issued in August 1946 with a quota of 28.75-acre feet per annum from the 1st of April to the 31st of August, for irrigation purposes (Department of Lands and Forests, 1946). Unfortunately, although efforts are made to limit use quotas, the requirement is not formal and ultimately up to the decision maker to consider.

The overallocation of British Columbia's water resources is not new and was identified by the Province as a concern in 1909 resulting in the establishment of the Board of Investigation to review record quotas when transferring to licences. Managing unknown water stocks are commonly achieved through water restrictions during times of scarcity or the redistribution of water use rights. Water restrictions can be achieved several ways including symmetrical restrictions where sacrifice is shared equally to prevent inequalities or priority restrictions where restrictions are applied to lower priority uses first or based on date (Richards, 2002). Although the Province continues to rely on the first in time, first in right principle during scarcity (priority based on date), the Water Sustainability Act (2014) introduced water licence reviews and amendments after 30 years without compensation (*s. 23*). However, these reviews are not required and include exemptions for power purposes licences issued after 2003 (since these licences are already restricted to 40-year terms), licences issued under the Industrial Development Act, 1996, (power production for Rio Tinto Alcan around Kitimat, BC), and licences issued following the development of a Water Use Plan. A Water Use Plan aims to coordinate water use between power production and other purposes by developing operating plans to maintain set water quotas in streams under varying water availability (Ministry of Environment, 1998). Therefore, in essence, Water Use Plans allow for temporary redistribution to meet minimum stream quotas for other uses. However, by exempting licenses issued under the

Industrial Development Act, 1996, the Province fails to provide fair redistribution of water use quotas, particularly since Alcan is able to use their use rights to sell power instead of running its aluminum smelters which the licences were originally issued for (*District of Kitimat and Richard Wozney v. Minister of Energy and Mines et al*, 2007). Also, it is unclear if the Province, when reviewing and amending licences, will apply a symmetrical approach where sacrifice is shared equally, or a redistributive approach based on priority uses or opportunity for conservation.

3.6 Conclusion

This chapter addressed the first research question: why and how have water institutions changed in BC? The chapter began explaining why integration is considered an integral part of sustainable water management and governance and provided an overview of the institutional resource regime framework as a tool to assess the sustainability of a resource regime. It then introduced an expansion to the institutional resource regime to highlight organizational structure as an important aspect of measuring coherence and factors of the external environment including related resources. Then it turned to an examination of the water institutional resource regime in British Columbia. Specifically, it examined the property rights system, public policies and the regime typology from 1859 to 2016. The examination showed that the water regime has progressed from simple to complex, failing to achieve an integrated regime typology and associated potential sustainable outcomes.

Overall, the examination highlights the complexity of water governance and management in British Columbia. The new Water Sustainability Act (2014), however, does provide the start of an integrated regime with the introduction of environmental flow needs, sensitive stream

designations, consideration of water for ecological function in the assessment of water authorizations, and provisions for thirty-year review of existing license terms and conditions. Moreover, the new Water Sustainability Act (2014) may provide additional coherence through the establishment of advisory boards to provide expert advice, the development of water objectives to protect water resources (both quality and availability), alternative governance arrangements to share decision making powers, and water sustainability plans to resolve conflicts. Nevertheless, limitations of the current regime in achieving integration were identified and attributed to:

1. Incomplete Aboriginal rights and title to water;
2. Jurisdictional and organizational fragmentation; and
3. Undefined water yield quotas and water quotas.

These findings contribute to the understanding of how the current water regime supports the concept of water sustainability through integration. However, limitations from jurisdictional and organizational fragmentation are not explicit. Specifically, the effectiveness of the current regime and efficiency of organizational structure requires further analysis to understand if misalignments exist. Moreover, it remains unknown how alternative governance arrangements, specifically a regional district or watershed agency, can provide additional coherence within the water rights system.

Chapter 4: Evaluation of alternative governance arrangements

The previous chapter examined the water regime from a broad lens through the IRR framework considering the property rights system and public policies along with the broader institutional environment. Results showed that while the water regime has progressed from simple to complex, incomplete Aboriginal rights and title to water, jurisdictional and organizational fragmentation and undefined water yield quotas and water quotas is not yet integrated.

This chapter provides further analysis on the water regime within the water rights system along with the opportunity for alternative governance arrangements. Specifically, it addresses the following research questions:

1. How efficient is the current arrangement?
2. How effective are alternative arrangements perceived, compared to the current arrangement?
3. Why have alternative governance arrangements not been implemented?
4. Why and how are transaction costs perceived to change under an alternative governance arrangement?

To identify whether an alternative governance arrangement can contribute to the coherence of the water regime, I evaluate the efficiency of two alternative governance arrangements using a transaction cost economics approach. The two alternative arrangements assessed in this analysis include a regional district and a watershed agency. Because the province has restricted the delegation of powers of alternative arrangements to operational management (strictly decision making, no responsibility for information and enforcement activities), opportunities for improved

coherence are considered limited given the complexity of actors involved in water authorizations. Specifically, the division of responsibilities related to water information, decision making and enforcement activities between three provincial organizations is considered fragmented. Therefore, this analysis will assess a regional district and watershed agency arrangement under two different scenarios to identify if there are additional efficiencies associated with the integration of all activities under the alternative arrangement. The first scenario assumes all activities related to information, decision making and enforcement are relinquished to the regional district or watershed agency. The second scenario assumes only activities related to decision making are relinquished to the regional district or watershed agency.

4.1 Introduction

The new Water Sustainability Act has a heavy task to “ensure that B.C.’s supply of fresh, clean water is sustainable – not just to meet our needs today, but for generations to come” (Ministry of Environment, 2013b, p. vii). One opportunity not yet fully developed in the Water Sustainability Act is the implementation of alternative water governance arrangements under Section 126.

The opportunity for alternative water governance arrangements follows international trends in water reform where polycentric water governance regimes are being promoted. Kellner et al. (2019) even identify polycentric governance as a way to compensate for incoherencies in the resource regime to improve adaptation capacity. However, for reform to meet the true definition of polycentric governance, both rule-making and enforcement need to be allowed at multiple levels as stated by Andersson and Ostrom (2008):

“In a polycentric governance system that is operationalized to a greater or lesser extent in the world of public affairs, each unit exercises considerable independence to make and enforce rules within a circumscribed scope of authority for a specified geographical area. In such a system, some units are general-purpose governments while others may be highly specialized.” (p.79)

In British Columbia, the opportunity for alternative arrangements does not include the delegation of rule-making and enforcement. Rather, alternative governance arrangements are limited to the relinquishment of decision making powers. Specifically, two types of alternative arrangements have been identified by the province and include a shared approach and a delegated approach (Ministry of Environment, 2009). Therefore, they can be described as opportunities for decentralized decision making and cannot be assumed to provide benefits from a polycentric approach. Still, communities throughout the province have responded to this opportunity advocating for a delegated approach, either a regional district or watershed agency, as a way to solve problems (see CVRD, 2014; Town of Gibson, 2018). Watershed groups have also noted a desire for a watershed agency arrangement followed by provincial and then regional district arrangement (Morris & Brandes, 2013). As such, research on water governance and management in British Columbia has focused on the benefits of regional district and watershed agency arrangements through the application of concepts from the literature on collaborative governance, adaptive governance, polycentric governance, and good governance (see Brandes & Curran, 2009; Brandes & O’Riordan, 2014; Brandes et al., 2016; Cohen, 2011; Joe et al., 2017; Nowlan & Bakker, 2007; Nowlan & Bakker 2010).

One method not looked at is the application of transaction cost economics to examine the costs associated with organizing and coordinating human and institutional interactions (Williamson, 1998). Transaction cost economics, along with new institutional economics, which examines the rules and incentives in how institutions (including organizations) are organized, are considered fundamental in the study of why some governance designs succeed and others fail (McCann et al., 2005; North, 1990; Williamson, 1998).

Governance designs are subject to transaction costs, which are an indication of incoherencies in the institutional resource regime (Bolognesi & Pfliefer, 2019; Marshall, 2013; Ostrom, 2005). The less coherent the regime, the higher the transaction costs (Biesbroek et al., 2011; Vatn, 2005). These transaction costs include costs related to information, support and decision making and enforcement (McCann et al., 2005). By comparing the costs of information activities, allocation activities and enforcement activities of alternative arrangements to the current arrangement, this analysis aims to identify if alternative arrangements will contribute to the integration of British Columbia's water regime through improved coherence within the organizational structure.

4.2 Evaluating alternative arrangements

According to Williamson (2005), firms are assumed to organize themselves to minimize transaction costs. An increase in transaction costs is associated with high asset specificity, complex environments, uncertainty, and frequent exchanges resulting in firms internalizing stages of production (in-house rather than contracting out). Following this logic, water governance and management in British Columbia with only one comptroller of water rights and

fifteen water managers with specialized skills, should have strong incentives to maintain vertical integration as their transactions are specific, frequent and often uncertain. However, although the current organizational structure is vertically integrated (fully public), it can also be considered somewhat mixed with water science and information, decision making and enforcement activities all taking place in different organizations. With continued commitment and pressure to further separate decision making through a range of governance approaches (Ministry of Environment, 2010b), understanding the coordination mechanisms of alternative organizational structures and associated transaction costs can assist with identifying when to use an alternative governance approach (Ministry of Jobs, Economic Development and Competitiveness, 2020).

This section provides the theoretical basis for measuring transaction costs including types of costs and limitations. It also provides context of water administration in British Columbia in relation to transaction cost types to assess vertical integration of activities under scenario 1 and further separation under scenario 2.

4.2.1 Transaction cost economics

Transaction costs are the costs associated with organizing and coordinating human and institutional interactions. It is a broad topic with traditional applications mostly economic until North (1990) applied the concept to account for actual costs beyond economic and market aspects. This opened the door to more empirical studies in political transaction costs looking at laws, policies and administration (e.g. Bolognesi, 2018; Garrick et al. 2014; McCann & Easter, 2004; Marion, 2012; Stiglitz, 1986). Specifically, Stiglitz (1986) considers administration costs and transaction costs as interchangeable concepts. This analysis will use the same approach since

no formal contracts are associated with organizational structure and the administration activities would be the same, just operated at a different scale.

An efficient regime is one that minimizes transaction costs. In the context of water regimes, transaction costs are the costs associated with the regulatory, monitoring and enforcement mechanisms related to water development, allocation, and management (Saleth & Dinar, 2004 p.10). These transaction costs are influenced by incoherencies in the resource regime at the various levels of decision making (vertical) and across uses (horizontal) (Bolognesi & Pflieger, 2019). Because the coherence between property rights and policies is extent related, regimes that search for integration by extending regulations over all goods and services are inadvertently at risk of increased transaction costs (Bolognesi & Pflieger, 2019). Nevertheless, as regimes search for integration, they also search for ways to improve coherence and reduce transaction costs. Understanding the transaction costs of alternative regimes can identify opportunity costs and help decision makers decide between alternatives (McCann & Easter, 2004).

In addition to the transaction costs identified within the institutional resource regime, transaction costs can be influenced by relationships between the institutional resource regime and the institutional environment. The institutional environment consists of broader political, social, economic and resource related factors (Easter et al., 1998; Meinzen-Dick & Nkonya, 2007; North, 1990; Saleth & Dinar, 2004). Saleth and Dinar (2004) refer to these relationships as institutional linkages and consider institutional environmental factors as exogenous. Young (2008) refers specifically to the interaction of related resource regimes as institutional interplay. For this analysis, the term institutional linkage is used to identify exogenous factors that interact

with the resource regime and influence the transaction costs and effectiveness of the regime. A linkage that enables synergies is one that promotes a mutual effect. In this case the institutions are coherent. An example of this would be climate policy aimed at reducing greenhouse gas emissions resulting in a more predictable or certain hydrologic cycle and less uncertainty about the availability of future flows. A constraining linkage is one that has a negative impact. In this case the institutions are incoherent. An example of this in relation to related resources would be the promotion of land development without restriction on surface water runoff resulting in greater peak flows in creeks, lower base flows and less groundwater recharge.

There are two typologies of transaction costs. First, static transaction costs are the costs of operating in an institutional resource regime and the broader institutional environment. Second, dynamic transaction costs are the costs of change and of future change. Because this analysis is interested in identifying if an alternative arrangement will contribute to improved coherence in the water regime, dynamic transaction costs are not considered. In the scenario under which alternative arrangements are restricted to operational management functions, these costs are likely to be minimal and would be specific for each case, depending on the circumstances (they could be limited to shifting duties from one existing organization to another existing organization as regional districts and many watershed agencies are already in operation).

Static transaction costs are composed of information costs, decision making costs and enforcement costs. In the context of administering water use rights, costs associated with information include activities and technologies associated with collecting information, searching for information and communicating information.

Costs associated with decision making include planning, issuing licences, approvals and permits, dealing with problems, re-evaluating licences, and asset management. Costs associated with enforcements include the measurement, enforcement and policing of rules. Table 4.1 summarizes these costs and associated factors to consider during measurement. They are based on factors identified in other studies (specifically McCann et al, 2005 and Saleth & Dinar, 2004) and water administrative and operation practices in British Columbia.

Type	Factors
Information costs	Time spent collecting data, calibrating data, communicating information, and identifying public expectations. Includes science and information systems, monitoring arrangements. Factors to consider include frequency of tasks, managing uncertainty and asset specificity.
Decision making costs	Time spent searching for information, planning, issuing licences, authorizations and permits, dealing with problems, re-evaluating licences, and managing assets. Factors to consider include incomplete information, power distribution and conflicting rules and policies.
Enforcement costs	Time spent monitoring compliance, ticketing and conflict resolution. Factors to consider include incomplete information, unclear rules, and conflicting rules and policies.

Table 4.1 Types of transaction costs

4.2.2 Limitations

Although institutional reforms aim to reduce transaction costs, reform is subject to limitations that can impact the types of reforms considered and their overall effectiveness (Libecap, 1989; North, 1990; Roberts & Greenwood, 1997). Therefore, it is important for this analysis to include factors related to limitations such as the overarching political setting, actor character and prevailing practices (Young et al. 2008). In regard to limitations of reform choices, Roberts and

Greenwood (1997) identify a constrained-efficiency framework. In their framework, reform is limited by lack of efficiency-based competition, cognitive constraints and satisfying level of efficiency. Path dependency is another constraint described by Libecap (1989) who refers to rule-changing activity as contracting and sees institutional change as path-dependent as past institutions create the framework for responding to proposed changes. These aspects limit the need for reform and the options that become available in turn constraining the effectiveness of a regime.

Another limitation to consider is organizational readiness for change. Given that alternative arrangements have been available since 2004, the need for reform has been identified and options made available. However, reform has not taken place. Weiner (2009) identifies that organizational readiness for change includes factors relating to organization members' shared value in the change and a shared belief of their collective capability. When an organizations readiness is high, organization members are more likely to implement change (Weiner, 2009; Puchalski & Straus, 2019; Lehman, Greener & Simpson, 2002).

4.2.3 Context

The current arrangement for water governance and management in British Columbia is centralized and complex. Understanding the water regime, types of transaction costs, and the actors involved needs to be distinguished to ensure accurate measurement (McCann & Easter, 2004). These aspects were identified broadly in the previous chapter focusing on the property rights and policies regulating water goods and services. In this section, I provide further details in relation to transaction cost types and the actors involved.

Information on water science (surface, ground and snow pack) is collected by federal, provincial, regional and municipal governments, as well as non-government organizations. The Ministry of ECCS provides hydrometric data (surface water) in a centralized data catalogue called the Aquarius Time-Series database online. The federal government provides data online through the water office. Both federal and provincial governments use AQUARIUS software for managing hydrometric data and can make their data available through AQUARIUS upon request. Local governments also collect water data in the field with some data sets available online. However, local governments typically do not use the AQUARIUS software due to cost and instead use FlowWorks or another software to display final data values. As a result, the calibration of data is not transparent and is used with caution. Groundwater data sets are also available online through the province's groundwater level data interactive map portal, GWELLS and iMapBC. GWELLS maps aquifers which is a new provincial government initiative to improve the communication of groundwater data. Information on water licences is also available online, however, monitoring use measurement, record and reporting information is only collected when requested by the province and not reported online.

Decisions around water authorizations (quotas, allocation and re-allocations) are made at the provincial level but involve actors at different levels of government. Involvement can be direct (establishing) or indirect (influencing). Federal actors have the ability to impact water quotas indirectly through the Canadian Environmental Assessment Act, International Boundary Waters Treaty Act, Canadian Navigable Waters Act, and Fisheries Act. Protection policies that rest with provincial actors also have the ability to directly impact water quotas through the Water

Protection Act and the Water Sustainability Act, and indirectly through the Environment Assessment Act and the Constitution Act which requires consultation and accommodation with First Nations. Allocations and re-allocations are influenced directly through the Water Sustainability Act, and indirectly through the Constitution Act which requires consultation and accommodation with First Nations before issuing licences, approvals and permits. These interactions are noted in figure 4.1.

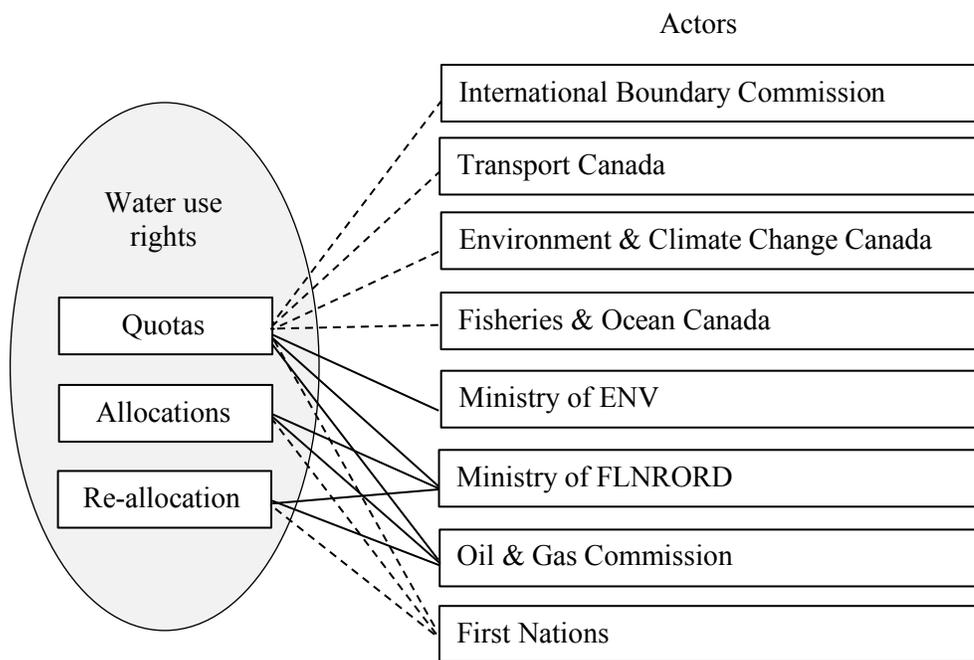


Figure 4.1 Actors involved in water authorizations

The individuals who issue authorizations through licences, approvals and permits are made by several actors designated under the Water Sustainability Act (2014). Designations include the comptroller of water, deputy comptrollers, water managers, assistant water managers, and engineers. Designated officials typically reside in the ministry of FLNRORD in operation offices, however, a single water manager has been designated in the Oil and Gas Commission

(Ministry of Forests, Lands, Natural Resource Operations and Rural Development, 2020). These officials have varying powers under the Water Sustainability Act (2014) which are outlined in table 4.2. The comptroller of water rights has the greatest power and responsibilities including the regulation of privately-owned water utilities, a responsibility not shared with any other designation (Water Utility Act, 1996; Utilities Commission Act, 1996).

Designation	Powers
Comptroller of water rights (& deputy comptrollers)	May issue licences to remove water from the province May issue licences for private water utility May issue licences and approvals for the diversion or use of water May issue approval to make changes in and about a stream May issue drilling authorizations May issue a 30-year review of licence terms and conditions
Regional water managers (& assistant water managers)	May issue licences and approvals for the diversion or use of water May issue approval to make changes in and about a stream May issue drilling authorizations May issue a 30-year review of licence terms and conditions
Engineers	May issue approval to make changes in and about a stream May issue drilling authorizations May issue change approvals or drilling authorizations

Table 4.2 Water designations and powers (source: Water Sustainability Act, 2014)

Enforcement and monitoring compliance of water authorizations is performed by the comptroller, a water manager, an engineer, an officer (natural resource officer, water officer), water board, and the board of investigation. Compliance actions include ticketing and issuing notices for breaching a section in the water sustainability act. Enforcement actions include violation tickets, penalties, orders, and prosecutions.

Monitoring (referred to as compliance verification by the Province) is completed by engineers and officers. Officers monitor a range of regulations including:

- Forest Act (including log salvage regulations for the Vancouver log salvage district, scaling regulation, timber marking and transportation regulation);
- Forest and range practices act (including forest planning and practices regulation, forest recreation regulation, forest service road use regulation, range planning and practices regulation, woodlot licence planning and practices regulation);
- Off road vehicle act;
- Part, conservancy and recreation area regulation (including firearm act, liquor control and licensing act, motor vehicle act, motor vehicle act regulations, cannabis control and licensing act, trespass act);
- Water sustainability act (including dam safety regulation, groundwater protection regulation, water sustainability regulation);
- Wildfire act (including wildfire regulation);
- Wildlife act (including controlled alien species regulation, wildlife act general regulation, motor vehicle prohibition regulation, public access prohibition regulation);
- Environmental management act (including open burning smoke control regulation); and
- Fish and seafood act (including fish and seafood licensing regulation).

When a violation ticket is issued, the officer works with a comptroller of water rights or a water manager who have the powers to issue orders.

4.3 Methods

This analysis employs a case method approach and a variety of data collection techniques to compare the transaction costs of two alternative governance arrangements to the current

arrangement for two scenarios. The first scenario assumes all activities related to information, decision making and enforcement are delegated to the regional district and watershed agency. The second scenario assumes only activities related to decision making are delegated to the regional district and watershed agency. Quantitative analysis was used to identify participant perceptions of the current state of water governance and whether either alternative arrangement would cost more, less or the same. Qualitative material was then used to highlight potential determinants of transaction costs and identify constraints and synergies.

This analysis is completed on the basis of the perceptions of actors involved in water science and information, planning, authorizations, compliance monitoring and enforcement. Buckley and Chapman (1997) note that although managers take transaction costs into account when making decisions, they do not do it in a numerical way. Instead, they rely on their perception of transaction costs. Although the perception of transaction costs does not necessarily compare exactly to the exact transaction costs, the perception of transaction costs is considered “more important” and are often used instead of real transaction costs (e.g. Badstue, 2004; Brockhoff, 1992).

4.3.1 Survey

The survey gathers information on the perception of transaction costs, constraints and synergies related to two alternative governance arrangements in British Columbia. Appendix A contains a copy of the full survey. Surveys are the recommended measurement method for both *ex ante* and *ex post* transaction costs (McCann et al., 2005) and is a common source of data for empirical tests of transaction cost economics (Masten, 1996).

The survey was structured into four sections. These include respondent (8 questions), resource environment (3 questions), transaction costs (36 questions), and organizational environment (7 questions). The sections on respondent and resource environment provides contextual information and assessment of water availability. The section on transaction costs is dedicated to identify participant perceptions on the effectiveness of the current arrangement, effectiveness of alternative arrangements, efficiency (coherence) of the current arrangement, and transaction costs of alternative arrangements (Bolognesi & Nahrath, 2020; McCann et al., 2005). The final section on organizational environment is dedicated to identify limitations to change including organizational change (Weiner, 2009) and satisfying level of efficiency (Roberts & Greenwood, 1997).

The survey used polytomous response formats with five response options (strongly agree to strongly disagree) for agreement questions and seven response options (much higher to much lower) for degree questions on transaction costs. An odd number of responses was used to provide a neutral response (neither agree nor disagree; about the same) which allowed participants to avoid having to respond negatively or positively by offering a neutral response (Clark & Watson, 1995). I also asked free-form questions to gather qualitative information to highlight specific determinants of perception of the efficiency of the current arrangement, effectiveness of the current regime, effectiveness of alternative governance arrangements, limitations to change, and transaction costs of alternative governance arrangements (McCann & Easter, 2004).

