THE SCHOOL OF PUBLIC POLICY

MASTER OF PUBLIC POLICY
CAPSTONE PROJECT

Alberta's Water Challenge: Water Valuation as a Management Tool

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Executive Summary

Water is our most valuable resource. It sustains life, environmental ecosystems and the economy. In Alberta, an integrated approach to water management is integral to our water conservation efforts. This means that a connection must be made in the use of water by municipalities, the agricultural sector and energy industry, while ensuring that the needs of the environment are met.

The objective of this Capstone Project was to research, analyze, and provide policy recommendations on water management issues in Alberta. Specific emphasis was on understanding the role water valuation should play in water management for Alberta's agricultural, energy and municipal sectors. Research was gathered through literature reviews and interviews with fourteen Alberta water experts.

Recent implementations of the *Land-Use Framework* (2008) and the *Water for Life* strategy (2003) demonstrate the province's pragmatic approach to land and water management. However, tangible tools and management strategies in Alberta are limited when connecting water for people, food, energy and the environment. Increased population growth and economic activity as well as impacts of climate change will strain Alberta's water resources. In light of these pressures, a renewed approach to water management is required.

To achieve this renewed approach, government policy-makers should consider the following recommendations:

1. Economic incentives should be used by decision-makers to guide Alberta's energy and agricultural sectors to use water more wisely;
2. Environmental and social values of water must be integrated into future water management policies, and;
3. To achieve integrated water resources management and proper use of valuation tools, improved communication must occur between different water users.

As Alberta's population continues to grow and demands on our water systems increase, our province will need to effectively respond to subsequent challenges. For this reason, an integrated approach to water management that recognizes the connection water has to communities, industry, the agricultural sector and the environment will be necessary.

Objective

"The reality is that fresh water is more valuable than crude oil."
- Peter Lougheed, former Alberta Premier, 2005

The purpose of this Capstone Project was to research, analyze, and provide policy recommendations on water management issues in Alberta to address the following research question:

> *What role should water valuation play in water management for Alberta's agricultural, energy, and municipal sectors to ensure that decision-makers are equipped to implement effective policies to address future challenges?*

To address this research question, a literature review explored agricultural, energy and municipal uses of water in order to demonstrate constraints on Alberta's water resources. Analyzing these uses of water indicated the need for *integrated water resources management*[1] and introduced different perspectives from water experts on the current and future value of water. To support this work, interviews were conducted with these water experts to understand varying levels of support for different water management approaches such as the role of valuation in water management, collaboration between sectors and stakeholders, water conservation and public education. The resulting policy recommendations are intended to inform policy-makers of the dialogue around water use and management in Alberta.

Methodology

To address the research question, a literature review of current water policies and regulations in Alberta was conducted. Furthermore, to understand the main uses of water in Alberta, a separate literature review of agricultural, energy and municipal uses of water was also undertaken. To understand the connectedness of these water uses, the concept of the *nexus approach* (the interconnections of various uses of water) was also reviewed.

After completing the literature review component of the research, interviews were conducted with fourteen Alberta water experts with various backgrounds. These interviews provided information about prevalent issues, first-hand experiences, and policy gaps in Alberta's approach to water management. Discussing these issues with water experts in the Province highlighted current perspectives on water management that further informed the concluding policy recommendations.

[1] Integrated Water Resources Management (IWRM) promotes coordinated and collaborative approaches to the management of water and other natural resources to further increase economic and social benefits without compromising surrounding ecosystems. See http://www.gwp.org/The-Challenge/What-is-IWRM/ for more information.

Key findings and policy recommendations highlighted in this report are the product of an extensive literature review and interviews with experts. Limitations of this approach, however, include potentially biased perspectives and occasional lack of information from experts involved in the interview process all complicated by limited time available to fully explore such a vast area of research in the literature review. Despite the limitations, the approach used to evaluate Alberta's management of water has resulted in well-informed policy recommendations that can provide the knowledge foundation for decision-makers to improve water management policies in the future.

1. Introduction

1.1 Identifying the Issue

Water is our most valuable resource. It sustains life, environmental ecosystems and the economy. In order to properly manage this precious resource, local communities and governments should collaborate to produce policies and best practices that ensure water resources are maintained for future generations. In practice, this requires an integrated approach to water management that incorporates Alberta's three main water demands: water for people, water for food, and water for energy.

In Alberta, this integrated approach, otherwise known as the *nexus approach*, is integral to our ability to wisely use water for current and future uses. Pursing a culture of water conservation that promotes the wise and efficient use of water has long term economic and environmental value, but leadership on this topic must be encouraged and facilitated by the provincial government and dominant water users. This means that a connection must be made in the use of water by municipalities, the agricultural sector, and energy industry, while ensuring the needs of the environment are met.

Water demands in Alberta are expected to increase significantly over the next two decades due to a growing population and increased economic activity. In addition, climate change will exert additional pressures on Alberta's water supply. Added to this mix is the fact that Alberta's water resources are unevenly distributed with 80% of Alberta's water located in the northern part of the province and 80% of the population living in the south[2].

Looking ahead, Alberta's population is expected to grow from 3.7 million people in 2009 to approximately 5.7 million people by 2036[3]. Given the projected growth in Alberta's population, demands on surface and groundwater sources will rise. In 2009, a total of 187, 551 private land owners held a water license resulting in 9.59 billion m^3 of water being extracted from the surface and 301 million m^3 being taken from groundwater sources[4]. Future population

[2] Droitsch, Danielle, and Barry Robinson. "Share the Water: Building a Secure Water Future for Alberta." *Water Matters and EcoJustice* (2009): 9.

[3] Statistics Canada. "Population Projection for Canada, Provinces and Territories 2009 to 2036." *Government of Canada* (2010): 58.

[4] "Facts about Water in Alberta." *Alberta Environment and Sustainable Development.* (2010): 34.

and economic growth estimates suggest that more water resources will be extracted to serve the growing Province.

Economic activity, mainly related to the agricultural and energy sectors, is also expected to grow over the next two decades. For example, "oil sands production is expected to rise from 1.7 million barrels per day (mmbd) in 2011 to 5.1 mmbd by 2035"[5], resulting in the need for more water to support oil sands developments. Additionally, "after oil, gas and petrochemicals, crops and livestock represent the provinces biggest exports, and as global demand for food rises, these markets will continue to grow"[6]. Overall, Alberta's population growth, projected increase in economic growth and the location of the Province's water resources demonstrate the need for a new approach to water management.

Despite the success of the *Water Act* (1999) and *Water for Life (2003)* strategy, Alberta's approach to water management is limited when connecting water for people, food, energy and the environment. The Government of Alberta has laid the groundwork for approaching water, food, energy and environmental management through the same policy lens as the *Land-Use Framework* and *Water for Life* Strategy. What is now required is a series of management tools that build on the tenets of these policies. For this reason, Alberta requires the concept of water valuation to be integrated into water resources management. An understanding of the economic, social, and environmental value that is placed on water would be helpful to decision-makers when ensuring water resources are used wisely today and maintained for future generations.

1.2 Legislative Background of Water Management in Alberta

1.2.1 Early Legislation

Alberta's history of water management dates back to 1882 when the region (before it became a province in 1905) became part of the Northwest Territories. As a result of this inclusion, the federal government gained control of water resources by implementing a system of riparian rights, a water management system that "gave any landowner whose property was adjacent to a body of water the right to make reasonable use of it"[7]. As economic developments such as irrigation and railroad construction continued to grow and expand, however, the system of riparian rights became a less effective method of managing water due to population growth and industrial expansion that required water resources.

In response to these significant economic and social developments as well as the inadequacy of the riparian rights system, Canada passed the *Northwest Irrigation Act* in 1894,

[5] Burt, Michael. "The Regional Economic Impacts of Oil Sands Production." *The Conference Board of Canada*. (2013) :6.

[6] Walberg, Rebecca. "Looking Beyond Oil: these three industries will drive growth in Alberta." *Financial Post. March 5, 2013. Web. Accessed August 28, 2013.*

[7] "Legislative History of Water Management in Alberta." *Alberta Environment and Sustainable Resource Development*. Accessed July 8, 2013. http://environment.alberta.ca/02265.html

which allowed the federal government to allocate water for specific uses such as irrigation and municipal consumption. Allocations were provided to water users under a system of seniority where, for example, "during water short periods, an irrigation farmer with a senior license would be able to divert water before a farmer with a recently issued license"[8]. Nearly four decades after the implementation of the *Northwest Irrigation Act* and post-Confederation, Alberta passed the *Water Resources Act* in 1931 that embodied similar principles as the previous legislation. The *Water Resources Act* confirmed Alberta's control over water resources within the province and allowed for the government to issue water licenses to potential users. This change in water governance formed the foundation of Alberta's water management system.

1.2.2 Prior Allocation

In 1999, the Government of Alberta amended the original *Water Resources Act* (1931) to become the *Water Act* (1999) and *Irrigation Districts Act* (2000). In both Acts, the principle of *prior allocation* primarily determines different uses of water. Commonly referred to as *First in Time, First in Right (FITFIR)*, prior allocation has been used in Alberta and much of western Canada since the start of the agricultural and mining sectors. Systems of prior allocation provide water licenses to users on a "first-come-first-serve" basis, depending on supply. Under the FITFIR system, water is provided to senior license holders before junior license holders in times of water scarcity. Under the *Water Act* (1999), water licenses establish the maximum volume, location, time, and purpose for water extractions. Similar circumstances apply to the *Irrigation Districts Act* (2000), however, the agricultural sector is the main water user.