The survey was subject to two rounds of pilot testing. The first round was an expert review performed with a government official. The expert provided detailed feedback around items related to transaction costs and alternative arrangements, resulting in modification to the survey. This first round was imperative to ensure the survey captured all types of administrative costs and by whom. The second round was a sample review performed with a group of 5 people who were familiar with my research, but not involved in water governance research themselves. The group provided feedback on confusing items and instructions along with the overall length and structure of the survey.

The survey population includes representatives of provincial government organizations (referred to as a government official or participant). Three inclusion criteria were used. First, the participant needed to be a current representative of the provincial government. Second, they needed to participate in water governance activities (science and information, decision making, enforcement). Finally, they needed to give consent to participate. No exclusion criteria were identified. As such, sampling was limited to government officials working in water science and information activities (hydrologists, water information technologists, groundwater technicians), decision making activities (water managers, engineers, authorization specialists, authorization technicians) and enforcement activities (compliance and enforcement managers, natural resource officers, natural resource officer investigators) in the following government organizations:

1. Ministry of Forests, Lands, Natural Resource Operations and Rural Development;
2. Ministry of Environment and Climate Change Strategy; and
3. Ministry of Public Safety and Solicitor General.

A total of 189 government officials were identified as potential participants using the provincial governments online directory and contacts from meetings. A personalized email was sent to all potential participants with a formal invitation to take part in the research. Included in the email was a link to the online survey (hosted by the University of British Columbia using Qualtrics software), a pdf attachment that included background information and my contact information, including phone number. Of these potential participants, fifteen responded noted they were not in a position to respond, twelve were on leave, no longer working for the province or in a new role outside of water management or governance, and three declined to participate in the survey (30 in total). A follow up email was sent to all remaining potential participants three to four weeks following the initial email.

A review of survey responses eight weeks following the first email invitation revealed a high number of potential participants had accessed the survey but did not continue past the resource environment section (13% completion). Follow up emails and phone calls were made to managers from all of the regional operation areas noting the low level of response and asking for assistance distributing to potential participants. Phone conversations with two potential participants identified that although the survey allowed for questions to be skipped that were outside the participants area of work, the survey was long. After another four weeks, a second review of responses was completed focusing on the distribution of responses by region and areas of work (science and information, decision making and monitoring compliance and enforcement). This review identified a low number of responses from potential participants working in monitoring compliance and enforcement and the potential for bias from an

underrepresented group (Blair et al., 2014). As a result, three alternative versions of the survey were created specific for potential participants who work primarily in: 1) water science and information; 2) decision making; and 3) monitoring compliance and enforcement. These focused survey versions included the same participant, resource environment and organizational environment questions as the full survey, but only included transaction cost questions related to their area of expertise. A third follow up email was then sent to potential participants with the focused survey link highlighted at the top of the email and the full survey link available at the bottom.

A total of 86 potential participants accessed the surveys and 36 completed the surveys as shown in table 4.3.

Survey	Accessed survey	Completed survey
Full survey	62	27
Information focused survey	4	2
Decision making focused survey	4	1
Enforcement focused survey	16	6
Total	86	36

Table 4.3 Survey responses

4.3.2 Interviews

Whereas the survey was used to investigate how transaction costs of alternative arrangements compare to the current arrangement and why transaction costs might be different, interviews provided further insight into why transaction costs might be different. This provided an opportunity to ensure data saturation and an additional data source to protect against bias (Silverman, 2006; Yin, 2014).

Interviews were completed in a semi-structured format which allowed me to ask target questions and then follow up to clarify and explore points of interest brought up by the interviewee. A copy of interview target questions is contained in Appendix B. Questions focused on the elements of transaction costs (information, decision making and enforcement), the identification of synergies and constraints specific to the experience and knowledge of the interviewee, themes and patterns observed in the survey, and normative questions around recommendations to improve the coherence of resource regimes in British Columbia. This allowed me to gain content at different levels of questions beyond the focus of the analysis (Yin, 2014). Common topics included: interviewee duties; how and why transaction costs might change under an alternative arrangement; issues associated with the current arrangement; and opportunities and concerns with alternative arrangements.

The interview population includes representatives of provincial government organizations (referred to as a government official or interviewee). Three inclusion criteria were used. First, the interviewee needed to be a current representative of the provincial government. Second, they needed to participate in water governance activities (information, decision making, enforcement). Finally, they needed to give consent to participate. No exclusion criteria were identified. As such, sampling was limited to government officials in water management and governance in the following government organizations:

1. Forests, Lands, Natural Resource Operations and Rural Development;
2. Environment and Climate Change Strategy; and
3. Public Safety and Solicitor General.

A total of twelve government officials were identified as potential interviewees from contacts I met at meetings or identified by these contacts and survey participants. A personalized email was sent to all potential interviewees with a formal invitation to take part in the research. A follow-up phone call and email were made over the course of six weeks.

A total of seven interviews were scheduled with two potential interviewees not able to attend due to last minute work commitments. Attempts were made to reschedule; however, they were too busy to make the time. One potential interviewee backed out before the interview, however, was available to provide input on the analysis and study objectives. Therefore, interviews with four key informants was completed. Interviews were conducted in person or over the phone, and lasted between 30-90 minutes. Three interviews were audio recorded and transcribed, and in one case the interviewee requested that I not record.

4.3.3 Empirical strategy

The empirical strategy was designed to examine jurisdictional and organizational fragmentation in relation to water authorizations along with opportunities for alternative governance arrangements to understand how alternative arrangements can contribute to water sustainability. Information on limitations to change was also sought to explain why alternative arrangements are not in place. Questions were very specific and required a detailed understanding of water governance in British Columbia and the activities associated with water authorizations.

Once survey data collection was completed, responses were exported to excel for the compiling. Survey data was then uploaded to SPSS for statistical analysis. Because focused surveys were implemented to improve participation and reduce bias from underrepresented groups, data from questions omitted in the survey were considered item nonresponse. Nonresponses items were dropped from variable analysis since sampling ensured representative responses were obtained.

Survey questions used Likert scale response categories to identify participant perception of the efficiency of the current arrangement, effectiveness of the current regime, effectiveness of alternative governance arrangements, limitations to change, and transaction costs of alternative governance arrangements compared to the current arrangement. Because the intervals between Likert scale response categories cannot be assumed equal, variables were considered ordinal (Cohen et al., 2017) which many researchers note requires the use of median or mode as the measure of central tendency (Clegg, 1998). However, mean scores are also considered appropriate if there are no outliers and the data is not skewed (Cohen et al., 2017). To identify the most appropriate measure of central tendency, the standard deviation can be calculated to identify the variation in responses with a high standard deviation relating to scores that are spread apart and a low standard deviation relating to clustering of scores (Cohen et al., 2017). Frequencies, or percentages of responses, for each category are also considered appropriate to describe responses (Blaikie, 2003). As such, descriptive statistics (frequencies) and central tendency (mean, median, mode) and dispersal (standard deviation) were calculated for each variable to identify the most useful statistic (Cohen et al., 2017). Because the standard deviation of variables was low to medium (0.379 to 1.509), data was often skewed and frequencies were common for more than one score, the mean and mode were not considered appropriate (Cohen et

al., 2017). Therefore, the median score is presented in the results section to describe and identify respondent perceptions.

In addition to descriptive statistics described above, to assess limitations from satisfying level of efficiency, correlation of efficiency and satisfactory level of efficiency variables was completed using one-way ANOVA. Likert summative scales were calculated for efficiency variables. To account for missing efficiency Likert scale items in the focused surveys, only responses with at least nine of the ten Likert items were included. Boxplots were used to visualize the results.

Interviews and free-form (open-ended) survey questions were assessed using a descriptive approach (Maykut & Morehouse, 1994). While reviewing responses, I employed memoing to cultivate an understanding of the data including initial categories and relationships (Maxwell, 1996). Once all interviews and surveys were reviewed and memos complete, data was uploaded into NVivo for coding. Although entering data into analysis software is time consuming, computer aided methods can augment validity and reliability of data through improved data organization and accessibility (Kelle & Laurie, 1995). MacLure (2013) describes coding as a process that “involves looking for pattern or order in a body of data – such as interview transcripts or field notes – by identifying recurring themes, categories or concepts” (p. 164). For the initial round of coding, I used broad topics of determinants related to core themes of this analysis: efficiency of the current arrangement, types of transaction costs, synergies, and limitations. Once this was completed, I reviewed all the data and refined codes. I then clustered the data and developed frequency counts to inform the analysis.

4.4 Results

Results of descriptive statistic calculations for all variables are provided in Appendix C.

4.4.1 Characteristics of survey participants

Analysis was based on data collected from 36 representatives from the Provincial government who participated in the survey. Characteristics of survey participants are summarized in Table 4.4.

Variable	Number of participants	Proportion of participants
Region		
Skeena/Northeast	5	14%
Omineca	2	5%
Cariboo	2	5%
Thompson/Okanagan	11	31%
Kootenay/Boundary	2	5%
West Coast	4	11%
South Coast	4	11%
All regions	6	17%
Ministry		
FLNRORD	31	86%
ENV	4	11%
EMBC	1	3%

Table 4.4 Characteristics of survey participants

4.4.2 Resource characteristics

Participants perceive water as being scarce (2.00 median). Table 4.5 reports the distribution of results with 54% of participants identifying water as being scarce and only 14% disagreeing. Conversely, the availability of sufficient water for specific uses was considered good (2.0 median). However, 20% of participants noted disagreement around sufficient water for ecological function. The distribution shows an important disparity suggesting incoherence of protection policies for ecological function compared to other uses.

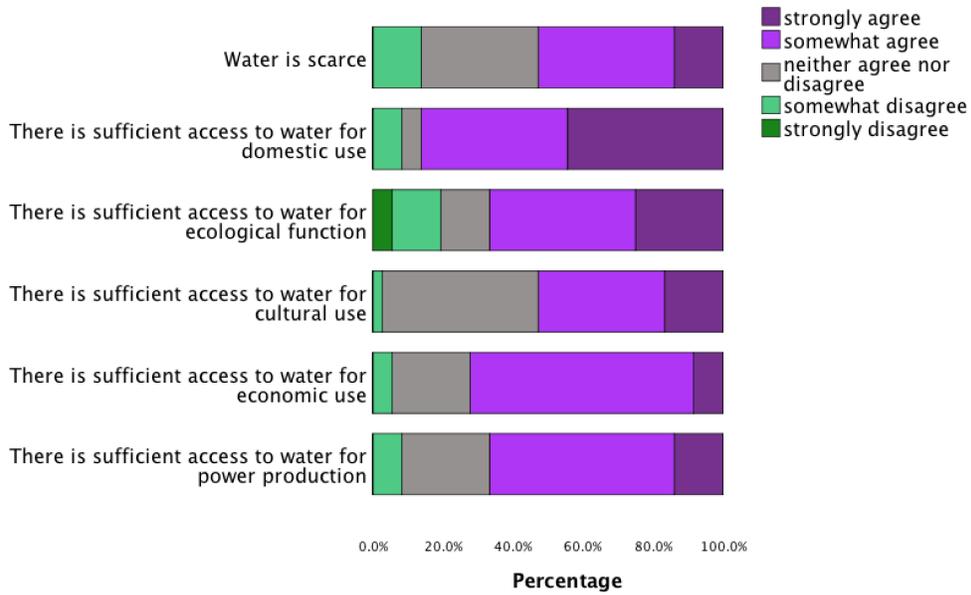


Figure 4.2 Water availability for different uses

The most important resource for economic development across the province was identified as forestry. Frequency of responses (top 3 identified by each participant) are provided in table 4.4.

Resource	N	Frequencies (%)
Forestry	32	91.4
Recreation	20	57.1
Mining	19	54.3
Oil and gas	16	45.7
Agriculture	16	45.7
Range activity	2	5.7
Missing	2	

Table 4.5 Top economic resources

4.4.3 Efficiency of current arrangement

4.4.3.1 Information

Participants perceived the current arrangement for information activities and technologies as somewhat inefficient (3.00 to 4.00 median range for all variables). Specifically, most participants indicated disagreement with the idea that identifying public expectations and information on related resource activities are efficient. Figure 4.3 shows the distribution of appraisals for all activities.

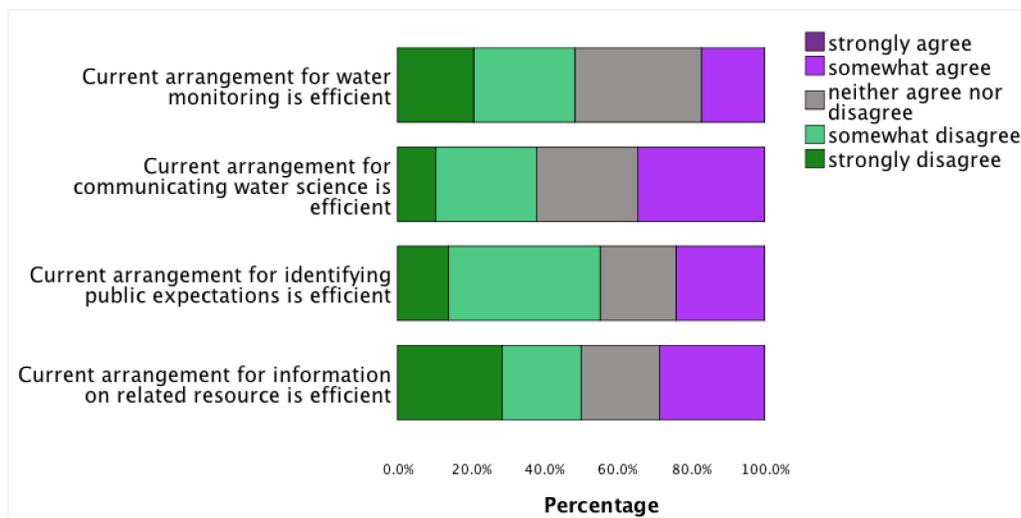


Figure 4.3 Efficiency of current arrangement for information activities

Participants confirmed the collection of water data and other data in the field by provincial government along with the use of water data collected by other organizations. However, three participants noted a lack of data collection:

“... in the Okanagan there used to be 152 hydrometric monitoring stations and now there are like 22. And so, with climate change, we realized that

hydrometric monitoring stations are critical infrastructure for data sources.”

(Interviewee 3)

One participant also noted a reliance on applicants for the collection of data when there is insufficient data. In regard to the current data management system, two participants noted efficiencies with the provincial process for information systems, with opportunities for improvement in other data systems:

“I do have to say that Gwells, which has been a relatively new initiative since I’ve been with the government, is much nicer and starting to meet both needs [storing and sharing data]. But I think we have other ones that also would need attention.” (Interviewee 4)

However, concerns around the separation of division of powers in relation to information and decision making was noted by one participant:

“MoE [Ministry of ENV] manages corporate data and information, but MFLNRO [Ministry of FLNRORD] implements operations in the field. This ministry split does not lend itself to cost accountability well.” (Participant 17)

Tension between Ministry of Environment and Climate Change Strategy (ENV) staff who collect water data and support stewardship and Ministry of Forests, Lands and Natural Resource Operations and Rural Development (FLNRORD) staff who make the decisions around water authorization (they also collect water data), was evident at one meeting I observed. Specifically, FLNRORD staff required additional information to assess risks to environmental flow needs in

the review of applications. However, this information was not available from ENV. With decisions needing to be made, and a lack of support from ENV, FLNRORD staff were required allocate water without proper consideration of environmental flows.

4.4.3.2 Decision making

When it comes to decision making, most participants perceived the current arrangement as somewhat inefficient for all activities (4.00 median for all variables). Figure 4.4 shows the distribution of appraisals for all decision making variables.

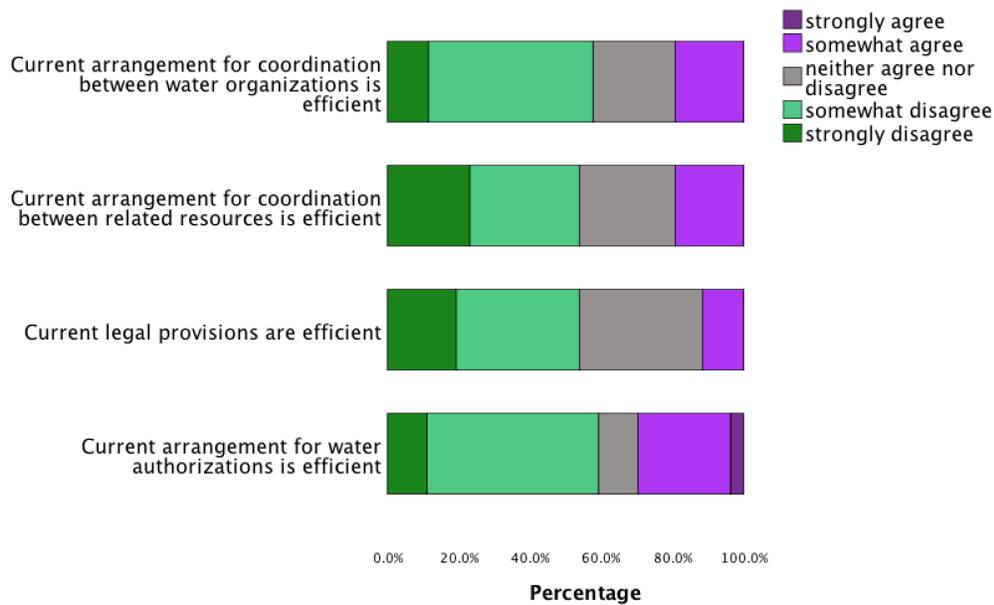


Figure 4.4 Efficiency of current arrangement for decision making activities

Inefficiencies were noted by seven participants in relation to lack of information, consultation and accommodation with First Nations, lack of knowledge around resource institutions, lack of staff, and complex coordination within a fractured organizational structure:

“The inefficiencies in the existing water authorization framework come from inadequate information about BC's water resources, the duty to accommodate First Nations' concerns about rights and title, illogical and poorly understood relationships between provincial Natural Resource statutes, and a lack of staff to navigate and deliver-on any of these issues.” (Participant 7)

“So, you know we are all doing ourselves a huge disservice, it's a very sluggish and slow paced. Meanwhile, I think citizens of British Columbia think they are all well protected, and honestly, I don't think we are.” (Interviewee 4)

In addition, three participants noted that the current arrangement lacks water accounting. This includes both the maintenance of database for current licences and the management of licences including renewals and reviews. One participant also noted concerns and inefficiencies from decisionmakers that are not water experts:

“If they don't understand what an EFM [environmental flow management] is, and they don't have the technical savvy to be able to really appreciate how that integrates, that is a problem. Similarly, if they don't understand the complexity of ground water-surface water interaction, even if they say they have considered it. So, if you are going to have a bureaucrat ultimately be in a position of statutory decision-making power, that bureaucrat, in order for the system to be efficiently managed, also needs to be a subject expert.

(Interviewee 2)

4.4.3.3 Enforcement

Participants perceived the current arrangement as somewhat inefficient when it comes to enforcement. Specifically, most participants indicated disagreement with the idea that activities associated with regulatory compliance are efficient (4.00 median) while, opinion seems to be divided with regard to activities associated with enforcement (3.00 median). Figure 4.5 shows the distribution of appraisals for all enforcement activities.

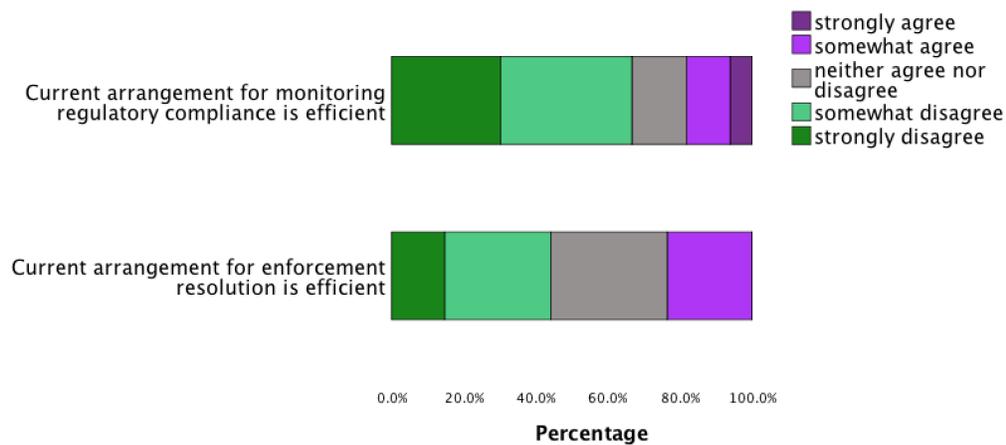


Figure 4.5 Efficiency of current arrangement for enforcement activities

Inefficiencies were noted in relation to process. Three participants noted the current process is time consuming and inefficient due to the need for officials with specific designations to review and issue orders and certain procedures that need to be followed for legal reason:

“Enforcing the WSA is difficult because taking action against someone who is in non-compliance with the Act often requires 2 (overworked) staff. Natural resource officers are responsible for enforcement of the WSA, however, they are not 'engineers' under the Act and therefore can basically only issue a stop-work order and issue a small ticket. Then a water manager (or someone

designated as an appropriate SDM) must review the case and determine whether to take further regulatory action (such as ordering works in and about a stream, amending an authorization, requiring someone to get an authorization, etc.).” (Participant 7)

Efficiencies were also noted for the current arrangement from the range of regulations monitored by officers. Specifically, three participants noted efficiency from compliance officers who enforce multiple regulations, coordinate inspections and apply multiple regulations outside of the water regime to solve water related issues:

“Currently CO's and Resource officers enforce a broad suite of legislation/regulation. They co-ordinate inspection activities to maximize efficiency.” (Participant 15)

Concerns with the current arrangement were identified and include insufficient fines, lack of guidance and lack of enforcement. Specifically, three participants noted concerns with insufficient fines resulting in an institutional culture that accepts violations:

“Moreover, fines are measly, and, except for the more egregious cases, water managers often to not have time to get involved in compliance and enforcement cases. [...] Tickets for WSA offences are also ridiculously low, and knowing this, many clients choose to ignore some of its requirements with the understanding that, if they were caught, the fine would be the cost of doing business.” (Participant 7)

Two participants noted concerns with consistency and lack of guidance with the Water Sustainability Act who often require clarity from decision makers. Lack of clarity around what qualifies as an infraction also causes issues for compliance officers:

“It is my opinion that the Water Sustainability Act is a symbolic law. The enforcement of the act was not taken into consideration when it was written [...], and in my opinion the Water Sustainability Act is one of the most poorly written piece[s] of legislation I encountered in all my years.” (Participant 31)

4.4.3.4 Related resources

When it comes to related resources, most participants indicated agreement with the idea that water regulations are integrated with other regulations related to land, forests and environment (2.00 mode).

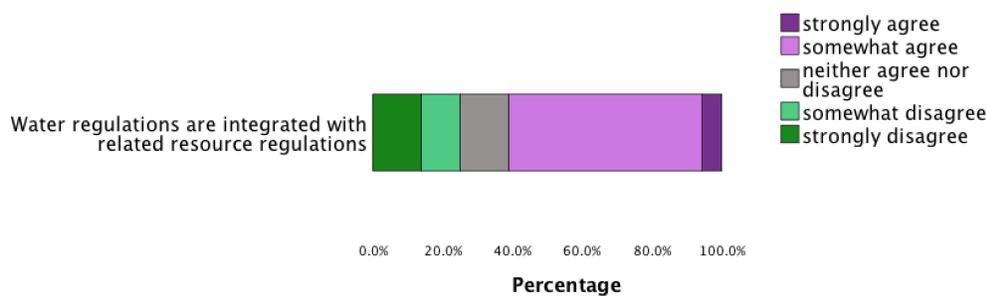


Figure 4.6 Integration of related resource regulations

However, two participants noted concerns associated with a lack of knowledge of related resource regulations and a lack of consideration of related resources when making decisions:

“[...] We might look at other specific water authorizations. But not Forestry. Not Land. We don’t know what tenures are necessary, that doesn’t necessarily play a part in our decision making. So, I do think that there’d be more, there’s room for more synergy there, for sure. Especially with climate change and how things are moving.” (Interviewee 3)

4.4.4 A need for change

To identify if alternative arrangements would be more effective at meeting the Provincial commitment to “ensure a sustainable supply of fresh, clean water that meets the needs of B.C. residents today and in the future” (Ministry of Environment, 2013), participants were asked about the effectiveness of the current arrangement compare to alternative arrangements and if they thought options are limited. Most participants indicated agreement with the idea that the current arrangement is effective (2.00 median). However, most participants also indicated agreement that a watershed agency would be more effective than the current arrangement (2.00 median) and disagreement that a regional district arrangement would be more effective than the current arrangement (4.00 median). Figure 4.7 shows the distribution of responses.