The amended version of the *Water Act* (1999) included four main changes that continue to define Alberta's current system of water management. First, *statutory preferences* were implemented to give priority to domestic and household uses of water. Next, in addition to the long-standing, indefinite licenses issues by the Province, short-term licenses would also be provided subject to an expiration date and renewal process. Third, inter-basin transfers of water between major waterways were prohibited. Lastly, included in the *Water Act* and *Irrigation Districts Act* was the option for tradable water licenses that could be bought and sold between license holders[9]. Perhaps most important of these changes, this final amendment altered Alberta's water management system by putting the mechanisms in place that could allow for a water market to develop.

In response to this final amendment, Nigel Bankes, a professor of law at the University of Calgary, stated:

> …some take the view that it is inappropriate to commodify water in this way either on ethical grounds or on the grounds that commodification of water rights will lead to the

[8] Ibid.

[9] "Legislative History of Water Management in Alberta." *Alberta Environment and Sustainable Resource Development*. Accessed July 8, 2013. http://environment.alberta.ca/02265.html

> "free trade" of water…others accept that a limited market in water is a natural consequence of closing basins to further allocations.[10]

Nonetheless, the Government of Alberta has an important role in properly managing the system of tradable water rights by providing a limited market. Prior allocation has created advantages and disadvantages for Alberta's water management schemes. On the one hand, successes in areas of economic and social development have occurred because water users receive water resources necessary to sustain growth. On the other hand, prior allocation does not rely on a system of integrated water management that connects our various uses of water. For this reason, a policy gap appears to exist with the results that it can be difficult for Albertans to understand the source and value of water available to them. This lack of integration presents difficulty for planners and managers when issues such a drought reduce water certainty in yearly flows; with the consequence of poorly managed water resources.

1.2.3 The Water for Life Strategy and Land-Use Framework

In response to projected growth of Alberta's population and economy, the Government of Alberta released the *Water for Life* strategy in 2003, and renewed this strategy in 2008. Accompanying the *Water Act* (1999), the *Water for Life* strategy contains three main goals: "to ensure safe and secure drinking water, healthy aquatic ecosystems, and reliable, quality water supplies for a sustainable economy."[11] This policy document guides the actions of industry, agriculture, municipalities, and the Government of Alberta and encourages people to more carefully consider their water use. In all, these goals reflect the need for Albertans to conserve, protect, and manage water resources in a more sustainable way.

Pursuant to these goals, Alberta created the *Land-Use Framework* in 2008 to guide the development of seven regional plans in land-use regions defined by Alberta's seven major watersheds. This policy was intended to improve decision-making around land-use and regional planning by using concepts such as *cumulative effects management*[12]. Taken together, Alberta's *Land-Use Framework* (2008) and approaches to water management indicate long-term plans for ensuring water availability and encouraging collaboration amongst different water and land users. Recent implementation of the *Land-Use Framework* and regional plans include the Lower Athabasca Regional Plan (released in August 2012) and the South Saskatchewan Regional Plan (to be released this fall) that exist alongside the *Water for Life* strategy further demonstrating Alberta's pragmatic approach to water management.

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[10] Bankes, Nigel. "Policy Proposals for Reviewing Alberta's Water (Re)Allocations Systems." *Journal of Environmental Law and Practice*. 20 (2010): 84-85.

[11] "Water for Life Strategy." *Alberta Environment and Sustainable Resource Development.* Accessed July 8, 2013. http://www.waterforlife.alberta.ca/

[12] Cumulative Effects Management is a system used by policy makers to comprehensively manage activities that impact the environment, society and the economy. See http://environment.alberta.ca/0891.html for more information.

1.3 A New Approach to Water Management

To date, a wide variety of research has been done on Alberta's system of water management that analyzes the future of prior allocation in Alberta. For example, a report published by the Alberta Water Research Institute (AWRI) and the Canada West Foundation states, "under new, growing and persistent demands for more water, government policies of the past are bumping up against a limited supply, raising serious questions about water in the future"[13]. While the Government of Alberta maintains legislation and policies aimed at maintaining the system of prior allocation, key challenges with future growth and water availability require new approaches. Alberta's population is expected to grow from 3.7 million people to approximately 5.7 million people by 2036[14], further supporting a growing consensus for developing a more effective way of thinking about water management.

The need for action became obvious in 2006 when the Government of Alberta discontinued water-license applications to the Bow River, Oldman River, and South Saskatchewan River sub-basins in the South Saskatchewan River Basin (SSRB). Essentially, southern Alberta has limited water resources that can no longer be allocated to new users. The result of this moratorium was twofold; water users pursuing economic development initiatives needed to look at other options for gaining necessary water resources, which led Albertans to realize the need for water conservation and a new approach to management[15]. These outcomes offered an opportunity for the Government of Alberta to re-evaluate prior allocation and understand how water is valued as a natural resource in the province, however, to date the subject has not been revisited.

Water management remains an area of public policy that will require continual attention due to changing circumstances. Moving forward, Alberta's decision-makers have a unique opportunity to utilize integrated approaches to realize the connection water has to energy, agriculture, people and the environment. The resulting, management policies could effectively promote the economic, social, and environmental value of water in Alberta.

2. Literature Review

This paper relied on the combination of a wide-ranging literature review on water and land use topics, and open-ended interviews with experts such as policy analysts, academics, managers in water-dependent industries and public interest non-profit representatives. Given this research approach, four major areas of concern emerged from the research question: the

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[13] Ploeg, Casey G. Vander. "From H20: Turning Alberta's Water Headache to Opportunity." *Canada West Foundation.* (2010): 59.

[14] Statistics Canada. "Population Projection for Canada, Provinces and Territories 2009 to 2036." *Government of Canada* (2010): 58.

[15] "Water Rights Trading" *Water -Matters Society of Alberta*. Accessed July 11, 2013. http://www.water-matters.org/topic/water-rights-trading

concept of the *nexus approach*, water supply for agriculture, uses of water by the energy sector, and municipal water needs.

The literature reviewed for this study provided necessary background information and analysis to determine current challenges and future solutions to water management in Alberta. In addition, organizations such as Alberta WaterSMART, Water Matters, and Alberta Innovates: Energy and Environment Solutions provided reports relevant to the project. Many issues surrounding water management were revealed throughout the literature review, however, key concerns are with Alberta's lack of an integrated approach to water management. For this reason, the literature review analyzes the *nexus approach* and Alberta's most dominant uses of water to further provide the framework to discuss integrated resource management and valuation tools for decision-makers. Before describing the findings of the following literature review, however, a general analysis of water use and value is necessary.

Without water, civilizations could not be built, crops could not be cultivated, and energy could not be produced. Realizing the inherent value of water, we can begin to understand its role in supporting our societies, ecosystems, and health. As stated by Steven Solomon, "the long sweep of history revealed that long enduring civilizations were underpinned by effective water control using the technology and organization methods of its time"[16]. Furthermore, "whenever the water flow was interrupted, whether from natural or political causes, crop production fell, surpluses dissipated, dynasties and empires toppled, and starvation and anarchy threatened the entire social order"[17]. Thus, history shows water resources are a major factors in the growth and prosperity of emerging societies, making it the most valuable natural resource.

While Canada's settlement history is much shorter than the ancient civilizations of Europe, Asia and the Middle East, our country's water resources tell a story of exploration and progress. Canada's navigable waters, the Great Lakes, pristine glaciers and rivers have all contributed to the belief and myth that Canada has abundant water resources. Due to population growth and increased economic activity, however, the strains on our water quality and quantity have become noticeable. In *Ethical Water: Learning to Value What Matters Most*, the authors state, "[Canadians] have discovered to our dismay that the qualities that make water so diversely valuable to us are the same qualities that easily allow it to become contaminated, polluted and lost to further use"[18]. As a result, a gap exists between the high value Canadians place on water and the management of this precious resource. For this reason, present and future policy-makers have the task to find solutions that combine the economic, social, and environmental values of water.

[16] Solomon, Steven. "Water: the Epic Struggle for Wealth, Power, and Civilization." Harper Collins. New York (2010): 367.

[17] Ibid. Pg. 25.

[18] Sandford, Robert William, and Merrell-Ann S. Phare. "Ethical Water: Learning to Value What Matters Most." Rocky Mountain Books: Toronto. (2011): 2.

Within Canada, Alberta provides a prime example of a jurisdiction with limited water availability in areas with high demand and management practices that could be improved. The following analysis of the *nexus approach* and Alberta's three dominant water uses will provide insight into reasons for understanding contemporary values of water and subsequent management policies that reflect these values.

2.1 Nexus Approach

In 2011, the World Economic Forum (WEF) brought attention to the *nexus approach* that connects water for food, water for energy, and water for communities. Broadly defined as the "integrated management and governance across sectors and scales"[19], the *nexus approach* attempts to connect society's different uses of water to further promote conservation and proper management. In its report, the WEF explains that growth in population, energy needs and food production will strain global water resources. For this reason, "it is at the local level that most opportunities can be found for improving resource efficiency and managing tradeoffs between energy, water and food production"[20]. For Alberta, this means establishing an integrated water management system that recognizes the needs of water users, including the environment, while still being able to prioritize uses in times of scarcity. To achieve this type of water management, WEF recommended that trade-offs between different water users be managed through a combination of market mechanisms and government regulations[21].

In 2013 the International Institute for Sustainable Development (IISD) produced a framework addressing the *nexus approach* and emphasized its application to landscape investment and risk management. The framework states:

> …Without taking into account the interconnections among sectors, resource allocation may easily be seen as (or actually become) a zero-sum game where intense competition for resource access can easily become conflict[22].

To address this challenge, the IISD recommended actions that are holistic and well rounded rather than narrow in focus. Specifically, stakeholder engagement, improved policy development, integrated resource planning, innovation and policies addressing environmental improvements are ways to apply the *nexus approach*[23].

In Alberta, the role of the agricultural and energy industry as key contributors to the province's economy as well as competition for land and limited water supplies demonstrates

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[19] Hoff, Holger. "Understanding the Nexus: Background Paper for the Bonn2011 Nexus Conference." *Stockholm Environment Institute*. (2011): 7.