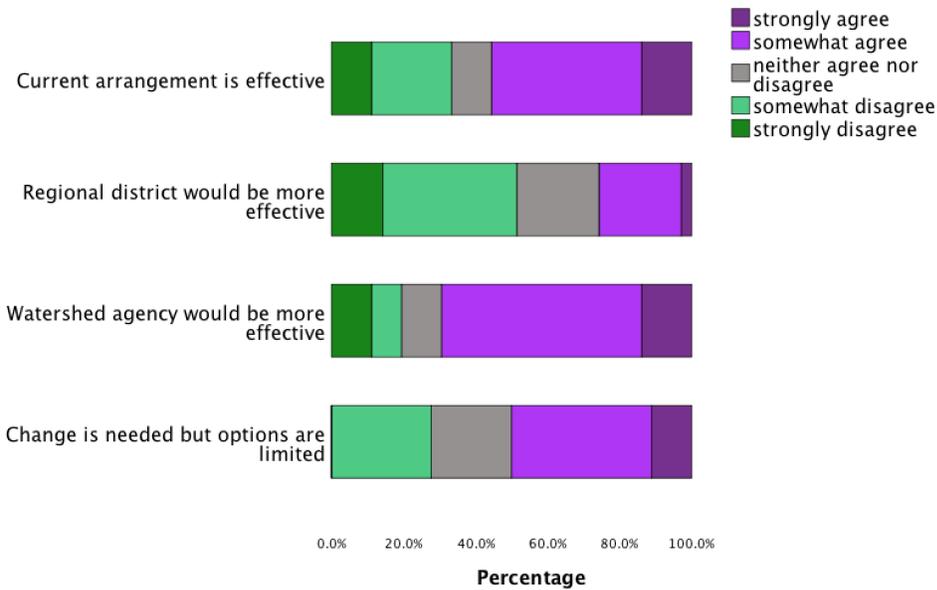


Figure 4.7 Effectiveness of the current and alternative arrangements

Two participants noted challenges with the current arrangement from a lack of water accounting and the number of administrative decision makers involved resulting in a lack of accountability. Specifically, one participant also noted concerns in relation to flooding and the division of responsibility between organizations resulting in lack of accountability:

“Public safety is cannablis, crime, and then there is a little piece of it, which is “let’s keep everybody safe from flooding, fire, landslides and seismic”. You know, it is a tiny little piece, but that piece means that I have the mandate to look at funding for flood. Well, if you take FLNRO, they have got a mandate to look after forestry, logging, lands, and then right at the bottom they’ve got a mandate there to look after public safety from flooding. So, how does that ADM [Administrative Decision Maker] get involved in that. So, from the provincial perspective, you have got an ADM across all of BC for each of the

different [FLNRORD] regions as well. So now we have five ADM's. And you've got two from EMBC. And [then there's] the ADM's in Ministry of Environment and Climate Change Strategy and there might be one, or two, or three ADM's there. So, all of a sudden, we've got ten ADM's and everyone is pointing at each other saying "well, it's your responsibility". So, no one does anything. (Interviewee 4)

However, opportunities associated with alternative arrangements were noted in relation to collection of additional water data (two participants) and effective monitoring compliance and enforcement (five participants). Moreover, two participants noted challenges associated with identifying how things would compare to the current arrangement given that the current arrangement is not optimized:

"While there are certainly problems arising from the current arrangement it is difficult to assess an alternative arrangement when we are so far from achieving what could be possible under the current one." (Participant 4)

"The main issue which will still be the same issue is funding, and as long [as we] don't get proper funding [we] can't expect it to work for any option for dealing with water stewardship". (Participant 29)

In regard to the opportunity for alternative governance arrangements under the Water Sustainability Act (2014), fifty percent of participants indicated agreement that change is needed

but current options are limited. One participant noted limited options due to public pressure during the Water Act modernization process:

“Also, our capacity to install alternative governance arrangement is significantly confined by public pressure. British Columbians overwhelmingly express that water is valuable to them, but are generally very reluctant to make significant changes to the way we manage water. Remember, as part of the Water Act modernization process, government proposed introducing water markets to BC and making changes to the FITFIR system of rights, and the ideas faced considerable opposition”. (Participant 7)

4.4.5 Readiness and limitations to change

In regard to organizational readiness for change, fifty percent of participants indicated agreement that their organization is committed to exploring new ways of achieving their goals (2.50 median), however, eighty percent of participants indicated agreement that their organization is limited by socio-political pressures (2.00 median). Opinion seems to be divided with regard to members valuing the opportunity for alternative arrangements (3.00 median) and knowing what it will take to implement an alternative arrangement (3.00 median). Most participants indicated disagreement with regard to having the resources to implement an alternative arrangement (4.00 median) and ability to implement an alternative arrangement effectively given their current situation (3.50 median). Figure 4.8 shows the distribution of responses for all variables.

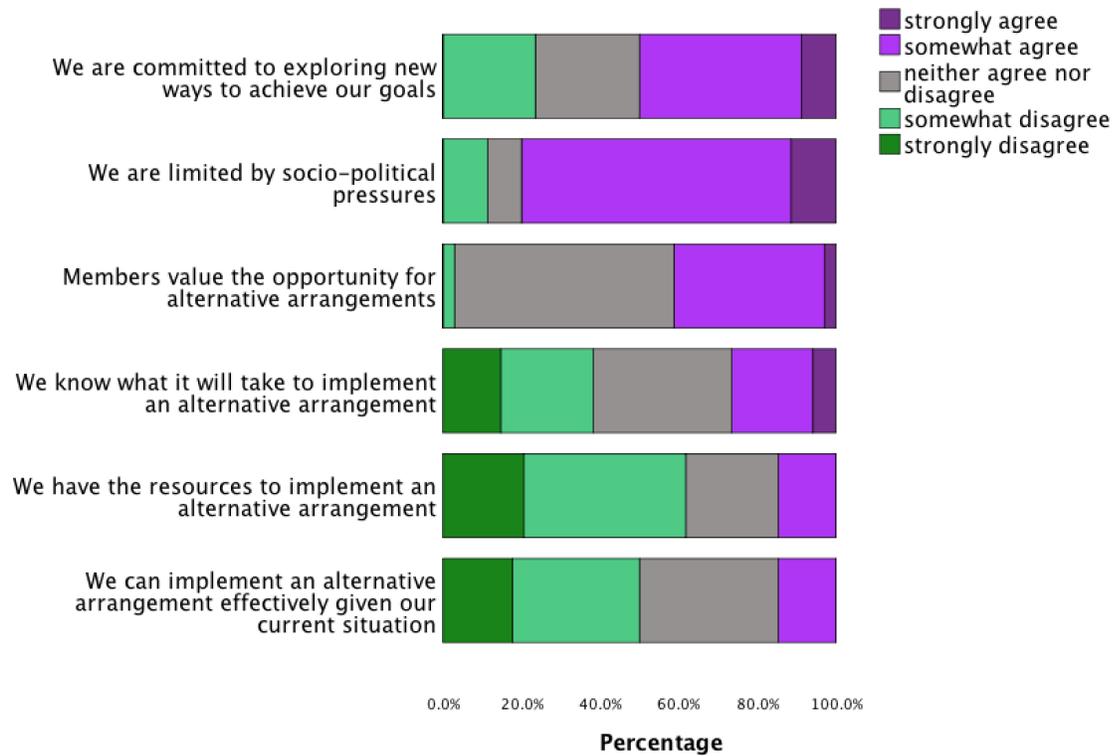


Figure 4.8 Organizational readiness for change

Factors limiting change were associated with other priorities in the new Water Sustainability Act and lack of funding. Specifically, two participants noted limitation of alternative arrangements due to staff capacity and focus on other policy priorities:

“We aren't ready to implement a new governance model...we are still reacting to the changes we created with the implementation of the WSA in 2016.”

(Participant 5)

Five participants also noted limitations from incomplete Aboriginal rights and title to water:

“Alternative governance opportunities will rest on the conversations regarding First Nations' reconciliation in BC. Any acceptable solution will likely include some aspect of co-governance.” (Participant 7)

Limitation from satisfactory level of efficiency was assessed using one-way ANOVA to identify differences in mean scores for efficiency variables by satisfactory level of efficiency (F=6.452, $p > 0.001$), with participants who strongly disagree that the current arrangement is operating at a satisfactory level of efficiency having higher scores for overall efficient (higher = less efficient) than those with different response categories. This suggests that satisfactory level of efficiency may be not a limiting factor in the search for more efficient options. Results are illustrated in Figure 4.9.

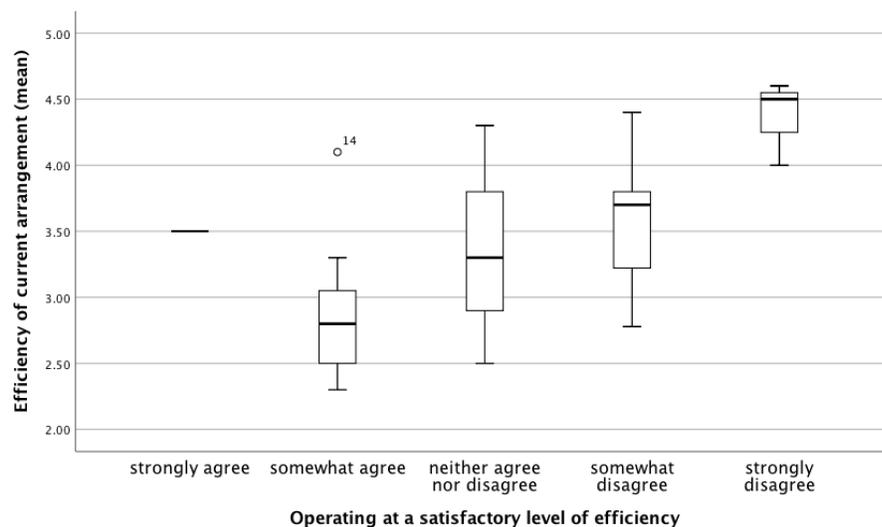


Figure 4.9 Relationship between participant efficiency rating and satisfactory level of efficiency

4.4.6 Transaction cost evaluation

4.4.6.1 Information Costs

In the first scenario, where an alternative arrangement receives responsibility for providing information activities, participants perceived both alternative arrangements as less efficient. For a regional district arrangement, most participants indicated that costs would be higher compared to the current arrangement (2.00 to 3.50 median range for all variables). In addition, no participant rated much lower (7) for any of the variables and only one participant rated moderately lower (6) for identifying public expectation. Figure 4.10 shows the distribution of responses for all variables.

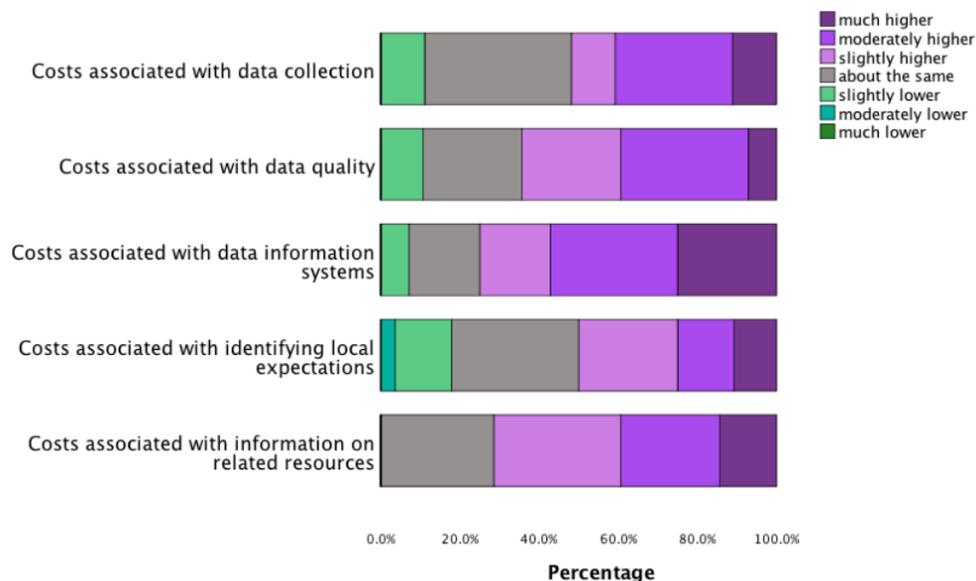


Figure 4.10 Perception of information TC – regional district (scenario 1)

For a watershed agency arrangement, opinion seems to be divided with regard to costs associated with data collection and identifying local expectations, while most participants indicated that costs for data quality, data information systems and information on related resources would be

higher compared to the current arrangement (3.00 to 4.00 median range for all variables). In addition, the range of ratings was from much higher to much lower (1 to 7). Figure 4.11 shows the distribution of responses for all variables.

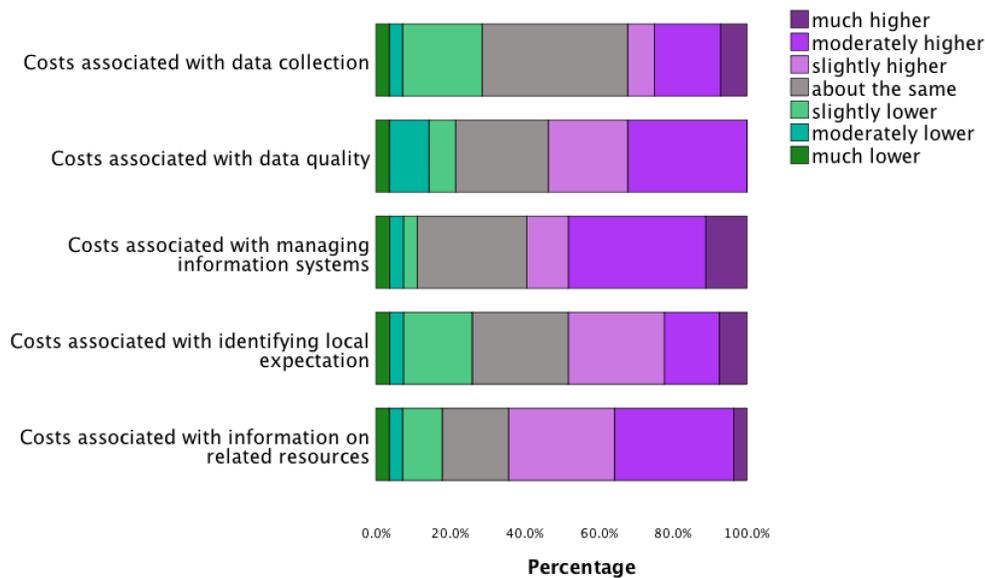


Figure 4.11 Perception of information TC – watershed agency (scenario 1)

Additional costs were associated with process and agreements, quality assurance, information system type and licencing, coordination of decentralized data, and higher expectations resulting in more data collection. Specifically, nine participants noted an increase in cost due to maintaining decentralized databases including linking data into the provincial dataset. Five participants noted additional costs associated with separate systems to manage data and concerns from standalone systems that are not able to transfer data easily resulting in less standardization. Four participants also noted an increase in costs for data quality assurance and quality control. The importance of information for the authorization of water and legal aspects, particularly in relation to water restrictions, was emphasized:

“There is information that the government possesses that is protected under freedom of information and other such rules. This information is critical for decision making and legal aspects of licensing. Maintaining decentralized databases and information sharing agreements would increase costs.”

(Participant 1)

“There is still a need for oversight on a provincial or federal level to coordinate standards to make sure that data is of a known quality. It is not possible to download something like this and expect self organization. The number of people skilled in this type of work is very small.” (Participant 27)

“Multiple institutions = multiple transaction costs associated with obtaining information including cost of policy making, ensuring consistency and quality, program development and operation, and technical consideration such as employing contractors for developing and maintaining applications used for data acquisition.” (Participant 19)

In the second scenario, where the provincial government retains responsibility for providing information activities, opinion seems to be divided (3.00 median for both arrangements). Many participants (43% for regional district and 39% for watershed agency) expressed that costs would be about the same, but only a slightly higher number (50% for a regional district and 46% for watershed agency) expressed that costs would be higher compared to the current arrangement. Figure 4.12 shows the distribution of responses.

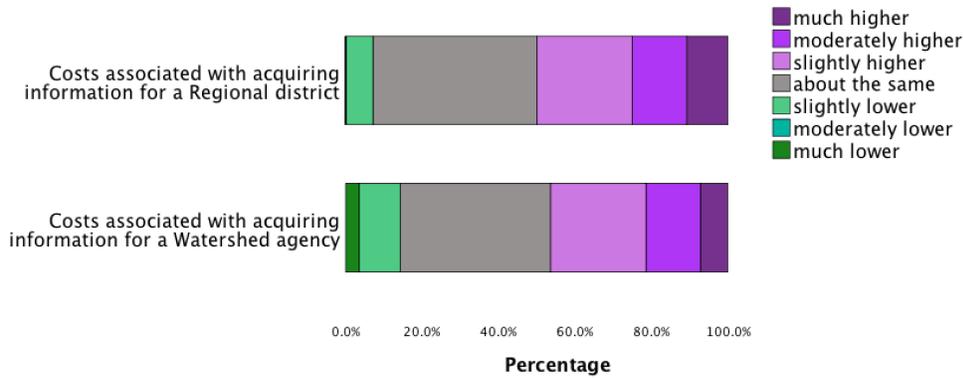


Figure 4.12 Perception of information TC – regional district and watershed agency (scenario 2)

Participants noted that this scenario is similar to the current arrangement where decisions around water authorizations are made in the operational departments of the ministry of Forests, Lands and Natural Resource Operations and Rural Development (FLNRORD) and information is collected by several departments in multiple ministries including the Ministry of Environment and Climate Strategy (ENV). Additional costs were identified as a result of organizing and coordinating information with another organization:

“Decision making can drive information gathering. If decision making and info gathering are separated, it is possible that there would be additional costs to coordinate the different programs.” (Participant 4)

4.4.6.2 Decision making costs

Overall, both arrangements are considered less efficient than the current arrangement when it comes to decision making activities. For a regional district arrangement, most participants indicated that costs would be higher compared to the current arrangement (2.00 to 3.00 median

for all variables). Particularly, almost all participants (88%) indicated that costs associated with planning would be higher. In addition, no participant rated much lower (7) or moderately lower (6) for any of the variables. Figure 4.13 shows the distribution of responses for all variables.

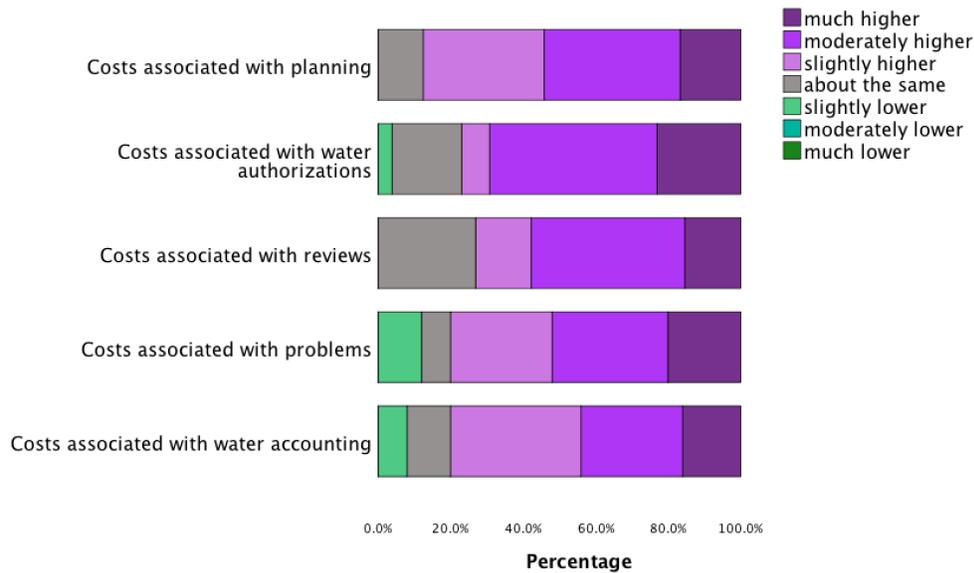


Figure 4.13 Perception of decision making TC – regional district

For a watershed agency arrangement, most participants indicated that costs would be higher compared to the current arrangement (3.00 to 4.00 median for all variables). However, opinion seems to be divided with regard to costs associated with planning (4.00 median) where many participants (46%) indicated that costs would be higher, some participants (33%) indicated that costs would be about the same and some participants (21%) indicated that costs would be lower. In addition, the range of ratings was from much higher to much lower (1 to 7). Figure 4.14 shows the distribution of responses for all variables.

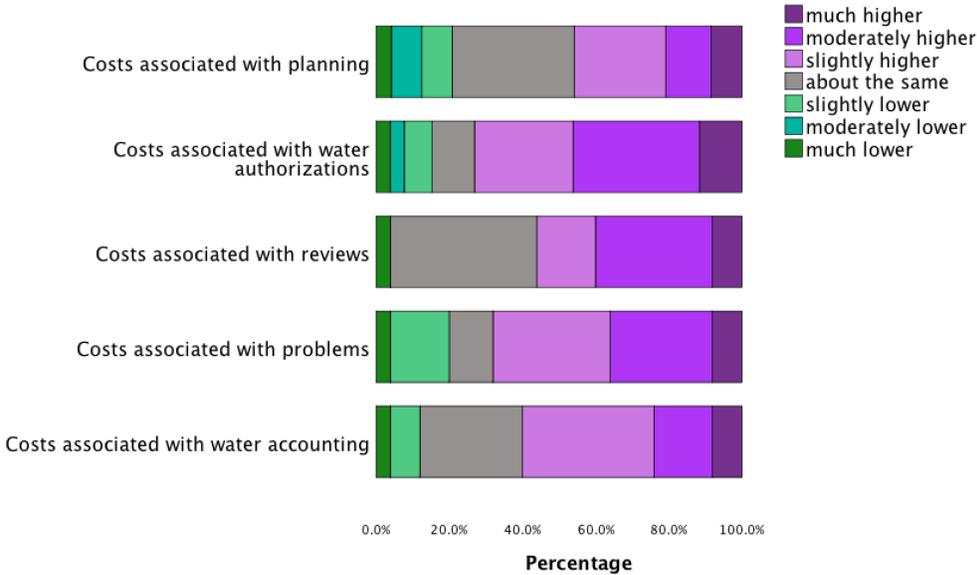


Figure 4.14 Perception of decision making TC – watershed agency

Participants identified an increase in transaction costs associated with additional coordination, higher expectations, and water accounting. Specifically, eight participants noted additional costs associated with coordination with an additional organization and the need for extra resources:

“You would be adding layers of administration and oversight for water resources management [...] there would be additional administrative costs to coordinate amongst the various groups.” (Participant 18)

“Large scale human resource capacity is required and many smaller institutions would simply be overrun with the scale of small issues that arise between water users, in addition to coordinating and handling larger more complex issues.” (Participant 19)

“As the RD or Watershed Agency are closer to the public, expectations would be higher and require a higher response.” (Participant 8)

In addition, five participants noted added costs for a regional district arrangement in relation to coordination due to multiple districts operating in a watershed and duplication of efforts:

“In the regional model multiple regions could share a watershed thus duplicating efforts to study and allocate that water and create a need for more agreements concerning water. The watershed model would increase costs in that you have many small groups trying to complete the same type of work without sharing operating costs.” (Participant 23)

However, two participants also noted opportunities for reduced coordination transaction costs through a regional district approach due to existing water system management responsibilities and integration of staff in planning and development.