[20] "Global Risks 2011 Sixth Edition: An Initiative of the Risk Response Network." *World Economic Forum*. (2011): 32.

[21] Ibid. Pg. 35.

[22] Bizikova, Livia, Dimple Roy, Darren Sawnson, Henry Venema and Matthew McCandless. "The Water-Energy-Food Security Nexus: Towards a Practical Planning and Decision Support Framework for Landscape Investment and Risk Management." *International Institute for Sustainable Development*. (2013): 5.

[23] Ibid. Pg. 11.

the need for decision-makers to implement a *nexus approach* that integrates plans and solutions to avoid future issues.

In addition to improving water management, the *nexus approach* encourages decision-makers to understand the connection between different uses of water and how these systems rely on each another. A report published by Grace Communications effectively highlights the relationship water has to society's main functions. For example, the report describes water, food, and energy systems individually to show that, "we alter water systems so we can fulfill our agricultural, municipal, commercial, industrial, and energy production needs"[24]. To address these major uses of water, approaches to management must also enhance our understanding of water systems. Improved information and data would also provide better monitoring of water resources, an understanding of economic costs related to water use, and a proactive approach to addressing growth that would enable decision-makers to ensure water resources are maintained for future generations.

2.2 Use of Water by the Agricultural Sector

The agricultural sector is Alberta's largest consumer of water, "accounting for 60 to 65 percent of all water consumed in the Province on average"[25]. In addition, nearly 43 percent of all allocated surface water is provided to Alberta's irrigators and "less than 1 percent of the total volume of groundwater is allocated for agricultural use"[26]. These irrigation practices support the agricultural sector, export markets and provide food for Canadians making this industry critical to Alberta's economy. Thus, increases in population and economic growth point to the need for improved water management to address future water availability issues. Alberta is already experiencing significant strains on water supply due to increasing demand for a finite resource especially in the SSRB where "75 percent of the water allocations are for irrigation, [as a result], competing demands and large irrigated agricultural water extractions have now been recognized as reaching a critical limit"[27].

The *Irrigation Districts Act* (2000) governs water for agricultural uses in Alberta. The purpose of the Act is to ensure that irrigation districts "manage and deliver water…in an efficient manner that provides for the needs of the users"[28]. This legislation governs irrigation practices to ensure water is properly used in each irrigation district, also that water diversions and uses comply with the conditions under the *Water Act*[29]. Of the thirteen irrigation districts

[24] Hanlon, Peter, Robin Madel, Kai Olson-Sawyer, Kyle Rabin, and James Rose. "Food, Water and Energy: Know the Nexus." *Grace Communications* (2013): 7.

[25] "Water Used for Irrigation." *Alberta Environment and Sustainable Resource Development*. Last updated March 2011. Accessed July 14, 2013. http://environment.alberta.ca/01723.html

[26] "Focus on Groundwater Use." *Alberta Environment and Sustainable Resource Development*. (2011): 3.

[27] "Water Used for Irrigation." *Alberta Environment and Sustainable Resource Development*. Last updated March 2011. Accessed July 14, 2013. http://environment.alberta.ca/01723.html

[28] Irrigation Districts Act. Revised Statues of Alberta. cI-11.7 s2. Alberta. 2000. Alberta Agriculture and Rural Development. Web. 12 July 2013.

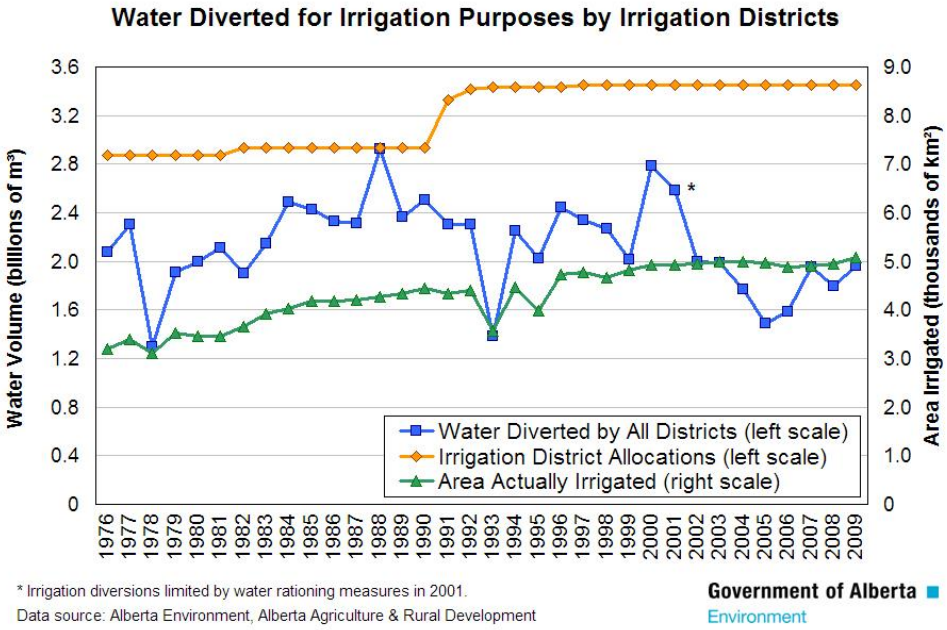
[29] "Irrigation Districts Act and Regulations." *Alberta Agricultural and Rural Development*. Accessed July 12, 2013. http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/acts6120

established in the Act, each maintains a senior water license allowing for extraction and diversion of water for irrigation purposes. For example, the Western Irrigation District "provides irrigation water to over 400 farms and 96,000 acres of land, and supplies municipal water to over 12,000 people in four different communities"[30]. Looking ahead, significant challenges face the Western Irrigation District such as sharing water supplies due to the closure of southern river basins in 2006, and meeting increased water demands as local populations continue to grow. While the *Irrigation District Act* (2000) maintains authority to govern irrigation practices, contemporary challenges surrounding water use and availability must be addressed by irrigation districts in a collaborative manner to meet the needs of water users.

Figure 1.1 shows the year-to-year diversions and allocations of water for irrigators, further displaying the stressed relationship between the supply of water and demand for water in Alberta. The graph shows that in 2009 irrigation districts held sufficient water allocations to irrigate nearly nine thousand square kilometres of land, however, the yellow line shows that only five thousand square kilometres of land required irrigation in that year. It is important to note that large licenses are provided to irrigators to manage water in both wet and dry years. For example, the chart shows greater water use in 1987 and 1988 due to drought conditions compared to 1978, 1993 and 2005 that were wet years. Comparatively, the blue line refers to other districts, mainly municipalities, requiring the same amount of water to be used for steady needs. In 2001, water rationing measures were implemented to manage drought conditions. Essentially, all water users shared the burden of the drought and reduced their water use instead of reverting back to the principle of FITFIR. As a result, all licensed water users were using as much water as was allowed. Following 2001, water use was lower due to relatively wet years and improvements in irrigation efficiency. The main conclusion drawn from Figure 1.1 is that water licenses have allowed irrigation districts to continue withdrawing large amounts of water in both wet and dry years to provide for irrigation needs and, in some cases, for municipalities. As a result, water use is determined by irrigation districts, further impacting water availability for municipalities, businesses and individuals.

[30] "Western Irrigation District: Where Water is Life." *Western Irrigation District.* Accessed July 12, 2013. http://www.wid.net/history.html

Figure 1.1



Addressing the impacts irrigation practices have on water, it is clear that in Alberta, the agricultural sector places significant stress on water resources. Corkal and Adkins address these stressors in their paper *Canadian Agriculture and Water* to argue for better governance structures, environmental programming and research. While they highlight Alberta's *Water for Life* strategy as a leading example of integrated resource management, they also state that, "due to the cross cutting nature of water resources, water management in Canada relies on shared provincial, local and federal jurisdictions; this fragmentation of roles lead[s] to associated governance issues"[31]. Consequently, Corkal and Adkins suggest the agricultural industry must balance "consumptive water use, competitive economic performance, and environmental protection"[32] when addressing water management issues and policies. Despite their focus on Canada generally, these comments further highlight the need for Alberta's decision-makers to find value in the economic, social, and environmental uses of water to further prioritize specific needs.

Other researchers identify Alberta's most pressing water issue as the need for long-term solutions to the system of prior allocation. Possible solutions include the prioritization of ecosystem needs and improvements to the water trading system that allows markets to exist. In a recent report, Henning Bjornlund, Research Chair at the University of Lethbridge, states,

[31] Corkal, Darrell R. and Philip E. Adkins. "Canadian Agriculture and Water." *Agriculture and Agri-Food Canada.* (2008): 7.

[32] Ibid. Pg. 12.

> …It is imperative that institutions and instruments facilitate the reallocation of water from low-value, inefficient uses in unsuitable locations to higher-value and more efficient uses in ways that minimize such effects on farmers and their communities[33].

While Bjornlund strongly advocates for the implementation of economic instruments to allocate water, his ideas reflect the broader strategy of valuing different uses of water to determine who receives water and when. Applying economic instruments to irrigation practices, however, has been met with opposition from select farmers and irrigators in some agricultural communities of Alberta. For this reason, many politicians trying to initiate change in water management have been unsuccessful in gaining support from the agricultural community showing that "the success of any water management policy largely depends on this sector's reactions"[34].

Notable changes have occurred due to goals established in the *Water for Life* Strategy where all industries including the agricultural sector were encouraged to improve water use and efficiency by 30 percent by 2015. Bjornlund, Klein, and Nicol explored the feasibility of this goal and found that support amongst irrigators for greater efficiency was weak throughout all of Alberta's thirteen irrigation districts because extensive technological changes have already been made to ensure maximum efficiency[35]. For this reason, the authors recommended that the Government of Alberta implement individual policies for each irrigation district to ensure water conservation[36]. While this policy recommendation could result in water use and efficiency strategies specific to each irrigation district, implementing thirteen different policies risks further fragmentation and increased regional tensions between different water users.