Concerns related with an alternative arrangement were noted in regard to First Nation consultation and accommodation, further delegation of responsibilities, lack of technical skills, and inconsistency across arrangements. Issues relating to additional reliance on private professionals and lack of expertise was echoed by four participants:

“British Columbia is proud to be senior government light and local government heavy. They are very, very proud to be completely hands off and as smaller government as possible, and that is why all of these issues are now

handled by academia, by groups that are of interest, but the coordination amongst all of these is very difficult.” (Interviewee 4)

*“More reliance on private professionals and jurisdictional issues.”
(Participant 2)*

“Plus, I don't believe they would have the Water authorization skill set to be consistent.” (Participant 21)

One participant noted opportunities with a watershed agency suggesting activities associated with decision making could be optimized while a regional district arrangement would bring about concerns around accountability:

“Water allocation, monitoring and accounting can be optimized if it is watershed based. It becomes difficult to hold regional districts accountable if they have a small tax base, are underfunded or have experienced unrelated costs or they cross watershed boundaries.” (Participant 26)

4.4.6.3 Enforcement Costs

In the first scenario where an alternative arrangement receives responsibility for enforcement activities, participants perceived both alternative arrangements as less efficient. For a regional district arrangement, most participants indicated that costs associated with monitoring regulatory compliance and enforcement variables would be higher than the current arrangement (3.00

median). In addition, no participant rated much lower (7) or moderately lower (6) for either variable. Figure 4.15 shows the distribution of responses for both variables.

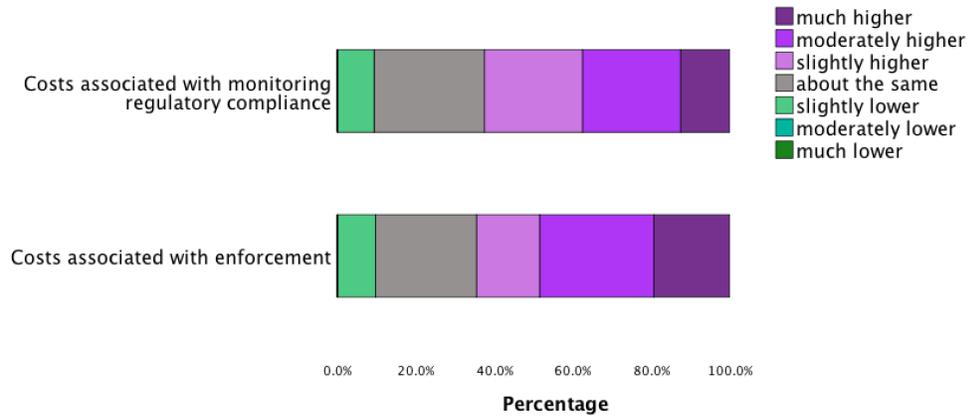


Figure 4.15 Perception of enforcement TC – regional district (scenario 1)

Similar results were found for a watershed agency arrangement, where most participants indicated that costs associated with monitoring regulatory compliance and enforcement variables would be higher than the current arrangement (3.00 median). However, in a watershed agency arrangement, the range of participant rating included much lower (7) and moderately lower (6).

Figure 4.16 shows the distribution of responses for both variables.

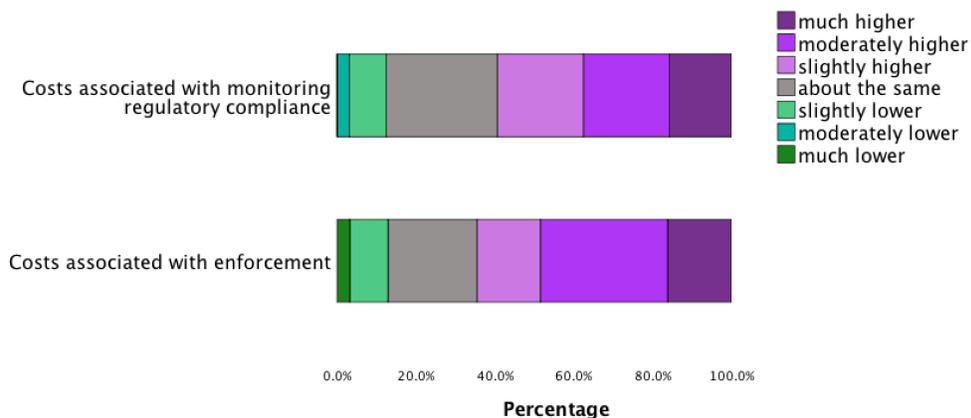


Figure 4.16 Perception of enforcement TC – watershed agency (scenario 1)

Participants identified additional transaction costs from factors associated with the need for additional staff, coordination and appeals. Five participants noted higher costs associated with separate compliance and enforcement for a single regulation resulting in a need for additional staff. However, one participant also noted a possibility for lower costs under a regional district arrangement from synergies with existing bylaw officers. Three participants noted a need for additional coordination with other organizations since water enforcement is often tied to the enforcement of other statutes:

“Water enforcement is often tied to enforcement of other statutes. If water enforcement is separated then additional coordination would be needed. Some options would also be taken off the table as sometimes issues can be dealt with through a single avenue (e.g., just under the Lands Act rather than LA and WSA)[...] Having to investigate a matter separately, and then coordinate with provincial staff, adds steps and complications compared to having all resource issued dealt with through the same organization.” (Participant 4)

Two participants also noted additional costs from appeals related to enforcement of the Water Sustainability Act. Specifically, synergies from other regulations provide an opportunity for enforcement without appeals:

“Separating Water enforcement would prevent the use of other statutes to solve water-related issues. Since Lands Act decisions cannot be appealed,

unlike WSA Orders, it is sometimes more efficient to use other statutes to resolve violations.” (Participant 4)

Concerns related with an alternative arrangement were noted in regard to lack of knowledge and expertise, jurisdictional boundaries and inability to use other regulations to enforce water issues. However, five participants noted opportunities with a delegated enforcement arrangement (either regional district or watershed agency) for effective enforcement. Specifically, officers’ time and attention is divided between all the regulations they enforce. By having a designated water officer, more issues could be addressed through effective enforcement:

“There may actually be more effectiveness in the compliance because of having person(s) dedicated to the enforcement of that specific Act could be very helpful.” (Participant 6)

In the second scenario where the provincial government retains responsibility for providing enforcement activities, most participants indicated that costs associated with coordinating enforcement activities would be higher compared to the current arrangement (3.00 median). The distribution of responses is shown in figure 4.17 and is very similar for both arrangements.

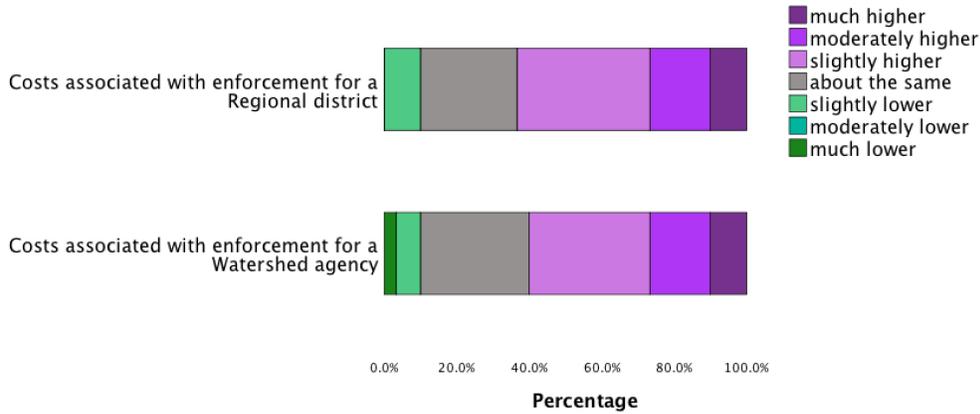


Figure 4.17 Perception of enforcement TC – regional district and watershed agency (scenario 2)

Additional costs were associated with time needed to coordinate and acquire information from another organization. For instance, a compliance officer may need to work with different water managers and engineers, depending on the jurisdictional boundaries, to understand allocation decisions before enforcement could take place:

“The Province would incur additional cost to understand the rationale behind alternative decision making around water allocation before fair enforcement action could be pursued.” (Participant 20)

4.4.6.4 Summary

Figure 4.18 summarizes the median transaction costs of both alternative arrangements under scenario 1. Results show that the transaction costs of both arrangements are perceived to be higher with a regional district arrangement costing more than a watershed agency arrangement.

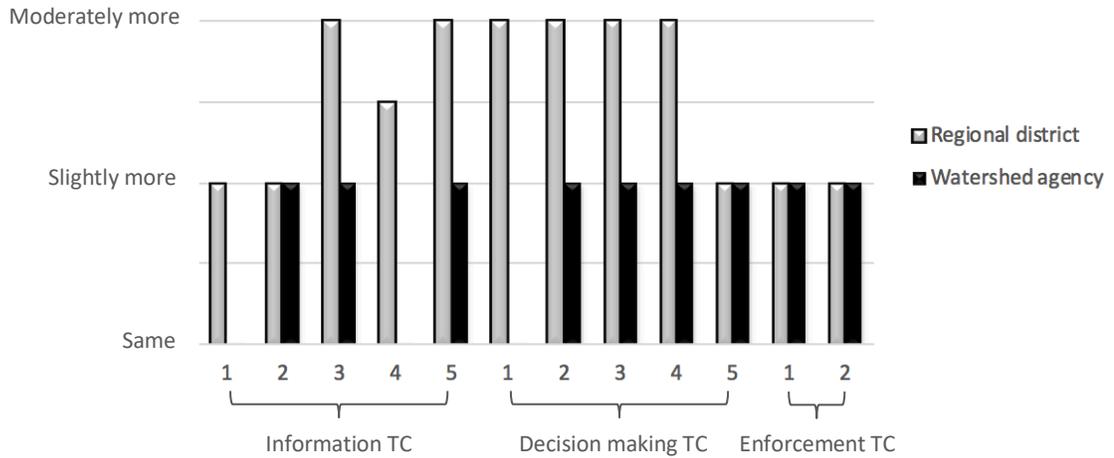


Figure 4.18 Scenario 1 comparative TC of alternative arrangements (median)

Figure 4.19 summarizes the median transaction costs of both alternative arrangements under scenario 2. Results show that the transaction costs of both arrangements are perceived to be higher with, again, a regional district arrangement costing more than a watershed agency arrangement.

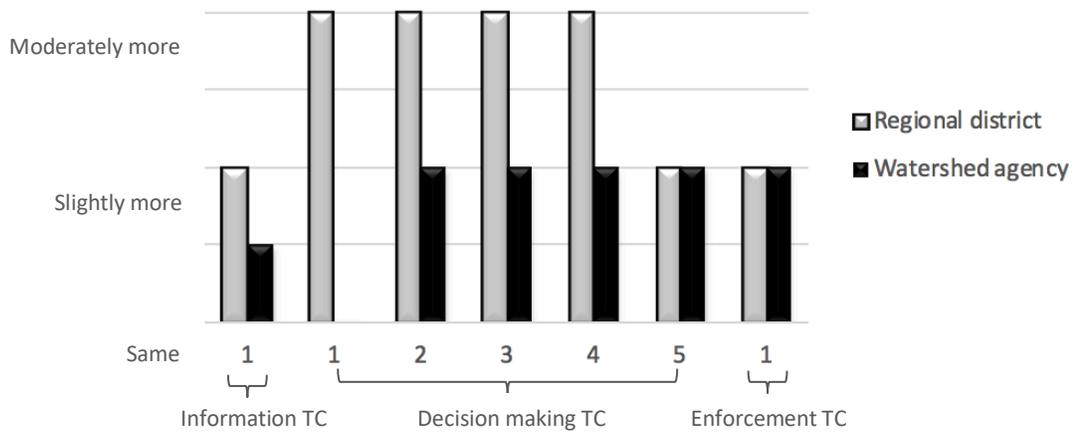


Figure 4.19 Scenario 2 comparative TC of alternative arrangements (median)

4.5 Discussion

Although participants noted that a watershed agency is perceived to be more effective than the current arrangement in achieving sustainability, results from the transaction cost analysis do not support the adoption of alternative arrangements to improve efficiency of the water regime.

In terms of efficiency, the current arrangement is considered somewhat inefficient for all information, decision making and enforcement variables. Factors impacting efficiency in a positive manner were identified in relation to improved data management systems at the provincial level and the ability of officers to enforce multiple regulations, taking advantage of other regulations to resolve violations without appeals. However, factors impacting efficiency in a negative way were identified in relation to consultation and accommodation with First Nations, lack of information, illogical and poorly understood relationships between natural resource regulations, lack of funding, and complex coordination. In addition, participants noted concerns from a reduction in data collection over the years, reliance on applicants to collect data, lack of water accounting, the division of powers between organizations, lack of expert knowledge, insufficient fines, and lack of clarity.

In terms of effectiveness, participants somewhat agree that the current arrangement is effective in its ability to achieve sustainability. However, a watershed agency was perceived to be more effective than the current arrangement. Participants noted opportunities associated with alternative arrangements related to the collection of additional water data and effective monitoring compliance and enforcement. However, two participants noted challenges associated with identifying how things would compare to the current arrangement given that the current

arrangement is not optimized. In addition, participants somewhat agree that current options are limited and noted that options were limited due to public pressure during the water act modernization process, particularly around water markets. Moreover, to improve the overall effectiveness of the water regime, one participant noted that a single organization responsible for all water goods and services is needed and would improve the current state of lack of accountability resulting from the number of administrative decision makers involved and continued delegation of responsibilities to professionals.

In terms of readiness for change, participant responses identified that organizational members are less likely to initiate change. However, members were also not likely to resist change.

Limitations from within the organizations were noted from other commitments in the Water Sustainability Act and resulting staff capacity. In regard to limitations from outside the organization, participants indicated that change is limited by socio-political pressures. Moreover, correlation of participant response to overall efficiency and satisfying level of efficiency suggests that participants are not satisfied with an inefficient system and that alternative arrangements are not limited by participants' satisfying level of efficiency.

In term of alternative governance arrangements, perceived transaction costs compared to the current arrangement were noted higher for both a regional district and watershed agency arrangement under both scenarios. For the first scenario, the data indicate that information transaction costs under both arrangements are expected to be higher with a regional district arrangement costing more. Specifically, a watershed agency is perceived to cost the same for data collection and identifying public expectations but more for data quality assurance and

quality control, managing information systems and understanding interconnected resource when compared to the current arrangement. Where a regional district arrangement is expected to cost more for all activities when compared to the current arrangement. Additional costs were identified in regard to training staff, effective communication, ensuring integrity of data quality, and the accountability of information for legal aspects of licencing.

Decision making transaction costs under both arrangements are also expected to be higher with, again, a regional district costing more. A watershed agency is perceived to cost the same for planning activities but more for issuing authorizations, reviewing authorizations, dealing with problems and water accounting when compared to the current arrangement. Where a regional district arrangement is expected to cost more for all activities when compared to the current arrangement. Participants identified concerns associated with consistency between administrative boundaries, duplication of efforts, additional public expectations and further reliance on private professionals due to concerns of lack of technical skills.

For enforcement transaction costs, the data indicate that both arrangements costs are expected to be higher by the same amount. Activities associated with monitoring are expected to cost the same, however, enforcement activities are expected to cost more. Participants identify factors associated with additional costs to include the need for additional staff, travel (depending on scale) and additional time to manage appeals. The additional time was highlighted by several participants noting synergies under the current arrangement, particularly from the Land Act. Under a delegated arrangement, officers would be limited to enforcement of the Water Sustainability Act.

For the second scenario, the data indicate that coordinating information would cost more for both arrangements compared to the current arrangement. Decision costs would be the same as the first scenario where both arrangements are also expected to be higher with a regional district costing more. A watershed agency is perceived to cost the same for planning activities but more for issuing authorizations, reviewing authorizations, dealing with problems and water accounting when compared to the current arrangement. Where a regional district arrangement is expected to cost more for all activities when compared to the current arrangement. Participants identified concerns associated with consistency between administrative boundaries, duplication of efforts, additional public expectations and further reliance on private professionals due to concerns of lack of technical skills. Issues relating to additional reliance on private professionals was echoed in interviews and participant observations. Coordinating enforcement costs is also expected to be more for both alternative arrangements compared to the current arrangement.

Overall, both alternative arrangements are perceived to cost more compared to the current arrangement. Even when information, decision making and enforcement activities are integrated under the same organization, transaction costs are perceived to be more than a fragmented structure due to data integrity and loss of synergies from the enforcement of other regulation (both the ability to enforce multiple regulations and avoidance of appeals). Therefore, in comparison to the two alternative arrangement assessed, the current arrangement is considered more efficient. This was echoed in one interview:

“So, I would suggest that the current system is efficient, for sure, and more efficient than probably other options. I think the problem with it is that, people argue all the time that, it is not equitable.” (Interviewee 2)

Given that results reveal that the government is using the most efficient arrangement available, Williamson’s theory that efficient systems stay in place may help explain why neither a regional district or watershed agency alternative arrangement have been implemented. However, results identified that half of the participants agreed that change is needed but options are limited. One interviewee noted a need for one ministry to look after all of water:

“The reason why it is fractured is because we have got too many ministries with too many ADM’s in each ministry, and no one authority taking the leadership role... So, we need one ministry that looks after water period. And that is surface water, groundwater, flooding. That’s a huge fractural change. Which, you know in the long run would save money. That is my passion.”

(Interviewee 4)

Moreover, given the province’s historic use and continued support of alternative governance arrangements, options may be limited due to path dependency. Path dependency occurs when past institutions create a framework for responding to proposed changes (Libecap, 1989). In this case, the opportunity for alternative governance arrangements in the Water Sustainability Act (2014) may be influenced by the acceptability of their application in other resource regimes. For example, a common form of alternative governance arrangements in British Columbia are community forests. Community forests were first recommended in the Royal Commission on the

Forests of British Columbia of 1945 (Sloan, 1945). As of July 2019, there were 59 community forest agreements awarded throughout the province to accommodate shared decision making (Ministry of Forests, Lands, Natural Resource Operations and Rural Development, 2019). The Ministry of Jobs, Economic Development and Competitiveness (2020) also identifies co-governance and shared decision-making as a policy option to 1) improve service effectiveness, 2) strengthen Indigenous communities and 3) achieve economies of scope (p. 17). However, options may also be limited by factors outside of the organization that make the rules (North, 1990; Young et al. 2008). Specifically, one participant noted that options related to different approaches to water licences, such as water markets, and deviation from priority dates (first in time, first in right) during times of scarcity are limited due to public opposition:

“Remember, as part of the Water Act modernization process, government proposed introducing water markets to BC and making changes to the FITFIR system of rights, and the ideas faced considerable opposition”. (Participant 7)

In fact, a range of options were presented by the Ministry of Environment (2010a) including:

- *Incentives, economic instruments (e.g., fee-based measures, rebates, tradeable permits, water markets), voluntary efficiency and conservation measures, and sector-based codes of practice;*
- *Water reserves for agriculture;*
- *Different approaches for managing water during times of scarcity, allowing deviation from priority date under exceptional circumstances; and*
- *Administrative efficiencies for users and for government. (p.7 & 11)*

Following public engagement on policy options, the Ministry of Environment (2010b) noted overwhelming support from industry and power production for improved efficiency through incentive and rebate economic instruments. However, comments related to tradable permits, including water markets, were not included in their Report on Engagement (Ministry of Environment, 2010b). Therefore, the amount of opposition to water markets and overall engagement process are uncertain. Yet, the Province released a statement on their Livingwatersmart blog that is no longer available, but referenced by Halvorson (2011) in a letter to the Honourable Murray Coell, Minister of Environment, in relation to public concern over water markets:

*“We’ve heard a great deal of concern from you over the past few days about our proposal to explore water markets and water rights trading and transfers. We’ve said it before, and because it’s so very important, we’ll say it again. **We are not proposing the privatization of BC’s water.** [their emphasis]” (p. 2)*

In addition, research by Morris and Brandes (2013) with watershed-based groups in British Columbia identified criticism over the consultation process, noting concerns related to engagement that was completed mostly through the province’s website and not in person. This lack of in person consultation may have led to the confusion over the option of water markets to improve sustainability. Nevertheless, concerns related to water markets continued to be expressed by the Council of Canadians including representative Meera Karunanathan who stated “the water market system is absolutely not the solution. We consider water to be a human right. When you allocate according to the laws of the market, then you see water going to those who can pay the most. So it goes to the highest bidder” (Fast forward weekly, 2011). In addition,

Brandes et al. (2008) note that although water markets are a tool to help address water scarcity through improved flexibility and adaptation of Canada's rigid water regime, their application beyond Alberta is not likely. Even in Alberta, water sharing through markets continued to lack support in some areas after adoption (Bjornlund et al., 2014).

Overall, given that both a regional district and a watershed agency arrangement are perceived as less efficient compared to the current arrangement and alternative options considered limited, the results do not support the adoption of a delegated approach. Specifically, the Ministry of Jobs, Economic Development and Competitiveness (2020) recommends alternative governance approaches when there are opportunities related to economies of scope, or cost savings. Not when additional costs are anticipated. Nevertheless, actors still consider the Okanagan basin as an opportunity for a delegated approach at the watershed scale noting that the existence of the Okanagan Basin Water Board provides additional benefits from improved coordination and accountability (Nowlan & Bakker, 2007; *interviewee 1*).

Limitations of the methods used in this analysis worth noting relate to limited sample size. There is no specified number of participants required for a study since the number of participants is dependent on the research design (Creswell, 2014). However, Creswell (2014) identifies a range of participants for narrative research (one to two participants), phenomenology (three to ten participants) and grounded theory (twenty to thirty participants). While Charmaz (2006) supports the idea of saturation where the researcher continues to collect data until no new insights or properties are presented. To overcome limitations from small sample size, qualitative data was

collected in the survey with 36 participants to identify themes and patterns. Interviews were then conducted until saturation was achieved.

4.6 Conclusion

This chapter provides further analysis on the water regime and the opportunity for alternative governance arrangements. It addressed the questions:

1. How efficient is the current arrangement?
2. How effective are alternative arrangements perceived compared to the current arrangement?
3. Why and how are transaction costs perceived to change under an alternative governance arrangement?
4. Do these perceptions influence why alternative governance arrangements have not been implemented?

The chapter began with explaining how transaction cost economics can be applied to evaluate the efficiency of alternative options. It then identified limitations associated with change and efficiency seeking from endogenous and exogenous factors. Lastly, it analyzed participant perceptions on the efficiency of the current arrangement, effectiveness of the current arrangement and alternative arrangements, readiness and limitations to change, and transaction costs of alternative governance arrangements compared to the current arrangement. The analysis showed that the current arrangement is perceived to be effective and more efficient than a regional district or watershed agency under both scenarios. However, a watershed agency arrangement was perceived to be more effective at ensuring a sustainability.

Limitations and concerns around the current arrangement in achieving an efficient and effective water regime were attributed to:

1. Consultation and accommodation with First Nations;
2. Lack of information and water accounting;
3. Lack of funding;
4. Complex coordination;
5. Lack of expert knowledge;
6. Division of powers; and
7. Lack of accountability.

Limitations and concerns around an alternative governance arrangement were attributed to:

1. Socio-political pressures;
2. Public pressure around acceptable options;
3. Lack of staff capacity to implement change;
4. Lack of technical skills and further reliance on professionals; and
5. Additional coordination required for consultation and accommodation with First Nations.

Opportunities identified in relation to a watershed arrangement specifically include:

1. Improved water accounting at the watershed scale;
2. Improved monitoring compliance and enforcement; and
3. Improved accountability.

These opportunities were not associated with a regional district arrangement due to differences in regional district and watershed boundaries, as it would be challenging to coordinate information and hold anyone accountable across boundaries.

Moreover, if information and enforcement activities were also delegated to an alternative arrangement (regional district or watershed agency), opportunities identified include:

1. Additional water data collection; and
2. Dedicated staff for monitoring compliance and enforcement could improve effectiveness.

However, concerns associated with the delegation of information and enforcement activities were also identified and include:

1. Oversight required to ensure quality data; and
2. Inability to use other regulations to resolve violations without appeals.

These findings contribute to the understanding of the effectiveness of the current regime and efficiency of the current organizational structure, limitations identified from the examination in the previous chapter. Moreover, it contributes to the understanding of why alternative arrangements have not been implemented along with why and how alternative governance arrangements, specifically a regional district or watershed agency, do not provide additional coherence within the water rights system. However, the benefits of a watershed arrangement in the Okanagan basin requires further analysis.

Chapter 5: Okanagan Basin comparison

Thus far, this study has examined the water regime in British Columbia at two levels. The third chapter employed a high-level examination of the water regime as a whole considering the institutional regime and the broader institutional environment. Results showed that the regime has progressed from simple to complex, but that incoherencies and gaps limit its ability to be considered integrated. These limitations were attributed to: 1) incomplete Aboriginal rights and title to water; 2) jurisdictional and organizational fragmentation; and 3) undefined water yield quotas and water quotas. The fourth chapter then implemented a survey and interviews to analyze jurisdictional and organizational fragmentation in relation to water authorizations. Specifically, the analysis identified participant perceptions on the efficiency of the current arrangement, effectiveness of the current arrangement and alternative arrangements, limitations to change, and transaction costs of alternative governance arrangements compared to the current arrangement. Results identified that neither a regional district or a watershed agency arrangement is anticipated to improve coherence of the water regime. Rather, both alternative arrangements are perceived as being less efficient. However, a watershed agency was identified as providing an opportunity to be more effective compared to the current arrangement. This result is echoed in research and discussion papers where the Okanagan basin is considered an ideal alternative arrangement to improve outcomes given the success of the Okanagan Basin Water Board (Nowlan & Bakker, 2007).

In this chapter, I address the third research question: How do the perceived transaction costs under a watershed agency arrangement in the Okanagan basin compare to the rest of the province? I analyze survey results from the previous chapter to identify if there are significant

differences between responses from respondents who work in the Okanagan region compared to the rest of the province. Specifically, I am interested in understanding if a watershed arrangement in the Okanagan is perceived different in its ability to improve efficiency. I also examine the implications of an alternative arrangement on the current services provided by the Okanagan Basin Water Board.

5.1 Introduction

The Okanagan basin is located in the semi-arid region of British Columbia and is popular for its warm dry summers, abundance of outdoor activities, wine tours, and agricultural products including cherries, apples and peaches. The basin is located in the interior of British Columbia and runs approximately 200 kilometers in length supporting an abundant of species, including a number of endangered species under threat from decreasing wetlands (OBWB, 2019). Water issues in the basin include invasive species, pollution and water scarcity and have been a concern since early development of the region. However, the natural dryness of the region is intensified with increased weather variability from climate change and continued increasing water demand from development. To help overcome these issues, the Okanagan Basin Water Board (OBWB) works with local governments and communities through a range of programs to improve water management in the basin.

The OBWB was formed in 1968 in response to eutrophication (fertility pollution) and increasing consumptive uses resulting in local governments and the province to explore options to improve outcomes in the region.

“Unfortunately, no administrative machinery yet exists to provide the means by which local problems can be properly researched and identified and the necessary corrective or preventive measure developed and enforced. The Okanagan Basin Water Board should be established to fulfill this function...”

(OBWB, 1968, p. 13)

The OBWB was officially designated as the local coordinating authority in 1974 to deal with the overwhelming watermilfoil and water pollution problems in the basin (OBWB, 2010). This was the main focus of the OBWB until 2006 when responsibilities expanded to “provide leadership for sustainable water management to protect and enhance the quality of life and environment in the Okanagan Basin” (OBWB, 2010 p. 3).

The success of the OBWB in its ability to help manage the basin’s water resource has resulted in its recognition as a leading example of watershed management in Canada (Nowlan & Bakker, 2007). As such, the OBWB has been identified as an example of where the adoption of an alternative governance arrangement could be successful (Nowlan & Bakker, 2007). Specifically, given that the OBWB has been in place for over fifty years, administrative functions, institutional knowledge, trust, and scientific programs that are already in place could be seen as opportunities to make an easy shift to delegate decision making. In addition, the structure of the OBWB provides a sense of accountability with representation from all three Regional districts on the board.

However, it is not known if the OBWB would provide additional benefits to the coherence of the current arrangement. Further, if OBWB were to take on a decision-making role, their ability to

continue as a successful leader and coordinator may suffer negatively. As Cohen (2011) notes, “some watershed-scale organizations felt they were able to act more effectively if they maintained their non-regulatory roles” (p. 138). To assess the adoption of a watershed arrangement in the Okanagan, I apply inferential statistics to survey results and qualitative results from interviews.

5.2 Context

The basin stretches approximately 200 kilometers in length from north to south down to the United States border. As a transboundary basin, it requires joint cooperation with the United States which is achieved through the International Osoyoos Lake Board of Control (IOLBC) and the U.S.-Canada International Joint Commission (IJC). The IOLBC was established in 1948 to implement orders from the IJC related to the operation of the Zosel Dam which are carried out by the State of Washington. This joint cooperation requires additional consideration in the governance and management of water in the basin to ensure minimum flows into the United States can be met.

The basin is located in a semi-arid region where precipitation is highly variable and can be as low as 30 centimeters per year in some areas (Mason et al., 2005). Climate change is expected to worsen current water stresses with less precipitation, earlier spring freshets and longer dry summers (Dickenson, 2005; Cohen & Miller, 2001) and an increase in water demands for irrigation needs (Nielsen et al., 2006). All of this puts additional pressure for improved management practices, both supply and demand side, to ensure water availability for all uses.

In addition to water scarcity issues, water pollution presents an ongoing issue in the basin (OBWB, 2019). Pollution sources include municipal wastewater and agricultural runoff, which contribute to algal blooms and other aquatic plant growth. Because many of the municipalities in the basin rely on lake water for drinking water sources, pollution can cause additional water treatment requirements. All of these issues, including land use change, are also concerns for local environment, particularly sockeye salmon and other fisheries.

5.2.1 The OBWB

The OBWB is an agency that influences the water institutional regime through the institutional environment as an exogenous actor. It was formed to support shared water interests of basin communities in 1968 and legislated in 1970 under the Municipalities Enabling and Validating Act.

The OBWB consists of six representatives from the three regional districts in the watershed, First Nations, the water supply association on BC, and the Okanagan Water Stewardship Council (Council) (Nowlan & Bakker 2007). Regional districts are not required to participate on the OBWB, but do so voluntarily. OBWB jurisdiction is defined by the watershed boundaries rather than the traditional political boundaries of regional districts (Nowlan & Bakker, 2007). They have the ability to tax, pass bylaws, and receive funding from tax assessments in order to implement programs aimed at achieving sustainable water supply in the basin (Nowlan & Bakker, 2007). In 2006, the Board formed the Council to initiate a basin wide network that links users, science and decision makers (OBWB, 2011). The Stewardship Council (the Council) consists of volunteers from the public and research institutes who meet monthly to take

advantage of local and scientific expertise for long term sustainable planning (OBWB, 2011). As such, the OBWB is a mixed organization with representation from both government and basin communities. These board members are illustrated in figure 5.1.

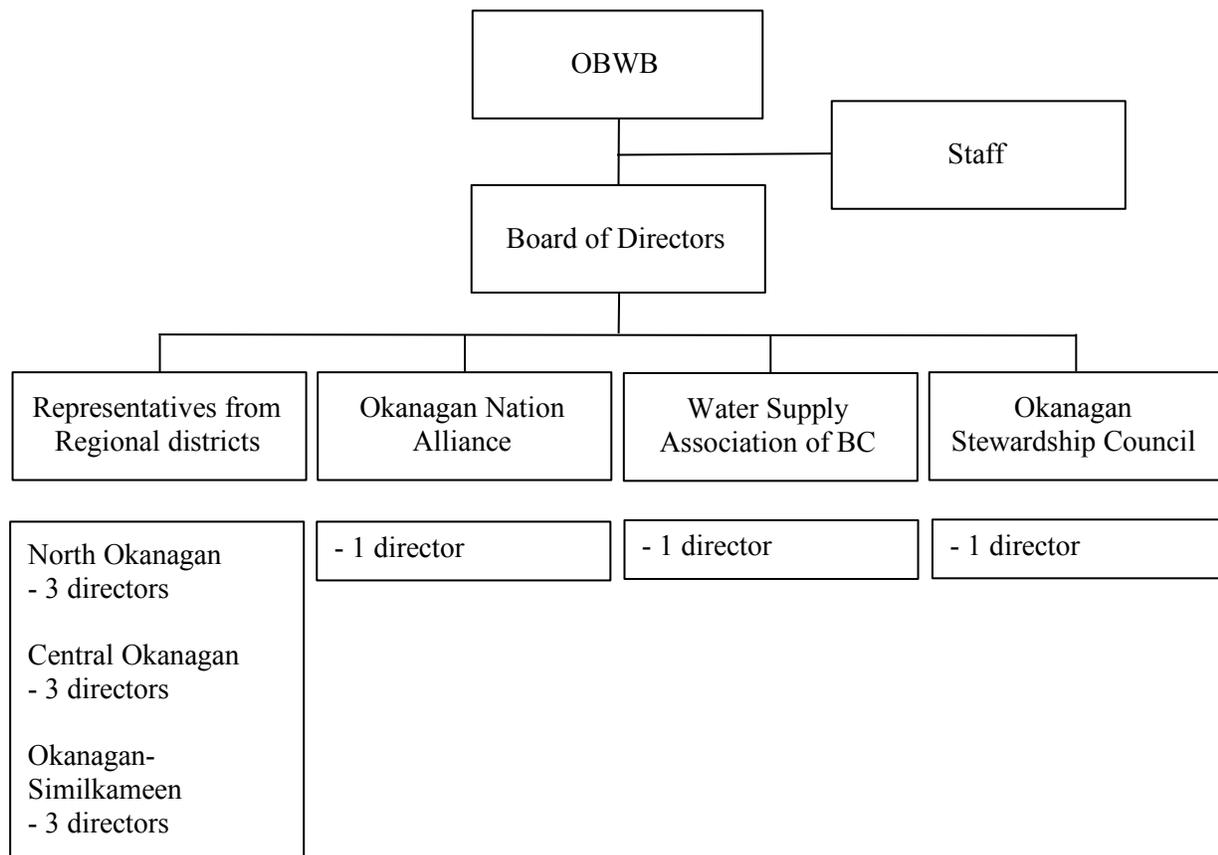


Figure 5.1 Structure of the OBWB

The Council was formed in 2006 and consists of government, academic organizations, professional organizations, NGO's, and industry. Members are appointed 2-year terms during which they provide technical and expert support on water regulations and policies, planning, water use studies, data collection, and research needs. Overall, the Council provides

collaboration and dialogue among water users and partners. Members also participate in council committees.

The OBWB originally focused on activities to do with algae blooms, water quality and invasions of milfoil water issues. Successful improvements to the water quality in the area and new risks caused the board to initiate a new water management initiative in 2006 along with the introduction of the Council.

“Providing leadership to protect and enhance quality of life in the Okanagan Basin through sustainable water resource management” (OBWB, 2019).

To accomplish their objectives, the OBWB water management program includes communication and outreach, water stewardship (water stewardship council), water conservation and water quality improvement grants, OBWB science and information projects, flood and drought work, milfoil control, sewerage facilities assistance grants. This program is endorsed every 4 years by the three Okanagan regional districts. Strategies identified in the strategic plan (annual report) provide direction for the water management program components.

Funding for the OBWB comes from senior government agencies (such as Emergency Management British Columbia) foundations (British Columbia Investment Agriculture Foundation), other sponsors, in-kind contributions, and pooling tax dollars from the three regional districts (which can levy up to \$0.21 / \$1000 assessed property value that is used to fund the sewerage facilities

grant program). It manages finances for collaborative partnerships (including research) and issues grants for projects aimed at improving local water quality and conservation. Sewerage facilities assistance grants to upgrade sewerage infrastructure to improve water quality. The OBWB also funds research and other projects through funding partnerships.

Overall, the OBWB and Council have created a social network that enables the identification of stakeholder values and the link between these values, science and decision making. This link has improved communication and compromise between water users and provides a continual inflow of scientific knowledge to decision makers to improve social-ecological resiliency.

5.3 Methods

This analysis utilizes a mixed methods approach to examine the potential for a watershed agency arrangement in the Okanagan basin. Data consists of surveys and interviews with key informants that were collected in the previous chapter. In addition, I attended two meetings and three conferences where I was able to discuss with representatives from the OBWB and council the opportunity for a watershed agency arrangement in the Okanagan basin which informed interview questions.

5.3.1 Analysis

To assess whether there are differences in responses from participants in the Okanagan region and other regions in British Columbia survey responses were analyzed in SPSS. Of the 36 completed surveys, 11 participants were from the Okanagan region and 25 from other regions in the province. Participants who work in all regions (for example, participants from the Water

Protection and Sustainability Branch in the Ministry of Environment and Climate Change

Strategy) were included with other regions as their perceptions were not specific to the Okanagan region.

Survey	Okanagan region	Other regions
Full survey	8	19
Information focused survey	1	1
Decision making focused survey	1	0
Enforcement focused survey	1	5
Total	11	25

Table 5.1 Survey responses by region

Independence of regions was tested using non-parametric and parametric methods depending on the normality of the variables. A list of variables and their type are included in table 5.1.

Distribution of each variable was checked to determine the method of analysis using Q-Q plots, frequency distribution and the Shapiro-Wilk test (Ghasemi & Zahediasl, 2012).

Variable name	Variable	Type
Okanagan_Q5	Region	Dichotomous
I1w_Q44	Costs associated with acquiring information	Ordinal
D1w_Q53	Costs associated with planning	Ordinal
D2w_Q56	Costs associated with water allocation	Ordinal
D3w_Q59	Costs associated with reviews	Ordinal
D4w_Q62	Costs associated with problems	Ordinal
D5w_Q65	Costs associated with water accounting	Ordinal
E1w_Q81	Costs associated with enforcement	Ordinal
ProvPower_Q6	Provincial power	Ordinal
Proud_Q7	Proud of current system	Ordinal
Respect_Q8	Respect for authority	Ordinal
Scarcity_Q10	Scarcity of water	Ordinal
CurtEff_Q14	Effectiveness of current system	Ordinal
RDEff_Q15	Effectiveness of a Regional district	Ordinal
WAEff_Q16	Effectiveness of a watershed agency	Ordinal
OpsLim_Q17	Limited options	Ordinal
LawsInt_Q18	Integration of laws	Ordinal
AllEfficiency	Efficiency of current system	Continuous
MeanOrgChange	Organizational readiness for change	Continuous

Table 5.2 Variables

Non-parametric tests such as chi-square homogeneity test, Mann-Whitney-U test and Kendall correlation test are considered appropriate analysis for Likert item data which is ordinal and non-normally distributed (Neely et al., 2010). Because the Chi-square test ignores the ordering of the categories, the analysis uses the Mann-Whitney U-test (also referred to as the Wilcoxon-Mann-Whitney test) to compare the differences between the mean ranks of the two regions (Okanagan and other). This test was also selected based on its ability to deal with small samples, different sample sizes and outliers (Fay, 2018; Mann & Whitney, 1947). Before the Mann-Whitney U test was carried out, the distribution of variables across regions was checked to ensure mean ranks could be used. The effect size was then calculated for statistically significant results (Gignac, 2019). In addition to reporting significant results, the spread of non-significant results are presented to identify distributional differences as these can sometimes be considered just as important as differences in p-values (Hart, 2001).

The t test was used to compare the means of normally distributed continuous variables (Bergin, 2018). Inspection of the Shapiro-Wilk test revealed that all variables were normally distributed for each region. The homogeneity of variance across groups was checked using the Levene's Test for Equality of Variances to ensure statistically significant difference in the variances between groups. Independent t test was run with a 95% confidence interval for the mean differences.

Although each method was determined based on the normality of the distribution between regions, de Winter and Dodou (2012) identify that five-point Likert items have similar power for

both the t test and Mann-Whitney U test. Although Clason and Dormody (1994) note that “the true mean for a Likert-type item may not be measurable because of limitations imposed” (p. 34), some statisticians use t tests or other parametric procedures (Sisson & Stocker, 1989). For groups that are greater than 5 or 10 in size, the Central Limit Theorem identifies that even if the data is not normally distributed, the means are approximately normally distributed (Sisson & Stocker, 1989). As such, variables were also checked using the t test.

To assess the implications of an alternative arrangement on the current functions of the Okanagan Basin Water Board, interview responses, including one key informant from the OBWB, were reviewed to identify opportunities and concerns. As such, results of this analysis are subject to limitations from a single key informant. However, with only six staff on the OBWB, of which two are dedicated to communications and watermilfoil control, the single key informant interviewee was considered acceptable. Nevertheless, to overcome this potential bias, findings were confirmed, where possible, with documentary information (Yin, 2014).

5.4 Results

Results of Mann-Whitney U and t tests of independence for the Okanagan and other regions included in the study are provided in Appendix D.

5.4.1 Mann-Whitney U test of significance

A Mann-Whitney test indicated that participants were more likely to agree that water is scarce if they worked in the Okanagan region (Mdn = 12.27) than in other regions in British Columbia (Mdn = 21.24), $U = 69.000$, $p = .013$. The effect size identified that 17.6% of the variability in

the ranks is accounted for by region. Figure 5.2 summarizes scarcity results by region represented by survey participants.

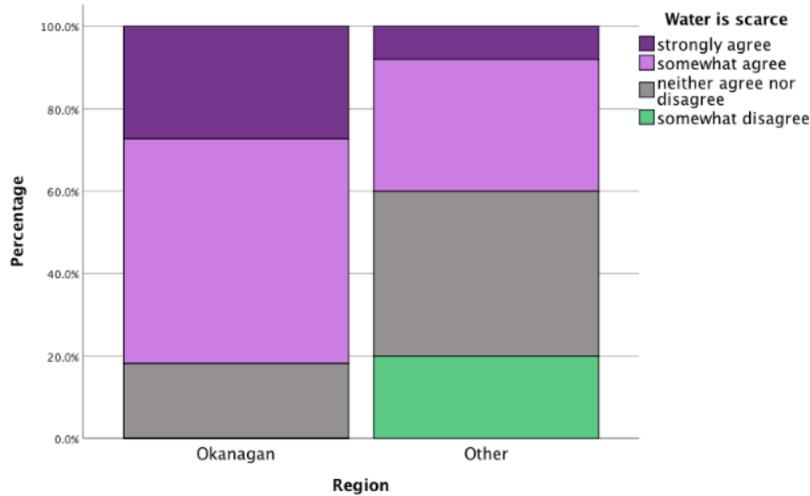


Figure 5.2 Relationships (significant) between regions for water scarcity variable

Non-significant relationships are also summarized in figures 5.3 for transaction cost variables and figure 5.4 for all other variables to assess distributional differences. One distributional difference was identified for the effectiveness of a watershed agency compared to the current arrangement variable where Okanagan participants were in more agreement that a watershed agency would be more effective. This variable shows a significant relationship under the t test as shown in the following section.

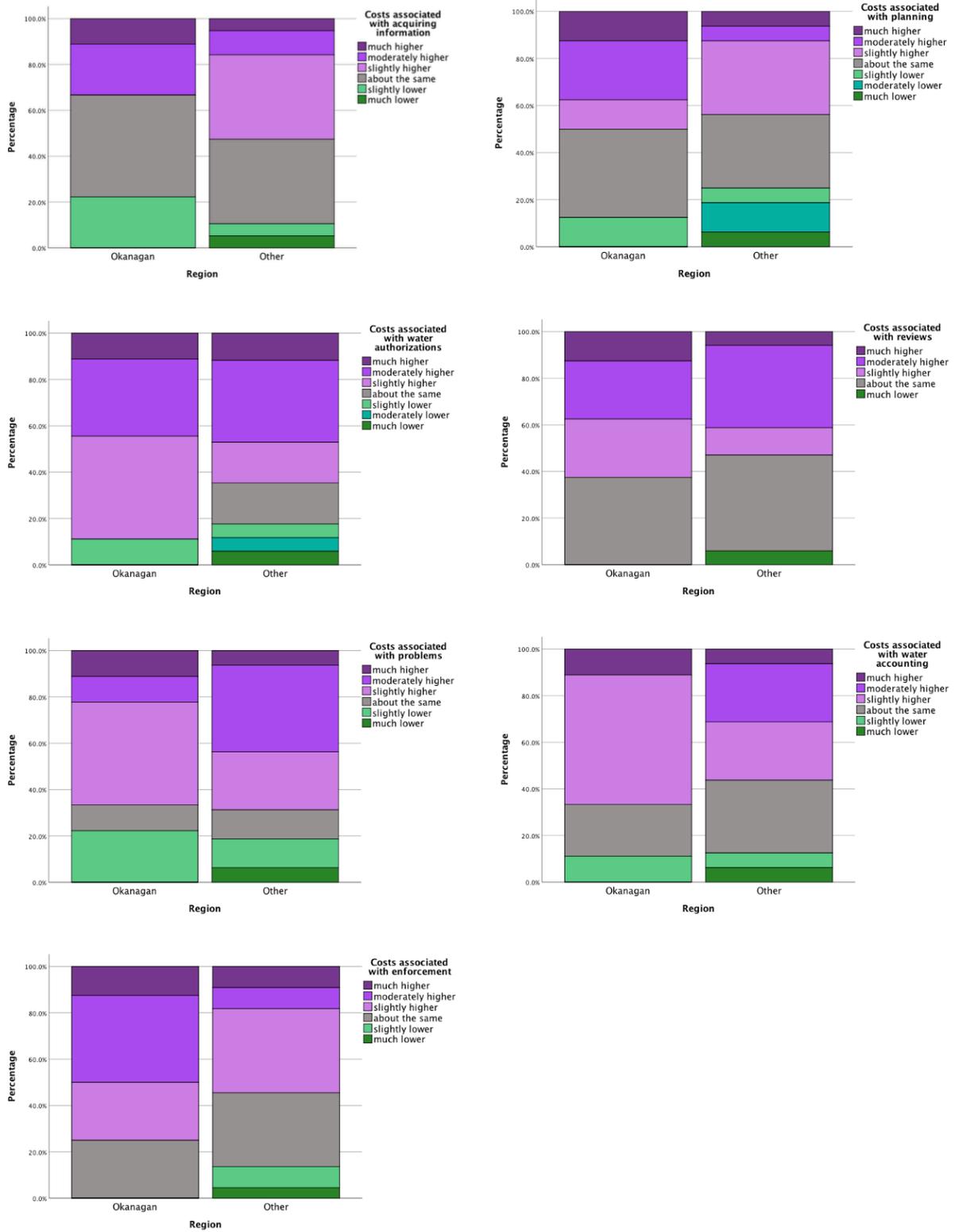


Figure 5.3 Relationships (non-significant) between regions for each transaction cost variables

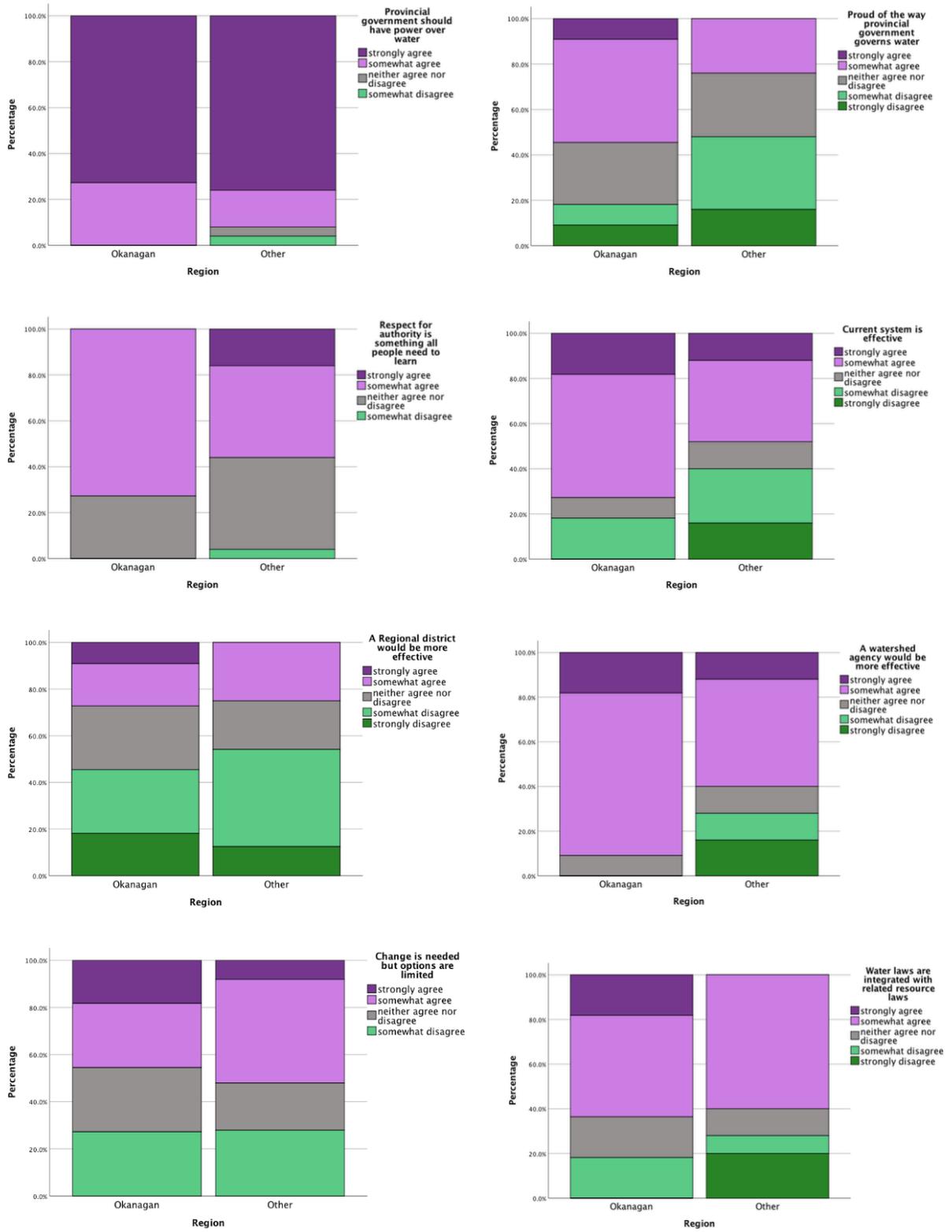


Figure 5.4 Relationships (non-significant) between regions for remaining ordinal variables

5.4.2 T test of significance

The t test was run for each continuous variable with a 95% confidence interval for the mean differences. It was determined that there is no statistically significant difference between the mean scores of participants in the Okanagan region and other regions for either variable. The results for efficiency of the current arrangement was $t(24) = -1.528$, $p = .140$, the effect size, $\eta^2 > .01$, was small and the 95% confidence interval was -1.05995 to 0.15828 . The results for organizational readiness for change was $t(32) = -.38$, $p = .970$, the effect size, $\eta^2 > .01$, was small and the 95% confidence interval was -0.34242 to 0.32979. Figure 5.5 illustrates the non-significant difference in means for each continuous variable.