While Alberta's irrigators continue to retain large licensed allocations from the Government of Alberta, the fact is much of this water remains unused in most years. The system remains flawed because, "allocations do not guarantee water supply; but rather, they guarantee the right to take water if sufficient water is available"[37]. For this reason, there appears to be an opportunity for decision-makers to look at how irrigators use and value their water resources to further determine whether or not this water should be provided to other users depending on yearly supply and demand.

2.3 Water Use in the Oil and Gas Sector

Alberta's oil sands production from mining and in-situ methods hold seven percent of water allocations in the province; the increases in demand from these sources pose long-term

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[33] Bjornlund, Henning. "The Competition for Water: Striking a Balance among Social, Environmental and Economic Needs." *C.D. Howe Institute*. 302 (2010): 1.

[34] Nicol, Lorraine, Henning Bjornlund and K.K. Klein. "Challenges in implementing economic instruments to manage irrigation water on farms in Southern Alberta." *Agricultural Water Management*. 92 (2007): 131.

[35] Ibid. Pg. 138.

[36] Ibid. Pg. 139-140.

[37] "Water Used for Irrigation." *Alberta Environment and Sustainable Resource Development*. Last updated March 2011. Accessed July 14, 2013. http://environment.alberta.ca/01723.html

public policy concerns. Presently, "northern Alberta accounts for about 85 percent of Alberta's water supply [while] the Athabasca River alone accounts for 17 percent of the provinces total supply"[38]. This highlights the river's important role in supplying major oil sands operations with necessary water resources. Depending on the method of extraction, the production of one barrel of oil requires approximately three to six barrels of water,[39] showing the value of water in the process of oil production. Recognizing this water demand, a recent National Energy Board (NEB) report estimated that "by 2035…oil sands bitumen production is projected to reach 5.1 million barrels per day, three times the production for 2010"[40], showing that water use will have to increase to meet future energy demands.

In Alberta's oil sands, water is used in two different methods of oil extraction: oil sands mining and in-situ recovery of bitumen deep underground[41]. Of these methods, the most common is in-situ production where processes include cyclical steam simulation (CSS) and steam-assisted gravity drainage (SAG-D). These processes use large amounts of water that is injected into deep rock formations by steam to further loosen underground bitumen and bring it to the surface. In-situ methods of oil extraction mainly use saline groundwater and produced water that has been recycled from previous oil wells. As cited in a *Water Matter's* report on in-situ oil recovery methods, "according to the ERCB (Energy Resources Conservation Board), the production of bitumen from in-situ operations is expected to increase by 140 percent by 2015 with a corresponding increase in water use"[42]. As a result, Alberta's surface and groundwater resources in the North will be increasingly relied on to support oil sands production. In relation to this water use,

> …Only 33 percent of total oil sands allocations were being utilized in 2005, [therefore], it has been estimated that the petroleum sector is using only 15 percent of their total allocations for thermal in-situ operations[43].

Thus, similar to the agricultural sector, water has been proportionately over allocated in the oil and gas sector. Figure 2.1 shows that oil sands maintains only seven percent of Alberta's water allocations compared to agriculture that has 44 percent followed by commercial and municipal uses. Despite this low percentage, the oil sands producers with large unused licenses could transfer them to new users or those with expanding water needs, under the governance structure required for transfers to occur. Therefore, producers would have the incentive to conserve water resources so they have excess amounts to transfer.

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[38] "Water Use in Canada's Oil Sands." *Canadian Association of Petroleum Producers*. (2012): 2.

[39] Donahue, W.F., and D.W. Shindler. "An Impending Water Crisis in Canada's Western Prairie Provinces." *PNAS*. 103 (2006): 7213.

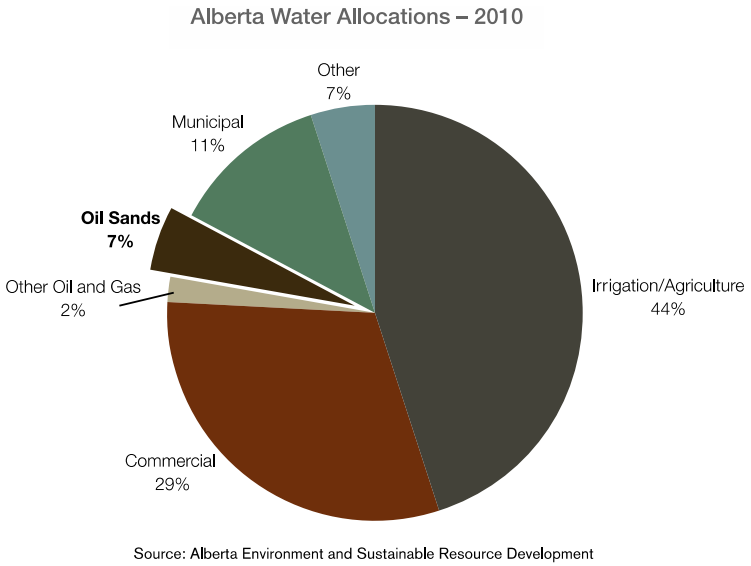
[40] National Energy Board. "Canada's Energy Future: Energy Supply and Demand Projections to 2035." *Government of Canada.* (2011): 18.