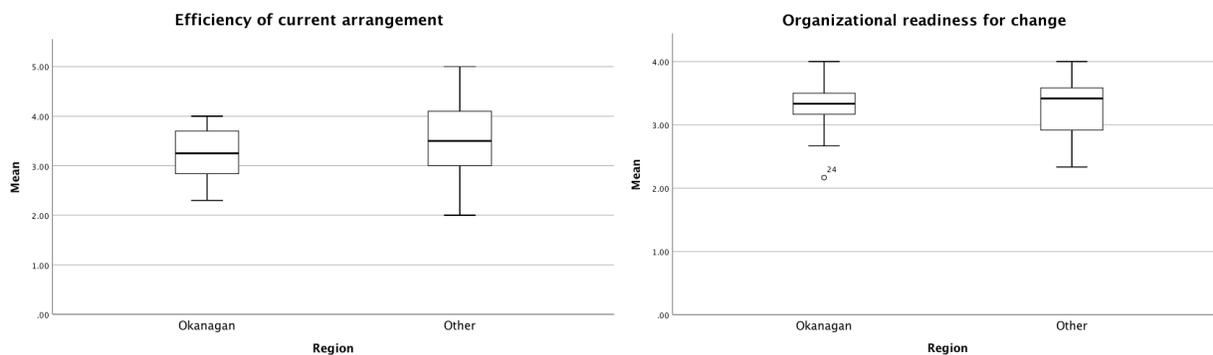


Figure 5.5 Relationships (non-significant) between regions for continuous variables

The t test was also run for the distributional difference identified in the Mann-Whitney U test for the effectiveness of a watershed agency compared to the current arrangement with a 95% confidence interval for the mean differences. It was determined that there is a statistically significant difference between the mean scores of participants in the Okanagan region and other regions. The results for the effectiveness of a watershed agency was $t(33.962) = -2.633$, $p = .013$, the effect size was $\eta^2 = .18$ and the 95% confidence interval was -0.483 to -0.185. Figure 5.6

illustrates the significant difference in means for participant perception on the effectiveness of a watershed arrangement compared to the current arrangement.

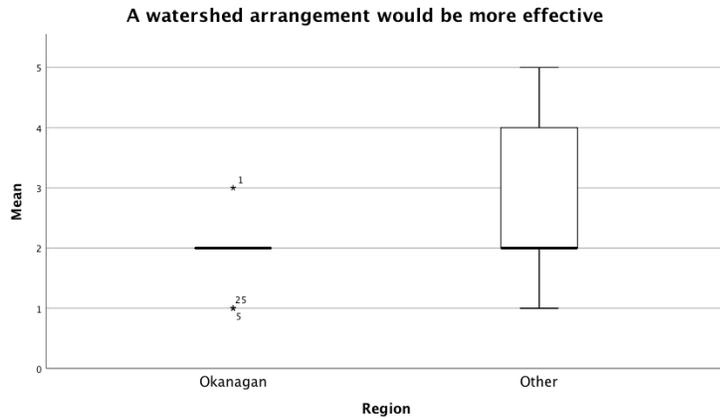


Figure 5.6 Relationships (significant) between regions for effectiveness of a watershed arrangement compared to the current arrangement

5.5 Discussion

Overall, Okanagan participants ranked similar to participants from other regions with the exception of two variables. Okanagan participants were more likely to agree that water is scarce and also more likely to agree that a watershed arrangement would be more effective than the current arrangement in achieving sustainability.

Given the geographical location of the Okanagan, its high irrigation water demand and limited water supply, it is not surprising that perceptions around water being scarce were statistically significant suggesting a difference in water availability between the Okanagan and other regions. In fact, studies have identified that the Okanagan basin is at risk from further season flow variability and a decrease in surface water runoff under a changing climate (Cohen et al., 2006; Harma et al., 2012). As a result, researchers have been studying how climate change will impact

water availability in the region and how to respond to irrigation demands through improved management practices (Neilson et al., 2018).

It is also not surprising that perceptions around a watershed agency being more effective were statistically significant given the success of the OBWB (Cohen et al., 2006; Melynychuk et al., 2017; Nowlan & Bakker, 2007). Moreover, it is known that the OBWB have submitted proposals to the governments for additional powers without success (Melynychuk et al., 2017). Their inability to have more influence over the management of water in the basin has resulted in their reliance on incentive-based programs to promote good water management throughout the basin (Okanagan Water Stewardship Council, 2008). Nowlan and Bakker (2007) suggest that additional powers be granted to the OBWB including water authorizations, management of upper reservoirs and aquifers, and develop regulations around conservation such as water pricing. However, Melynychuk, Jatel and Warwick Sears (2017) note that “greater formal authority is not necessarily a guarantee of greater influence or effectiveness” (p. 423) and that the regulatory role is more appropriate with senior governments rather the OBWB. This was reflected by the key informant who noted concerns in relation to delegated authority around collaboration with First Nations, enforcement activities and corruption at the local level. Specifically, the delegation of power to the OBWB would hinder collaboration with First Nations and probably create tension with the government:

“I think negatively to be honest. I think that our ability to collaborate with First Nations would be hindered. I think, it would probably create tensions between senior levels of government, including the province.”

The key informant described the current arrangement as streamlined and quite efficient. They noted that a watershed agency arrangement would be less efficient than the current arrangement which is in line with responses throughout the province and in the Okanagan. Specifically, the key informant identified a lack of capacity for staff to be represented at multiple meetings or groups throughout the watershed. This was noted as something that is important for successful collaboration but would cost more and possibly be too costly.

Benefits of the OBWB in its current role were noted in relation to providing shared knowledge, a place for First Nation representatives and government officials to come together, efficient collaboration, and information management. Specifically, the ability of the OBWB to bring together people to create synergies and collaboration was highlighted by several interviewees, including the key informant, and participants at water meetings. Collaboration becomes even more important in situations where coordination requirements cross jurisdictional boundaries and can help overcome barriers of knowledge transfer to local stakeholders (Kim et al., 2017). This was highlighted by the key informant:

“We always talk about the OBWB having this concept of soft power, and the whole concept behind soft power is that we have no legal force on the landscape. But, at the same time, we create forums where people can effectively come and collaborate. And it really does create some synergies, and especially if you think about kind of the boundary divisions between like regional government, or municipal government and the watershed.”

The OBWB are able to identify gaps, whether they be science and information gaps or coherence gaps, and can effectively support the development of solutions around complex problems that would otherwise be avoided by higher levels of government. The key informant noted the ability of the OBWB in its current role to bring together stakeholders around tough subjects. This ability to bring people together to confront more complex issues between stakeholders was attributed to the OBWB's lack of ability to directly influence change through rule making:

“I personally think that because we don't have that authority, and the authority rests with largely senior levels of government, in some cases with local government, it just allows us to be moral influencers. So, I would suggest that the barriers that exist in terms of us directly influencing things is very light. And yet, over the long term it seems to be working really well. It helps us bring people together, it supports collaborative projects, and, ultimately, it kind of enables this broader conversation about how do we deal with some of these really complex social water issues. Like conflicts between fish and farmers. Or, take your pick.”

The key informant also noted the ability of the OBWB to bring together First Nation representatives and government officials. This creates opportunities to include First Nations in more than just authorizations (through consultation and accommodation), including expanding our way of knowing through water science and information:

“What I think was so interesting, that in this case, like you talk about science and information, but this is a perfect example where traditional knowledge

came into play. We developed some data sets around naturalized flows for the nineteen streams from the data we had, and it was kind of limited, so the First Nations came back and said, “We hear you, we see what the science has shown, but we have traditional knowledge that paints a different picture. We know there are fish in these streams 50 years ago, and the level of water that you are suggesting should have been in those streams 50 years ago doesn’t line up with the life cycles that we know existed”. And, that tension created a way better outcome in the project. So, I think that one of the coolest ways that we have been able to sort of manage information is through very specific projects that includes multiple partners.”

The ability of the OBWB to bring people together was also noted to provide efficiency benefits:

“I feel like the OBWB is one player among many, and the role of bringing people together and having some of these common conversations, I would suggest creates huge amounts of efficiency”.

This is consistent with research where watershed groups are recognized as an instrument to promote effective management and planning, particularly those who operate in watersheds that cross multiple jurisdictional boundaries (Barham 2001; Kenney 1997; Marsh 2002; NRC 1999).

Finally, concerns identified in relation to the adoption of a watershed agency alternative arrangement were noted in relation to hindered collaboration with First Nations, ad-hoc

administration of enforcement activities and corruption at the local level. Specifically, concerns around interactions between entrepreneurs and public officials suggests that risks from corruption at the local level are real. The key informant noted that corruption is a real concern and suggests having it separated from local politics:

“So, I would say the current system for issuing a license doesn’t allow, say a company like “Nestle” to go and talk to a statutory decision maker, “Jane”, and say, “Can you please ensure that we get THIS, and we will give you whatever?”. I think having it removed from the local politics makes a ton of sense. If you were to put allocation down to the sub-basin level you would be getting into the same kind of political dynamics that you have for, arguably, land use management at the local level, which is kind of a shit show.”

This issue is often overlooked by advocates of decentralization (Stalgren, 2006), but can be a real issue (Asthana, 2008).

Overall, although participants in the Okanagan region were more likely to agree that a watershed agency would be more effective, the OBWB sees itself as a collaborator:

“The ongoing commitments to collaboration by the OBWB and its water stewardship council, local governments, First Nation communities, and all aspects of the water sector are further evidence that this is a unique and powerful base to grow and improve our relationship to water and the way it is shared and managed. The desire to work together and thrive together remains an integral part of the Okanagan culture.” (OWSC, 2019, p. 3)

5.6 Conclusion

This chapter addressed the third research question: How do the perceived transaction costs under a watershed arrangement in the Okanagan basin compare to the rest of the province? The chapter began with a review of the OBWB, its implementation, structure and responsibilities. It then analyzed survey results from the previous chapter to identify if there are significant differences between participants who work in the Okanagan region and the rest of the province. From there, it examined the implications of an alternative arrangement on the current services provided by the OBWB.

Overall, Okanagan participants ranked similar to participants from other regions with the exception of two variables. Okanagan participants were more likely to agree that water is scarce and also more likely to agree that a watershed arrangement would be more effective than the current arrangement in achieving British Columbia's sustainability goal.

Furthermore, interviews, including key informant interviewee, revealed that the benefits provided by the OBWB throughout the basin would be put at risk under a watershed arrangement and that the regulatory role is more appropriate with senior governments. These benefits include providing shared knowledge, support for First Nation representatives and government officials to come together, efficient collaboration, and information management.

Chapter 6: Conclusion

“Excellence is never an accident. It is always the result of high intention, sincere effort, and intelligent execution; it represents the wise choice of many alternatives – choice, not chance, and it determines your destiny” Aristotle

6.1 Introduction

One year following the declaration of the new British Colony of British Columbia and a flood of European and American settlers struck with gold fever, the government of British Columbia introduced the Gold Fields Act of 1859. Regulations under the Gold Field Act of 1859 set the framework for prospectors to claim water for mining activities, establishing the Province’s first regulations involving water use rights. The water regime saw many changes over the following fifty years with the establishment of the Water Act of 1909 and followed by the revised Water Act of 1914. However, for the next one hundred years, British Columbia’s Water Act saw few changes in how water use rights were governed. As a result, concerns related to increasing pressures on water resources, increasing population growth and climate change caused the government to commit to changes through what was referred to as “British Columbia’s Water Act Modernization” (Ministry of Environment, 2008; Ministry of Environment, 2009).

Following five years of consultation and policy development, the province introduced the Water Sustainability Act of 2014, with the promise to protect water supply to “ensure that B.C.’s supply of fresh, clean water is sustainable – not just to meet our needs today, but for generations to come” (Ministry of Environment, 2013b, p. vii). However, water governance and management in British Columbia involves many pieces of legislation, not just the Water Sustainability Act,

2014. As such, to understand if the province is able to deliver on its sustainability commitment, this study looked beyond the Water Sustainability Act to include all water regulations and external factors from the institutional environment. In addition, to better understand opportunities associated with alternative governance arrangements, which have been available for implementation since 2004, this study aimed to understand if either a regional district or watershed agency can promote sustainable outcomes through improved efficiency.

The research presented in this dissertation provided an analysis of the water regime in British Columbia to answer the following question: How does the current water regime in British Columbia support sustainability and how can alternative governance arrangements help? This question was broken down into six questions:

1. Why and how have water institutions changed in British Columbia?
2. How efficient is the current arrangement?
3. How effective are alternative arrangements perceived compared to the current arrangement?
4. Why and how are transaction costs perceived to change under an alternative governance arrangement?
5. Do these perceptions influence why alternative governance arrangements have not been implemented?
6. How do the perceived transaction costs under a watershed arrangement in the Okanagan basin compare to the rest of the province?

To answer these questions, I carried out an examination of the water regime in British Columbia from 1859 to 2016 to identify if the regime typology is headed towards integration and associated sustainable outcomes. This was followed by further analysis on the water regime within the water rights system and detailed analysis of alternative governance arrangements. Because alternative governance arrangements are restricted in their powers to only water use decisions, the analytical approach is limited to the coherence of the organizational structure as defined by the coordination between actors for all activities related to decision making. To analyze prospects for institutional change (and more sustainable policies), I applied a transaction cost economics approach to compare the perceived costs of a regional district arrangement and a watershed agency arrangement to the current arrangement. Then, I analyzed the results of perceived transaction costs for a watershed arrangement to identify if there is a significant difference between participants in the Okanagan region compared to the rest of the province. This chapter provides a summary of the study, key findings, limitations, and future research.

6.2 Summary of results

6.2.1 Examination of water governance reform in British Columbia

Chapter 3 examined the British Columbia water regime from 1859 to 2016 to identify if changes are heading in a direction that enables integrated resource governance and in turn the promotion of sustainable resource use. It examined these changes using the institutional resource regime framework, considering both the extent and coherence of the property rights system and public policies. An expansion of the framework was developed to include factors from the institutional environment including related resources. The analysis identified four main phases of regime change and the transition of regime typology from simple to complex.

The *first* phase (1859-1909) is considered simple due to limited extent over water use rights and protection policies. In addition, jurisdiction over water was shared between the provincial and federal governments creating incoherencies in the properties rights system. The *second* phase (1909-1970) is also considered simple due to continued low extent and low external coherence. However, during this phase, an increase in coherence within the property rights system and public policies provided clearer use rights and alignment between jurisdictions. Significant developments during this phase include provincial jurisdiction over water ownership, the establishment of a single central agency for water authorizations, the development of a standard unit of water measurement and revisions to use quotas based on data collected by the Board of Investigation when transferring records to licences. However, protection policies remained limited to pollution control and stream obstructions to protect fisheries. The *third* phase (1970-2010) is considered complex due to an increase in competition over limited water resources, the affirmation of Aboriginal rights and title, decentralization of water authorizations and major developments in public policies as environmental issues became paramount. Specifically, federal government provisions to improve water science and information provided resources to begin understanding resource yield quotas, although much of this support was disbanded by the beginning of 2000 and failed to be picked up by the provincial government. Nevertheless, these changes resulted in an increase in extent and coherence within public policies, but incoherencies within the property rights system. The *fourth* phase (2010-2016) is also considered complex due to high extent from the expansion of water use rights over groundwater sources and medium to high coherence. Specifically, the extension of water authorizations to the Oil and Gas Commission brought additional division to an already fragmented organizational structure.

However, opportunities under the Water Sustainability Act (2014) provided the start of an integrated regime with the introduction of environmental flow needs, sensitive stream designations, consideration of water for ecological function in the assessment of water authorizations, and provisions for thirty-year review of existing license terms and conditions. Moreover, the new Water Sustainability Act (2014) may provide additional coherence through the establishment of advisory boards to provide expert advice, the development of water objectives to protect water resources (both quality and availability), alternative governance arrangements to share decision making powers, and water sustainability plans to resolve conflicts.

Overall, the property rights system and public policies have both developed over time to expand the scope of the water regime to include most uses and to become more coherent. However, the main hinderance of becoming an integrated regime remains from gaps and incoherencies in water regulations from Aboriginal rights and title to water, jurisdictional and organizational fragmentation and the absence of a defined water yield quotas and water quotas.

6.2.2 Evaluation of alternative governance arrangements

Chapter 4 provided further analysis on the water regime within the water rights system along with opportunities for alternative governance arrangements to understand how they impact coherence within the water rights system. Specifically, this chapter examined participant perceptions on the efficiency of the current arrangement, effectiveness of the current and alternative arrangements, readiness and limitations to change, and transaction costs of alternative arrangements. Alternative arrangements included 1) a regional district arrangement, and 2) a

watershed agency arrangement under two scenarios. The first scenario involved the delegation of information, decision making and enforcement activities. The second scenario involved only the delegation of decision making activities. The analysis revealed that an alternative arrangement is not perceived to provide efficiency benefits and therefore would not contribute to the integration of British Columbia's water regime through improved coherence.

In terms of efficiency, the analysis revealed that the current arrangement is perceived somewhat inefficient. Factors impacting efficiency in a positive manner were identified in relation to improved data management systems at the provincial level and the ability of officers to enforce multiple regulations, taking advantage of other regulations to resolve violations without appeals. However, factors impacting efficiency in a negative way were identified in relation to consultation and accommodation with First Nations, lack of information, illogical and poorly understood relationships between natural resource regulations, lack of funding, and complex coordination. In addition, participants noted concerns from a reduction in data collection over the years, reliance on applicants to collect data, lack of water accounting, the division of powers between organizations, lack of expert knowledge, insufficient fines, and lack of clarity.

In terms of effectiveness, the analysis revealed that the current arrangement is considered effective in its ability to achieve sustainability. However, a watershed agency is perceived to be more effective than the current arrangement. Participants noted opportunities associated with alternative arrangements related to the collection of additional water data and effective monitoring compliance and enforcement. However, two participants noted challenges associated with identifying how things would compare to the current arrangement given that the current

arrangement is not optimized due to lack of funding. In addition, participants somewhat agree that current options are limited and revealed that options were limited due to public pressure during the water act modernization process, particularly around water markets. Moreover, to improve the overall effectiveness of the water regime, one participant noted that a single organization responsible for all water goods and services is needed and would improve the current state of lack of accountability resulting from the number of organizations involved, continued delegation of responsibilities to professionals and illogical relationships between resource regulations.

In terms of readiness for change, the analysis revealed that organizational members were less likely to initiate change. However, members were also not likely to resist change. Limitations from within organizations were noted from other commitments in the Water Sustainability Act and resulting staff capacity. In regard to limitations from outside the organization, data revealed that change is limited by socio-political pressures. Moreover, correlation of participant response to overall efficiency and satisfying level of efficiency suggests that participants are not satisfied with an inefficient system and that alternative arrangements are not limited by participants' satisfying level of efficiency.

In term of alternative governance arrangements, perceived transaction costs compared to the current arrangement were higher for both a regional district and watershed agency arrangement under both scenarios. For the first scenario, the data revealed that information transaction costs under both arrangements are expected to be higher with a regional district arrangement costing more. Decision making transaction costs under both arrangements are also expected to be higher

with, again, a regional district costing more. For enforcement transaction costs, the data revealed that both arrangements costs are expected to be higher by the same amount. For the second scenario, the data revealed that coordinating information would cost more for both arrangements compared to the current arrangement. Decision costs would be the same as the first scenario where both arrangements are also expected to be higher with a regional district costing more. A watershed agency is perceived to cost the same for planning activities but more for issuing authorizations, reviewing authorizations, dealing with problems and water accounting when compared to the current arrangement. Where a regional district arrangement is expected to cost more for all activities when compared to the current arrangement.

6.2.3 Okanagan Basin comparison

Chapter 5 examined the perceived transaction costs of a watershed agency with delegated authorizations activities in the Okanagan Basin compared to the rest of the province. The Okanagan watershed is often referred to by both government officials and researchers as an opportunity for the implementation of a delegated approach at the watershed scale, particularly because of the presence of the Okanagan Basin Water Board. However, to understand if responses from the Okanagan region different from other regions in regard to a watershed agency's ability to improve efficiency, this chapter further analyzed the perceived transactions cost of a watershed agency arrangement based on participant region and identified implications on the current services provided by the Okanagan Basin Water Board.

Overall, the data revealed that participants located in the Okanagan region ranked similar to participants from other regions with the exception of two variables. Participants that work in the

Okanagan region were more likely to agree that water is scarce and also more likely to agree that a watershed arrangement would be more effective than the current arrangement in achieving sustainability.

Furthermore, the data identified that the benefits provided by the OBWB throughout the basin would be put at risk under a watershed arrangement. These benefits include providing shared knowledge, support for First Nation representatives and government officials to come together, efficient collaboration, and information management. In addition, the regulatory role was identified as being more appropriate with senior governments. Concerns were identified in relation to hindered collaboration with First Nations, ad-hoc administration of enforcement activities and corruption at the local level.

6.3 Key research findings

The results of phase 2, 3 and 4, collectively reveal that although the new Water Sustainability Act provides additional extent and coherence, both within the institutional water regime and between the institutional water regime and institutional environment, the water regime continues to fall short in achieving an integrated status. Limitations include incomplete Aboriginal rights and title to water, jurisdictional and organizational fragmentation and undefined water yield quotas and water quotas. Moreover, until opportunities under the Water Sustainability Act are fully implemented, additional incoherencies will remain.

First, incomplete Aboriginal rights and title to water represent a major shortcoming in the current water regime. Phase 2 revealed that recent legal proceedings and Federal legislative changes

have recognized Aboriginal rights and title to water resulting in the provincial government committing to consultation and accommodation with First Nations prior to the issuance of water authorizations. However, this does not align with the Assembly of First Nations National Water Declaration (2012) that states First Nations have inherent water rights, including the right to manage and govern water. To reduce tensions, the Provincial government has also committed to new relationships with First Nations, such as the Nicola watershed pilot memorandum of understanding with Nicola First Nations in 2018 where decision making is shared between the provincial government and Nicola First Nations. While the Nicola watershed pilot is the only one of its kind in British Columbia, potential benefits of shared decision making include more equitable and more efficient governance (Armitage et al., 2007). Perhaps potential efficiency benefits can help overcome current inefficiency resulting from the duty to consult and accommodate with First Nations identified in phase 3. Phase 4 also revealed that non-government organizations also have the ability to influence the institutional resource regime. Specifically, the OBWB provides support to overcome limitations of the consultation and accommodation process by bringing First Nation and government officials together and enabling the inclusion of First Nations in more than just authorizations. Nevertheless, although the opportunity for shared decision making has been initiated by the Provincial government and First Nation inclusion beyond consultation and accommodation of water authorizations has occurred in the Okanagan basin, the water regime fails to formally recognize Aboriginal rights and title to water.

Second, the division of powers and responsibilities between and within both federal and provincial governments has created a complex arrangement of regulations and organizational

structures. Specifically, phase 2 revealed jurisdictional and organizational fragmentation from the distribution of water protection policies between federal and provincial organizations and decision making for water use rights between three organizations (water authorizations reside with the Ministry of Forests, Lands, Natural Resource Operations and Rural Development, and the Oil and Gas Commissions; and waste discharge authorizations reside with the Ministry of Environment and Climate Change Strategy). Gaps were also identified in the institutional water regime including lack of regulations around recreational, cultural, conservation, views, and flood control, along with water use right exemptions for unrecorded water, exploration uses, short term uses, and deep well sources, and public policy exemptions for waste absorption uses. In addition, interplay between the water institutional regime and relate resources to address cumulative impacts on water quality, quantity and availability remain limited to water quality regulations for ecological function and water availability for drinking water sources. Phase 3 supported these findings revealing that the current arrangement is somewhat inefficient for all information, decision making and enforcement variables. Furthermore, it was revealed that relationships between provincial Natural Resource statutes are illogical and poorly understood, there is a lack of expert knowledge amongst decision makers, the division of powers and responsibilities has resulted in complex coordination, and the overlapping of responsibilities has resulted in a lack of accountability. However, the Water Sustainability Act (2014) does allow for the establishment of advisory boards to provide expert advice and support the development of water objectives including regulations for a designated watershed, stream, aquifer or area for the protection of water quality, quantity and water availability by requiring a public officer, regional district, municipality, local trust committee or prescribed person to consider water objectives when making decisions that relate to the watershed, stream, aquifer, or area. Therefore, water quality

objectives provide an opportunity to address limitations from gaps in the current regime in relation to related resources, recreation, waste absorption, cultural uses, views, and domestic uses. However, waste absorption permits would continue to reside under the Ministry of Environment and Climate Change Strategy and it is unclear how water objectives would coordinate with the Environmental Management Act and associated regulations including existing liquid waste management plans. Furthermore, gaps would continue to exist around flood control, a concern identified by one participant due to the number of administrative decision makers involved, lack of funding and reliance on professional advice. In addition, the establishment of advisory boards and development of water objectives would require additional resources, however, phase 3 revealed existing concerns around proper funding to carry out commitments in the Water Sustainability Act (2014).

Third, without a defined global water quota, or quotas in the event of climate change, the amount of water available for use remains unknown and individual use quotas will remain at risk to overallocation. Phase 2 revealed past efforts to identify additional water allocation restrictions have not always succeeded resulting in the overallocation of water resources. To overcome overallocations, the Water Sustainability Act introduced water licence reviews and amendments after 30 years without compensation. However, phase 3 revealed that there is a current lack of data collection and without data to identify how much water is available (water yield quota) and how much water is available for allocation (global water quota) to ensure water for all goods and services, the opportunity for reallocations to ensure water sustainability will be futile. Phase 3 also revealed opportunities associated with a watershed arrangement specifically include improved water accounting at the watershed scale, improved monitoring and improved

accountability. These opportunities were not associated with a regional district arrangement as participants identified that it would be challenging to coordinate information and hold anyone accountable across boundaries. Moreover, if information and enforcement activities were also delegated to an alternative arrangement, opportunities identified included additional water data collection and more effective monitoring compliance and enforcement through dedicated staff. However, concerns associated with the delegation of information and enforcement activities were also identified and include oversight required to ensure quality data and inability to use other regulations to resolve violations without appeals. Furthermore, phase 4 revealed that the OBWB is able to support and develop solutions to science and information gaps in the Okanagan basin highlighting improved extent within the regime from the institutional environment.

Finally, in regard to the efficiency of alternative governance arrangements, phase 3 revealed that a regional district and a watershed agency are not perceived to provide additional efficiencies within the water rights system. Even when information and enforcement responsibilities are delegated (in an attempt to improve coordination of all water authorization activities), the results maintained that a regional district and a watershed agency do not provide additional efficiencies. In addition, phase 3 revealed that a watershed agency arrangement is perceived to be more effective in achieving sustainable outcomes. However, further analysis of survey results in phase 4 identified that participants from the Okanagan were more likely to agree that a watershed agency would be more effective than participants from other regions. Specifically, participants from other regions were more likely to respond neutral. Whether this is a result of the OBWB is unknown, however, the difference in responses is worth noting. Moreover, phase 3 revealed that 79% of participants agreed that change is limited by socio-political pressures.

Overall, British Columbia's water regime Water Sustainability Act (2014) provides opportunities to develop the start of an integrated water regime through additional extent and coherence in the water regime. However, its potential remains limited due to lack of funding, socio-political pressures and without a defined water yield quotas and water quotas, British Columbia's water resources will remain at risk to overallocation. In addition, the water regime fails to address regulatory gaps around flood protection, fails to address jurisdictional and organizational fragmentation around waste absorption uses and water allocation, and fails to recognize Aboriginal rights and title to water. In regard to alternative governance arrangements, both a regional district and a watershed agency alternative governance arrangement are perceived to be less efficient than the current arrangement. And although most respondents agreed that a watershed agency arrangement would be more effective at ensuring a sustainable supply of fresh, clean water that meets the needs of British Columbia residents today and into the future, including improved water science and information, accountability and enforcement, many of these opportunities were also identified from the presence of the OBWB watershed group in the Okanagan basin. Moreover, a watershed agency arrangement in the Okanagan basin through the OBWB was considered to have potential negative impacts on the success of the OBWB and introduce risks from corruption at the local level. Therefore, although alternative governance arrangements at the regional district and watershed scale have been promoted by others, their ability to promote sustainable resource use through improved coherence were not warranted in this study.

6.4 Limitations

While Case studies are considered an appropriate method for descriptive, exploratory or explanatory research (Yin, 2014), results from case studies are subject to limitations. First, the amount of data derived from case study research can result in important observations being omitted and, in addition, can make the analysis difficult to summarize, especially when the situation being examined is complex (Hodkinson & Hodkinson, 2001). Second, numeric representation of qualitative case study research can be difficult due to a lack of precision (Hodkinson & Hodkinson, 2001). Still, many researchers attempt to quantify their results which can lead to undermining of the phenomenon under examination. Third, samples tend to be “small and idiosyncratic, and because data is predominantly non-numerical, there is no way to establish the probability that data is representative of some larger population” (Hodkinson & Hodkinson, 2001, p. 10). The final limitation of case study research relates to the researcher and how they make judgements about the research including the formulation of questions and what to observe (Hodkinson & Hodkinson, 2001). As such, “researcher expertise, knowledge and intuition is a vital part of the case study approach” (Hodkinson & Hodkinson, 2001, p. 10). To strengthen the study, multiple sources of evidence were used to triangulate data and protect the study against bias (Yin, 2014).

Another limitation of the study arises from the implicit comparison of transaction costs. Because the study aimed to identify transaction costs associated with alternative arrangements that have not yet been implemented, no actual measurement of transaction costs could take place. Instead, the analysis was limited to the perception of differences in transaction costs for each activity compared to the current arrangement. This is consistent with other studies where the perception

of transaction costs from informed persons who are familiar with transaction cost trends and sources were applied (Brown & Potoski, 2005; Lawson, 2009). Furthermore, Lawson (2009) notes “clearly, it is futile to attempt any detailed measurement of net transaction costs per dollar of aid. Nevertheless, there is probably some value in assessing the perceptions of transaction costs across different resource persons and triangulating these observations in order to get a sense of overall trends” (p. 17). As such, study participants were limited to individuals with detailed knowledge on transaction cost trends and sources. This reduced the number of participants that could take part in the study introducing another limitation.

There is no specified number of participants required for a study since the number of participants is dependent on the research design (Creswell, 2014). However, Creswell (2014) identifies a range of participants for narrative research (one to two participants), phenomenology (three to ten participants) and grounded theory (twenty to thirty participants). While Charmaz (2006) supports the idea of saturation where the researcher continues to collect data until no new insights or properties are presented. To overcome limitations from small sample size in phase 3, qualitative data was collected in the survey with 36 participants to identify themes and patterns. Interviews were then conducted until saturation was achieved. In phase 4, analysis was subject to limitations from a single key informant. However, with only six staff on the OBWB, of which two are dedicated to communications and watermilfoil control, the single key informant interviewee was considered acceptable. Nevertheless, to overcome this potential bias, findings were confirmed, where possible, with documentary information (Yin, 2014).

6.5 Further research

The results of this study have important implications for practice and theory. In terms of practice, the study offers two important findings. First, although the Water Sustainability Act provides opportunities to develop the start of an integrated water regime, without a defined water yield quota and global water quota, British Columbia's water resources will remain at risk to overallocation. In addition, the Water Sustainability Act fails to address regulatory gaps around flood protection, jurisdictional and organizational fragmentation around waste absorption uses and issuance of water use authorizations and Aboriginal rights and title to water. Second, regional district and watershed agency alternative governance arrangements are perceived to be less efficient than the current arrangement. Moreover, a watershed agency arrangement in the Okanagan Basin through the OBWB would negatively impact the success of the OBWB and could introduce risks from corruption at the local level.

In the case of alternative water arrangements in British Columbia, although the data revealed that a regional district and watershed agency alternative arrangement are perceived less efficient than the current arrangement, it does not mean that the additional costs would not be worth the benefits. One participant suggested that a trade-off between cost and additional benefits would be something worth looking at. Although this study revealed possible benefits of an alternative arrangement, it was not a focus of the study and any benefits are considered assumed.

Nevertheless, improved methods for predicting and verifying benefits would enable research on policy options to include a cost-benefits analysis.

Furthermore, when the Province proposed alternative arrangements in 2009, options were typically separated into arrangements that enabled shared decision making or arrangements that delegated decision making to a watershed agency. However, there is no reason why both cannot take place together. Phare, Simms, Brandes and Miltenberger (2017) published a report on watershed co-governance highlighting opportunities for collaborative consent at the watershed scale. This was ultimately the approach taken with the recent Nicola watershed pilot memorandum of understanding. This could mean that alternative governance arrangements might look quite different than originally anticipated and include a range of approaches such as: 1) a shared approach at the current scale; 2) a shared approach at the watershed scale; or 3) a delegated shared approach at the watershed scale. However, First Nation traditional territories do not follow watershed boundaries and water-centric approaches at the watershed scale continue to fall short in achieving intended outcomes (Molle, 2009). Moreover, the study revealed that alternative options were considered limited. Therefore, further research on alternative options and appropriate scales for alternative governance arrangements is needed. Perhaps even considering broader natural and social factors including coordination between decision makers of related resources.

This study also provides important implications for the development of the institutional resource regime framework and transaction cost economics. This study reveals that factors outside of the institutional resource regime can affect the extent and coherence of the resource regime. It also provides empirical application of transaction cost economics to evaluate policy options through the comparison of implicit transaction costs of alternative arrangements. Moreover, the approach

to institutional analysis and design in this study provides a conceptual framework for other researchers who want to examine resource regimes in the real-world action arena.

Nevertheless, this approach will benefit from further theoretical work. Particularly since factors may only be relevant in certain situations. For example, the OBWB is a unique watershed organization that has powers to tax residents and businesses in the basin to gain funding to support its programs. Therefore, ability of other watershed organizations to influence the extent and coherence of the water regime might not be the case.

In addition, further empirical research is needed to confirm findings on the efficiency of a regional district and watershed agency alternative arrangements. First, implicit transaction cost evaluations before reform has taken place is limited from a single source of evidence, whereas post-reform analysis can use multiple sources of evidence to support perceptions. To improve transaction cost measurement techniques pre-reform, I originally hoped to compare the results from this study with transaction cost measurements post reform. However, given other commitments in the Water Sustainability Act that have resulted in additional outputs, marginal transaction costs would need to be considered.

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Appendices

Appendix A Interview questions

The following questions guided interviews to enable open-ended discussions with interviewees.

- My research is on the evaluation of alternative water governance arrangements throughout British Columbia. The reason for this research builds on recent advancements in the new *Water Sustainability Act* that allows for alternative governance arrangements that are commonly associated with higher performance in diverse contexts through better adaption to changing conditions, customized rules that meet local needs and a sense of trust among stakeholders. To better understand what type of alternative arrangement would be successful, this research aims to assist with identifying what arrangement would be most efficient and what factors could be limiting efficiency. I'm hoping that this research can help the Province identify if an alternative arrangement can help achieve the goals of the Water Sustainability Act. I would like to know your opinion on different arrangements, how they may impact information, coordination and enforcement activities, and synergies and constraints between resource legislation is important.
- May I interview you as part of my research?
- May I audio-record this interview?
- What is your role?
- In your opinion, are alternative governance arrangements needed?
- How could alternative arrangements help solve some of the issues around water in British Columbia?

- In your opinion, what would be the best arrangement?
- In your opinion, are alternative arrangements constrained by sociopolitical legitimate designs?
- In your opinion, is efficiency seeking a good thing?

The following questions guided interviews to obtain specific information on different aspects of the research.

ACCOUNTABILITY AND TRUST

- How would the government ensure accountability under an alternative arrangement?
- Do you trust other organizations to govern water?

INSTITUTIONAL LINKAGES AND CONSTRAINTS

- Do the existing division of legal responsibility favor an integrated treatment of water planning? How?
- Do legal linkages between oil and gas and water complement each other to improve efficiency? How?
- Do legal linkages between mining and water complement each other to improve efficiency? How?
- Do legal linkages between forestry and water complement each other to improve efficiency? How?
- Do legal linkages between the environment and water complement each other to improve efficiency? How?
- Do Federal water institutions complement each other to improve efficiency? How?

TRANSACTION COSTS (OPERATIONAL INTERVIEWEES)

- How does your organization manage information including science and information systems, monitoring arrangements and public participation?
- How much does it cost to manage information?
- How will information management change under an alternative arrangement?
- How does your organization coordinate with other organizations?
- How do you think coordination costs will change under an alternative arrangement?
- How does your organization ensure water regulatory compliance?
- How much does it cost to enforce?
- How do you think enforcement costs would change under an alternative arrangement?

WSA Alternative Governance Arrangements

Start of Block: Welcome

Q1 This study is part of a thesis being completed by Angela Lockrey Mawdsley, a PhD candidate in the Department of Forest Resources Management, Faculty of Forestry, University of British Columbia (UBC) under the supervision of Dr. Harry Nelson. The thesis is on the evaluation of alternative water governance arrangements throughout British Columbia and your opinion on the costs of different arrangements is important as it can allow the comparison of existing arrangements to theoretical arrangements to identify which type is most efficient. Your participation is voluntary and will involve completing a survey that will take approximately 30 minutes. This survey will include questions regarding the evaluation of transaction costs and constraints associated with two alternative governance arrangements in British Columbia. For the theoretical alternative arrangement being investigated, you will be asked to estimate how costs may change compared to the current arrangement. In order to estimate the needs associated with the different arrangements, I will be asking questions about information, coordination and enforcement activities. There are no right or wrong answers to any of the questions and the questionnaire is not a test. You do not have to answer any questions you feel uncomfortable answering and you can end the survey at any time with no repercussions. Your confidentiality will be respected. Original data collected in this study will be examined by the research team members only. Although limited identifying information will

be collected, identifying information will be removed and encrypted and password protected, accessible only to the research team for five (5) years. Any hard copies of study materials will be securely kept in a locked filing cabinet at UBC only accessible to the research team for five (5) years at which time all material will be shredded and discarded. The results of this study will be reported in a graduate thesis and may also be published in journal articles and books. At the time of publication, the researcher may be required to make data publicly available. Any data made available and publications on the results of this study will use anonymous identities. This will be done by changing the name and disguising any details of the interview which may reveal an identity or the identity of people discussed. Your informed consent is required before participating. If you require more information on the study please contact Angela at [REDACTED]. By completing or partially completing this questionnaire you are consenting to participate in this research. If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598.

End of Block: Welcome

Start of Block: Section 1: Respondents Background

Q2 What organization do you work for?

Q3 What is your current position?

Q4 How would you describe what you do?

Q5 What region(s) do you work in?

Cariboo (1)

Kootenay/Boundary (2)

Northeast (3)

Omineca (4)

Thompson/Okanagan (5)

Skeena (6)

South Coast (7)

West Coast (8)



Q6 In your opinion, the Provincial government should have power over water resources.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q7 In your opinion, you are proud of the way the Provincial government has governed water resources in the past.

- Strongly agree (1)
- Somewhat agree (2)
- Neither agree nor disagree (3)
- Somewhat disagree (4)
- Strongly disagree (5)

Q8 In your opinion, respect for authority is something all people need to learn.

- Strongly agree (1)
- Somewhat agree (2)
- Neither agree nor disagree (3)
- Somewhat disagree (4)
- Strongly disagree (5)

End of Block: Section 1: Respondents Background

Start of Block: Section 2: Resource Environment

Q9 The following questions are related to access to water and resources in the region you work in.

Q10 Water is scarce.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q11 There is sufficient access to water for:

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)
Domestic use (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wildlife (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cultural purposes (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Economic purposes (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hydro electricity (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q12 What are the top three resources for economic development.

- Forestry (1)
- Range activities (2)
- Mining (3)
- Oil and gas (4)
- Agriculture (5)
- Recreation and tourism (6)

End of Block: Section 2: Resource Environment

Start of Block: Section 3: Transaction Costs

Q13 The following section involves the consideration of costs associated with two alternative governance arrangements. When considering costs, it is important to consider how costs may change to carry out activities as they relate to how things are done currently. Costs to carry out these activities may change under an alternative arrangement due to factors such as frequency, uncertainty and asset specificity. For example, under an alternative arrangement, it may take

more time to coordinate with another organization when developing plans. Alternatively, collecting information may be more efficient as the alternative arrangement may take advantage of existing field operations. The survey is intended to isolate activities for comparison. Any additional activities you feel are important may be identified at the end of each section or at the end of the survey.

The two alternative arrangements that have been broadly discussed amongst water practitioners are: 1. Regional District; and 2. Watershed Agency. Regional District: A Regional district arrangement would identify an existing jurisdiction boundary such as the Cowichan Valley Regional District. A Regional district may cross watershed boundaries and other operational scales.

Watershed Agency: A watershed agency arrangement would require the identification of a watershed unit such as the Okanagan Basin. This may be a surface watershed unit or a below ground watershed unit which may cross Regional District boundaries and other operational scales.

Although additional governance arrangements may be possible, this survey is interested in understanding potential differences in costs between the existing arrangement and the two proposed alternative arrangements. This survey is also restricted to measuring static transaction costs and does not consider dynamic costs of transitioning to alternative arrangements (such as setting up an alternative arrangement, acquiring operational assets, establishing data protocols, or future costs to transition to another arrangement). When answering please do not include

dynamic costs, they will be identified in interviews. If you would like to be interviewed, please contact me at iamangie@mail.ubc.ca

Q14 Overall, the status quo in water governance will ensure a sustainable supply of fresh, clean water that meets the needs of B.C. residents today and in the future.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q15 A regional district arrangement would be more effective at ensuring a sustainable supply of fresh, clean water that meets the needs of B.C. residents today and in the future.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q16 A watershed agency arrangement would be more effective at ensuring a sustainable supply of fresh, clean water that meets the needs of B.C. residents today and into the future.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q17 Change is needed but acceptable options are limiting.

- Strongly agree (1)
- Somewhat agree (2)
- Neither agree nor disagree (3)
- Somewhat disagree (4)
- Strongly disagree (5)

Q18 Current water laws are synergetic (or integrated) with other laws related to land, forest and environment.

- Strongly agree (1)
- Somewhat agree (2)
- Neither agree nor disagree (3)
- Somewhat disagree (4)
- Strongly disagree (5)

Q19 The following questions relate to information costs.

Costs associated with information include activities and technologies associated with collecting information, searching for information and communicating information such as science and information systems, monitoring arrangements, and public participation.

Q20 The current Provincial water monitoring arrangement is efficient.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q21 The current Provincial system for communicating water science is efficient.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q22 The current Provincial system for public participation in water is efficient.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q23 The current Provincial system for understanding resources that are interconnected is efficient.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q24 Does your organization collect water data in the field (such as rainfall, groundwater, streamflow, etc.)?

- Yes (1)
 - No (2)
-

Q25 Does your organization collect other data in the field?

Yes (1)

No (2)

Q26 Does your organization use water data collected by other organizations?

Yes (1)

No (2)

Q27 Considering costs associated with collecting water data in the field:

Q28 How would costs change under a regional district arrangement where the regional district is responsible for collecting water data?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q29 How would costs change under a watershed arrangement where the watershed agency is responsible for collecting water data?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q30 Considering costs associated with ensuring data quality:

Q31 How would costs change under a regional district arrangement where the regional district is responsible for data quality?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q32 How would costs change under a watershed arrangement where the watershed agency is responsible for data quality?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q33 Considering costs associated with managing information systems (such as maintaining, housing and communicating data platforms):

Q34 How would costs change under a regional district arrangement where the regional district is responsible for managing information systems?

Much higher (1)

Moderately higher (2)

Slightly higher (3)

About the same (4)

Slightly lower (5)

Moderately lower (6)

Much lower (7)

Q35 How would costs change under a watershed arrangement where the watershed agency is responsible for managing information systems?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q36 Considering costs associated with public participation:

Q37 How would costs change under a regional district arrangement where the regional district is responsible for identifying local expectations?

Much higher (1)

Moderately higher (2)

Slightly higher (3)

About the same (4)

Slightly lower (5)

Moderately lower (6)

Much lower (7)

Q38 How would costs change under a watershed arrangement where the watershed agency is responsible for identifying local expectations?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q39 Considering costs associated with acquiring information on interconnected resources:

Q40 How would costs change under a regional district arrangement where the regional district is responsible for acquiring information on interconnected resources?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q41 How would costs change under a watershed arrangement where the watershed agency is responsible for acquiring information on interconnected resources?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q42 Assuming the Provincial government would retain responsibility for providing science and information systems and monitoring arrangements and only decision making is delegated to an alternative arrangement.

Considering costs associated with acquiring information from Provincial and Federal governments:

Q43 How would costs change under a regional district arrangement?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q44 How would costs change under a watershed arrangement?

- Much higher (1)
- Moderately higher (2)
- Slightly higher (3)
- About the same (4)
- Slightly lower (5)
- Moderately lower (6)
- Much lower (7)

Q45 Why might information costs be more or less under an alternative arrangement?

Q46 The following questions relate to coordination costs

Costs associated with coordination include time spent negotiating agreements, in meetings and

communicating. These cost may be impact by many factors including organizational arrangements, scales, power distribution and conflicting rules and policies.

Q47 The current system for administrative coordination between water organizations is efficient.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q48 The current system for administrative coordination between integrated resource organizations is efficient.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q49 The current legal provisions for co-ordination mechanisms are efficient.

- Strongly agree (1)
- Somewhat agree (2)
- Neither agree nor disagree (3)
- Somewhat disagree (4)
- Strongly disagree (5)

Q50 The current provincial system for authorizing water licenses and approvals is efficient.

- Strongly agree (1)
- Somewhat agree (2)
- Neither agree nor disagree (3)
- Somewhat disagree (4)
- Strongly disagree (5)

Q51 Considering costs associated with planning activities:

Q52 How would costs change under a regional district arrangement where the regional district is responsible for planning?

- Much higher (1)
 - Slightly higher (2)
 - About the same (3)
 - Slightly lower (4)
 - Much lower (5)
-

Q53 How would costs change under a watershed arrangement where the watershed agency is responsible for planning?

- Much higher (1)
- Moderately higher (2)
- Slightly higher (3)
- About the same (4)
- Slightly lower (5)
- Moderately lower (6)
- Much lower (7)

Q54 Considering costs associated with authorizing water licenses and approvals:

Q55 How would costs change under a regional district arrangement where the regional district is responsible for water authorizations?

Much higher (1)

Moderately higher (2)

Slightly higher (3)

About the same (4)

Slightly lower (5)

Moderately lower (6)

Much lower (7)

Q56 How would costs change under a watershed arrangement where the watershed agency is responsible for water authorizations?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q57 Considering costs associated with reviewing existing plans and allocations:

Q58 How would costs change under a regional district arrangement where the regional district is responsible for reviewing plans and allocations?

Much higher (1)

Moderately higher (2)

Slightly higher (3)

About the same (4)

Slightly lower (5)

Moderately lower (6)

Much lower (7)

Q59 How would costs change under a watershed arrangement where the watershed agency is responsible for reviewing plans and allocations?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q60 Considering costs associated with dealing with problems :

Q61 How would costs change under a regional district arrangement where the regional district is responsible for dealing with problems?

Much higher (1)

Moderately higher (2)

Slightly higher (3)

About the same (4)

Slightly lower (5)

Moderately lower (6)

Much lower (7)

Q62 How would costs change under a watershed arrangement where the watershed agency is responsible for dealing with problems?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q63 Considering costs associated with participating in continuous sharing and accounting of water assets:

Q64 How would costs change under a regional district arrangement where the regional district is responsible for water accounting?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q65 How would costs change under a watershed arrangement where the watershed agency is responsible for water accounting?

- Much higher (1)
- Moderately higher (2)
- Slightly higher (3)
- About the same (4)
- Slightly lower (5)
- Moderately lower (6)
- Much lower (7)

Q66 Why might coordination costs be more or less under an alternative arrangement?

Q67 The following questions relate to enforcement costs

Costs associated with enforcements include the measurement, enforcement and policing of rules.

Q68 The current Provincial system for water regulatory compliance is efficient.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q69 The current legal provisions for conflict resolution mechanisms are efficient.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q70 Does your organization monitor for water regulatory compliance?

- Yes (1)
 - No (2)
-

Q71 Does your organization monitor for other regulatory compliance?

Yes (1)

No (2)

Q72 Does your organization enforce water regulatory compliance?

Yes (1)

No (2)

Q73 Considering costs associated with monitoring compliance:

Q74 How would costs change under a regional district arrangement where the regional district is responsible for monitoring for compliance?

Much higher (1)

Moderately higher (2)

Slightly higher (3)

About the same (4)

Slightly lower (5)

Moderately lower (6)

Much lower (7)

Q75 How would costs change under a watershed arrangement where the watershed is responsible for monitoring for compliance?

- Much higher (1)
- Moderately higher (2)
- Slightly higher (3)
- About the same (4)
- Slightly lower (5)
- Moderately lower (6)
- Much lower (7)

Q76 Considering costs associated with enforcement of regulations:

Q77 How would costs change under a regional district arrangement where the regional district is responsible for enforcement?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q78 How would costs change under a watershed arrangement where the watershed is responsible for enforcement?

- Much higher (1)
 - Moderately higher (2)
 - Slightly higher (3)
 - About the same (4)
 - Slightly lower (5)
 - Moderately lower (6)
 - Much lower (7)
-

Q79 Assuming the Provincial and Federal governments would retain responsibilities for enforcement activities and only decision making is delegated to an alternative arrangement.

Considering costs associated with communicating enforcement activities from Provincial and Federal governments:

Q80 How would costs change under a regional district arrangement?

Much higher (1)

Moderately higher (2)

Slightly higher (3)

About the same (4)

Slightly lower (5)

Moderately lower (6)

Much lower (7)

Q81 How would costs change under a watershed arrangement?

- Much higher (1)
- Moderately higher (2)
- Slightly higher (3)
- About the same (4)
- Slightly lower (5)
- Moderately lower (6)
- Much lower (7)

Q82 Why might enforcement costs be more or less under an alternative arrangement?

End of Block: Section 3: Transaction Costs

Start of Block: Section 4: Institutional Environment and Constraints

Q83 The following questions relate to your organization's readiness for alternative governance arrangements.

Q84 We are committed to exploring new ways of achieving our goals.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q85 We are operating at a satisfactory level of efficiency.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q86 We are limited in how we do things by socio-political pressures.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q87 Organizational members value the opportunity for alternative governance arrangements.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q88 We know what it will take to implement an alternative governance arrangement.

- Strongly agree (1)
- Somewhat agree (2)
- Neither agree nor disagree (3)
- Somewhat disagree (4)
- Strongly disagree (5)

Q89 We have the resources to implement an alternative governance arrangement.

- Strongly agree (1)
 - Somewhat agree (2)
 - Neither agree nor disagree (3)
 - Somewhat disagree (4)
 - Strongly disagree (5)
-

Q90 We can implement an alternative governance arrangement effectively given our current situation.

- Strongly agree (1)
- Somewhat agree (2)
- Neither agree nor disagree (3)
- Somewhat disagree (4)
- Strongly disagree (5)

Q91 Additional comments:

End of Block: Section 4: Institutional Environment and Constraints

Appendix C Results of statistical analysis of alternative arrangements

C.1 Results of water scarcity

Table C.1a Perception of water availability

Variable	N	Frequencies (%)					Mean	Median	Mode
		SA (1)	sA (2)	N (3)	sD (4)	SD (5)			
Water is scarce	36	13.9	38.9	33.3	13.9	0.0	2.47	2.00	2
Sufficient water for domestic use	36	44.4	41.7	5.6	8.3	0.0	1.78	2.00	1
Sufficient water for wildlife	36	25.0	41.7	13.9	13.9	5.6	2.33	2.00	2
Sufficient water for cultural use (recreation & spiritual)	36	16.7	36.1	44.4	2.8	0.0	2.33	2.00	3
Sufficient water for economic use	35	8.3	63.9	22.2	5.6	0.0	2.25	2.00	3
Sufficient water for Hydro electricity use	36	13.9	52.8	25.0	8.3	0.0	2.28	2.00	3

C.2 Results of efficiency of current system

Table C.2a Efficiency of current system – information

Variable	N	Frequencies (%)					Mean	Median	Mode
		SA (1)	sA (2)	N (3)	sD (4)	SD (5)			
Monitoring	29	0.0	17.2	34.5	27.6	20.7	3.52	3.00	3
Communicating data	29	0.0	34.5	27.6	27.6	10.3	3.14	3.00	2
Public participation	29	0.0	24.1	20.7	41.4	13.8	3.45	4.00	4
Interconnected resources	28	0.0	28.6	21.4	21.4	28.6	3.50	3.50	2 ^a

a multiple modes exist. The smallest value is shown.

Table C.2b Efficiency of current system – decision making

Variable	N	Frequencies (%)					Mean	Median	Mode
		SA (1)	sA (2)	N (3)	sD (4)	SD (5)			
Efficient coordination with water actors	26	0.0	19.2	23.1	46.2	11.5	3.50	4.00	4
Efficient coordination with interconnected resource actors	26	0.0	19.2	26.9	30.8	23.1	3.58	4.00	4

Variable	N	Frequencies (%)					Mean	Median	Mode
		SA (1)	sA (2)	N (3)	sD (4)	SD (5)			
Efficient rules	26	0.0	11.5	34.6	34.6	19.2	3.62	4.00	3 ^a
Authorizations	27	3.7	25.9	11.1	48.1	11.1	3.37	4.00	4

a multiple modes exist. The smallest value is shown.

Table C.2c Efficiency of current system – enforcement

Variable	N	Frequencies (%)					Mean	Median	Mode
		SA (1)	sA (2)	N (3)	sD (4)	SD (5)			
Regulatory compliance	33	6.1	12.1	15.2	36.4	30.3	3.73	4.00	4
Resolution mechanisms	34	0.0	23.5	32.4	29.4	14.7	3.35	3.00	3

C.3 Results of institutional effectiveness (a need for change)

Table C.3a Effectiveness of current system and alternative arrangements

Variable	N	Frequencies (%)					Mean	Median	Mode
		SA (1)	A (2)	N (3)	D (4)	SD (5)			
Provincial government should have power*	36	75.0	19.4	2.8	2.8	0.0	1.33	1.00	1
Proud of provincial government*	36	2.8	30.6	27.8	25.0	13.9	3.17	3.00	2
People need to learn to respect authority*	36	11.1	50.0	36.1	2.8	0.0	2.31	2.00	2
Current system is effective	36	13.9	41.7	11.1	22.2	11.1	2.75	2.00	2
Regional district would be more effective	35	2.9	22.9	22.9	37.1	14.3	3.37	4.00	4
Watershed agency would be more effective	36	13.9	55.6	11.1	8.3	11.1	2.47	2.00	2
Options are limited	36	11.1	38.9	22.2	27.8	0.0	2.67	2.50	2
Related resource laws are integrated	36	5.6	55.6	13.9	11.1	13.9	2.72	2.00	2
Level of efficiency is satisfactory	35	2.9	34.3	17.1	37.1	8.6	3.14	3.00	4

* random questions not associated with variables described in section 2 (included for review)

C.4 Results of institutional readiness for change

Table C.4a Readiness and limitations to change

Variable	N	Frequencies (%)					Mean	Median	Mode
		SA (1)	A (2)	N (3)	D (4)	SD (5)			
Commitment to exploring	34	8.8	41.2	26.5	23.5	0.0	2.65	2.50	2
Socio-political limitations	35	11.4	68.6	8.6	11.4	0.0	2.20	2.00	2
Members value alternative arrangements	34	2.9	38.2	55.9	2.9	0.0	2.59	3.00	3
Implementation know how	34	5.9	20.6	35.3	23.5	14.7	3.21	3.00	3
Implementation resources	34	0.0	14.7	23.5	41.2	20.6	3.68	4.00	4
Implementation effectiveness	34	0.0	14.7	35.3	32.4	17.6	3.53	3.50	3

C.5 Results of information transaction costs

Table C.5a Perception of information TC – Regional district

Variable	N	Frequencies (%)							Mean	Median	Mode
		MH (1)	MdH (2)	SH (3)	Eq (4)	SL (5)	MdL (6)	ML (7)			
Data collection	27	11.1	29.6	11.1	37.0	11.1	0.0	0.0	3.07	3.00	4
Data QA/QC	28	7.1	32.1	25.0	25.0	10.7	0.0	0.0	3.00	3.00	2
Information systems	28	25.0	32.1	17.9	17.9	7.1	0.0	0.0	2.50	2.00	2
Identifying public expectations	28	10.7	14.3	25.0	32.1	14.3	3.6	0.0	3.36	3.50	4
Related resources	28	14.3	25.0	32.1	28.6	0.0	0.0	0.0	2.75	3.00	3
If Provincial government maintains responsibilities associated with information (scenario 2)											
Provincial-regional district	28	10.7	14.3	25.0	42.9	7.1	0.0	0.0	3.21	3.50	4

Table C.5b Perception of information TC – Watershed agency

Cost variable	N	Frequencies (%)							Mean	Median	Mode
		MH (1)	MoH (2)	SH (3)	Eq (4)	SL (5)	MoL (6)	ML (7)			
Data collection	28	7.1	17.9	7.1	39.3	21.4	3.6	3.6	3.75	4.00	4
Data QA/QC	28	0.0	32.1	21.4	25.0	7.1	10.7	3.6	3.54	3.00	2
Information systems	27	11.1	37.0	11.1	29.6	3.7	3.7	3.7	3.04	3.00	2
Identifying public expectations	27	7.4	14.8	25.9	25.9	18.5	3.7	3.7	3.59	4.00	3a
Related resources	28	3.6	21.1	28.6	17.9	10.7	3.6	3.6	3.25	3.00	2
If Provincial government maintains responsibilities associated with information (scenario 2)											
Provincial-watershed agency	28	7.1	14.3	25.0	39.3	10.7	0.0	3.6	3.21	3.50	4
a multiple modes exist. The smallest value is shown.											

C.6 Results of decision making transaction costs

Table C.6a Perception of decision making TC – Regional district

Variable	N	Frequencies (%)							Mean	Median	Mode
		MH (1)	MdH (2)	SH (3)	Eq (4)	SL (5)	MdL (6)	ML (7)			
Planning	24	16.7	37.5	33.3	12.5	0.0	0.0	0.0	2.42	2.00	2
Allocations	26	23.1	46.2	7.7	19.2	3.8	0.0	0.0	2.35	2.00	2
Reviewing allocations	26	15.4	42.3	15.4	26.9	0.0	0.0	0.0	2.54	2.00	2
Problems	25	20.0	32.0	28.0	8.0	12.0	0.0	0.0	2.60	2.00	2
Water accounting	25	16.0	28.0	36.0	12.0	8.0	0.0	0.0	2.68	3.00	3

Table C.6b Perception of decision making TC – Watershed agency

Variable	N	Frequencies (%)							Mean	Median	Mode
		MH (1)	MdH (2)	SH (3)	Eq (4)	SL (5)	MdL (6)	ML (7)			
Planning	24	8.3	12.5	25.0	33.3	8.3	8.3	4.2	3.63	4.00	4
Allocations	26	11.5	34.6	26.9	11.5	7.7	3.8	3.8	2.96	3.00	2

Variable	N	Frequencies (%)							Mean	Median	Mode
		MH (1)	MdH (2)	SH (3)	Eq (4)	SL (5)	MdL (6)	ML (7)			
Reviewing allocations	25	8.0	32.0	16.0	40.0	0.0	0.0	4.0	3.08	3.00	4
Problems	25	8.0	28.0	32.0	12.0	16.0	0.0	4.0	3.16	3.00	3
Water accounting	25	8.0	16.0	36.0	28.0	8.0	0.0	4.0	3.28	3.00	3

C.7 Results of enforcement transaction costs

Table C.7a Perception of enforcement TC – Regional district

Variable	N	Frequencies (%)							Mean	Median	Mode
		MH (1)	MdH (2)	SH (3)	Eq (4)	SL (5)	MdL (6)	ML (7)			
Monitoring	32	12.5	25.0	25.0	28.1	9.4	0.0	0.0	2.97	3.00	4
Enforcement	31	19.4	29.0	16.1	25.8	9.7	0.0	0.0	2.77	3.00	2
Scenario 2 (provincial government retains responsibilities associated with enforcement)											
Provincial-regional district	30	10.0	16.7	36.7	26.7	10.0	0.0	0.0	3.10	3.00	3

Table C.7b Perception of enforcement TC – Watershed agency

Variable	N	Frequencies (%)							Mean	Median	Mode
		MH (1)	MdH (2)	SH (3)	Eq (4)	SL (5)	MdL (6)	ML (7)			
Monitoring	32	15.6	21.9	21.9	28.1	9.4	3.1	0.0	3.03	3.00	4
Enforcement	31	16.1	32.3	16.1	22.6	9.7	0.0	3.2	2.90	3.00	2
Scenario 2 (provincial government maintains responsibilities associated with enforcement)											
Watershed	30	10.0	16.7	33.3	30.0	6.7	0.0	3.3	3.20	3.00	3

Appendix D Results of statistical analyses for Okanagan Basin comparison

D.1 Results of bivariate analysis (Mann-Whitney U)

Table D.1 Results from Mann-Whitney U-test for relationships between categorical variables for Okanagan comparison

Variable 1	Variable 2	Mann-Whitney U	Wilcoxon W	Z	p-value	Significance level
Okanagan_Q5	I1w_Q44	77.500	267.500	-0.410	0.682	
Okanagan_Q5	D1w_Q53	49.000	85.000	-0.945	0.345	
Okanagan_Q5	D2w_Q56	68.500	113.500	-0.445	0.656	
Okanagan_Q5	D3w_Q59	62.000	98.000	-0.368	0.713	
Okanagan_Q5	D4w_Q62	63.500	199.500	-0.496	0.620	
Okanagan_Q5	D5w_Q65	71.000	207.000	-0.059	0.953	
Okanagan_Q5	E1w_Q81	57.000	93.000	-1.507	0.132	
Okanagan_Q5	ProvPower_Q6	136.000	461.000	-0.068	0.946	
Okanagan_Q5	Proud_Q7	83.500	149.500	-1.920	0.055	
Okanagan_Q5	Respect_Q8	129.000	195.000	-0.321	0.748	
Okanagan_Q5	Scarcity_Q10	69.000	135.000	-2.480	0.013	*
Okanagan_Q5	CurtEff_Q14	97.500	163.500	-1.438	0.150	
Okanagan_Q5	RDEff_Q15	124.500	190.500	-0.277	0.781	
Okanagan_Q5	WAEff_Q16	91.500	157.500	-1.741	0.082	
Okanagan_Q5	OpsLim_Q17	135.500	201.500	-0.072	0.943	
Okanagan_Q5	LawsInt_Q18	108.500	174.500	-1.098	0.272	
Significance levels denoted as follows: p<0.05 ^{***} , p<0.01 ^{**}						

D.2 Results of bivariate analysis (T-test)

Table D.2 Results from T-test of independence for relationships between categorical and continuous variables and between categorical normally distributed variables for Okanagan comparison

Variable 1	Variable 2	Levene's test		t-test				
		F	Sig.	t	df	p-value	lower	upper
Okanagan_Q5	Allefficiency	0.310	0.583	-1.528	24	0.140	-1.05995	0.15828
Okanagan_Q5	MeanOrgChange	0.001	0.972	-0.038	33	0.970	-0.34242	0.32979

Variable 1	Variable 2	Levene's test		t-test				
		F	Sig.	t	df	p-value	lower	upper
Okanagan Q5	I1w Q44	0.689	0.414	-0.055	26	0.957	-1.123	1.065
Okanagan Q5	D1w Q53	0.002	0.968	-1.165	22	0.256	-2.085	0.585
Okanagan Q5	D2w Q56	1.886	0.182	-0.718	24	0.480	-1.748	0.846
Okanagan Q5	D3w Q59	0.468	0.501	-0.524	23	0.605	-1.491	0.888
Okanagan Q5	D4w Q62	0.305	0.586	0.159	23	0.875	-1.165	1.359
Okanagan Q5	D5w Q65	1.037	0.319	-0.162	23	0.872	-1.241	1.060
Okanagan Q5	E1w Q81	0.128	0.723	-1.495	28	0.146	-1.859	0.290
Okanagan Q5	ProvPower Q6	0.875	0.356	-0.352	34	0.727	-0.591	0.416
Okanagan Q5	Proud Q7	0.010	0.920	-1.982	34	0.056	-1.547	0.019
Okanagan Q5	Respect Q8	4.700	0.037	-0.181	34	0.857	-0.577	0.482
			Non eq	-1.696	25.177	0.826	-0.483	0.388
Okanagan Q5	Scarcity Q10	1.945	0.172	-2.670	34	0.012*	-1.428	-0.194
Okanagan Q5	CurtEff Q14	3.205	0.082	-1.519	34	0.138	-1.607	0.232
Okanagan Q5	RDEff Q15	0.519	0.477	-0.359	33	0.722	-0.960	0.672
Okanagan Q5	WAEff Q16	12.655	0.001	-1.971	34	0.057	-1.647	0.025
			Non eq	-2.633	33.962	0.013*	-1.437	-0.185
Okanagan Q5	OpsLim Q17	0.197	0.660	-0.117	34	0.907	-0.800	0.713
Okanagan Q5	LawsInt Q18	1.160	0.289	-1.211	34	0.234	-1.383	0.350
Significance levels denoted as follows: p<0.05***, p<0.01***								

D.3 Results of bivariate analysis (Chi-square)

Likert-type items were also assessed using the nonparametric statistical technique chi-square homogeneity test for Okanagan comparison.

Table D.3.a Results from Chi-square tests of homeogeneity for relationships between categorical variables for Okanagan comparison

Variable 1	Variable 2	Chi-square	Likelihood ratio	df	p-value (Chi-sq)	p-value (L-ratio)	Significance level
Okanagan Q5	Ilw Q44	6.396a	8.607	5	0.270	0.126	
Okanagan Q5	D1w Q53	4.313a	5.197	6	0.634	0.519	
Okanagan Q5	D2w Q56	4.434a	5.932	6	0.618	0.431	
Okanagan Q5	D3w Q59	1.563a	1.811	4	0.816	0.770	
Okanagan Q5	D4w Q62	3.195a	3.702	5	0.670	0.593	
Okanagan Q5	D5w Q65	4.814a	6.385	5	0.439	0.271	
Okanagan Q5	E1w Q81	4.318a	4.703	5	0.505	0.453	
Okanagan Q5	ProvPow Q6	1.390a	1.940	3	0.708	0.585	
Okanagan Q5	Proud Q7	5.291a	5.657	4	0.259	0.226	
Okanagan Q5	Respect Q8	4.179a	5.540	3	0.243	0.136	
Okanagan Q5	Scarcity Q10	6.332a	7.651	3	0.097	0.054	
Okanagan Q5	CurtEff Q14	2.775a	3.899	4	0.596	0.420	
Okanagan Q5	RDEff Q15	3.063a	3.216	4	0.547	0.522	
Okanagan Q5	WAEff Q16	4.189a	6.167	4	0.381	0.187	
Okanagan Q5	OpsLim Q17	1.446a	1.420	3	0.695	0.701	
Okanagan Q5	LawsInt Q18	7.959a	9.547	4	0.093	0.049	*
a violates assumption (>20%)							
Significance levels denoted as follows: p<0.05***, p<0.01***							

Due to the small number of data sets, expected counts were often below 5, violating the χ^2 test assumption (McHugh, 2013). Responses were then pooled and re-assessed.

Table D.3.b Results from Chi-square tests of homeogeneity for relationships between categorical variables for Okanagan comparison (TC variables pooled: more, same, less; and agreeance variables pooled: agree, neither, disagree)

Variable 1	Variable 2	Chi-square	Likelihood ratio	df	P-value (Chi-Sq)	P-value (l-ratio)	Significance
Okanagan Q5	PIIw Q44	1.165a	1.154	2	0.559	0.562	
Okanagan Q5	PD1w Q53	0.508a	0.543	2	0.776	0.762	
Okanagan Q5	PD1w Q56	2.223a	3.179	2	0.329	0.204	
Okanagan Q5	PD1w Q59	0.578a	0.877	2	0.749	0.645	
Okanagan Q5	PD1w Q62	0.048a	0.047	1	0.976	0.977	
Okanagan Q5	PD1w Q65	0.694a	0.711	2	0.707	0.701	

Okanagan Q5	PE1w Q81	1.591a	2.346	2	0.451	0.309	
Okanagan Q5	PProvPow Q6	0.932a	1.510	2	0.628	0.470	
Okanagan Q5	PProud Q7	3.886a	3.980	2	0.143	0.137	
Okanagan Q5	PRespect Q8	1.132a	1.429	2	0.568	0.489	
Okanagan Q5	PScarcity Q10	5.822a	7.215	2	0.054	0.027	*
Okanagan Q5	PCurtEff Q14	1.990a	2.083	2	0.370	0.353	
Okanagan Q5	PRDEff Q15	0.263a	0.261	2	0.877	0.877	
Okanagan Q5	PWAEff Q16	4.189a	6.167	2	0.123	0.046	*
Okanagan Q5	POpsLim Q17	0.249a	0.243	2	0.883	0.885	
Okanagan Q5	PLawsInt Q18	0.521a	0.529	2	0.771	0.767	
a violates assumption (>20%)							
Significance levels denoted as follows: p<0.05 ^{***} , p<0.01 ^{**}							