[41] Griffiths, Mary, Amy Taylor, Dan Woynillowicz. "Troubled Waters, Troubling Trends: Technology and Policy Options to Reduce Water Use in Oil and oil Sands Development in Alberta." *The Pembina Institute*. (2006): 14.

[42] "Water Use by Thermal *In Situ* Oil Sands: Backgrounder." *Water Matters Society of Alberta*. (2009): 3.

[43] Ibid. Pg. 3.

Figure 2.1



Source: Alberta Environment and Sustainable Resource Development

To address water use issues in the oil sands, the Government of Alberta implemented the *Water Conservation and Allocation Policy for Oilfield Injection* in 2006. This policy provides objectives for conservation measures to be implemented, regulatory measures to reduce freshwater use, technical evaluations, improved environmental practices and adaptability to respond to environmental and regulatory changes[44]. This guiding policy document was developed to complement the *Water for Life* strategy and ensure the in-situ production would reduce and conserve water resources. In practice, this policy has resulted in "all in-situ operators…reduce[ing] the use of freshwater sources where possible by using alternatives such as deep saline water zones and to maximize water recycling"[45]. Despite this progress, there remains no government policy that provides oil companies with the incentive to reduce water use to *minimal* amounts, especially for in-situ production. For this reason, assigning an economic value for water used during oil production would incentivize producers to limit their water consumption.

In Alberta, this high demand for water is problematic given limited resources in the winter months, therefore, in the long term the oil sands industry (like the agricultural sector) must be held accountable for their water use if sustainable supplies are to be ensured. David Schindler and William Donahue address these challenges by suggesting that Canada's Prairie Provinces are facing an impending water crisis. They state, "[the current] amount of water used for deep well injection is less than 1% of licensed water withdrawals in Alberta, but the water is permanently removed from the water cycle"[46]. This issue highlights the need for integrated water management in Alberta that includes cooperation from the oil sands industry to collaborate with other water-users.

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[44] "Water Conservation and Allocations Guideline for Oilfield Injection." *Government of Alberta* (2006): 3.
[45] "Water Use in Canada's Oil Sands." *Canadian Association of Petroleum Producers.* (2012): 8.
[46] Schindler, David and William Donahue. "An Impending Water Crisis in Canada's Western Prairie Provinces." *PNAS* 103 (2006): 7213.

Sarah Jordaan, a postdoctoral fellow at the Energy Technology Innovation Policy research group at Harvard University and Professor of Political Science at the University of Calgary, also addresses the impacts of oil sands production on land and water: "The ultimate goal of comparing the land and water impacts of energy technologies is to understand trade-offs related not only to resource use, but also larger scale landscapes and watersheds"[47]. Water used for in-situ oil sands developments affect river flow levels in the Athabasca River. To limit water withdrawals in low flow periods, the *Athabasca River Management Framework* categorizes river flows into green, yellow and red zones[48]. Green zones allow for water extraction and diversions to occur while the red zones disallow industry to remove water due to low river flows. While this form of management is effective because attention is paid to low and high flow seasons, it does not ensure sustainable water resources for future generations on a long term sustainable basis.

In a recent report titled *Troubled Waters, Troubling Trends: Technology and Policy Options to Reduce Water Use in Oil Sands and Oil Sands Development in Alberta*, the Pembina Institute provided recommendations aimed at water conservation and improved regulations for oil sands developments. More specifically, they recommend:

> …the government begins by establishing water use targets for the oil sector, implementing user fees on fresh water consumption (as opposed to water that is diverted, used, and returned to the water shed) by the sector, and further evaluate other policy options if reduction targets are not met.[49]

While water pricing is beyond the scope of this report, the Pembina Institute's suggested measures indicate how economic incentives can both control water use in the oil sands and maintain the health of the Athabasca River especially in low flow periods. To achieve a healthy ecosystem, oil sands producers, and more specifically those using in-situ methods of extraction, must become more cognizant of the impact they are having on water resources and other water users. For example, "approved oil sands mining companies are licensed to divert 359 million m^3 per year from the Athabasca River"[50], however, this is a small amount relative to the Bow River, which is in turn smaller than the Athabasca.

In their report, the Pembina Institute addresses the question of value by explaining the inadequacy of the *Water Conservation and Allocation Policy for Oilfield Injection Framework* (2006). Due to the absence of high quality data and information, financial incentives to reduce water use and a lack of adaptability, oil sands companies are not pushed by government policy

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[47] Jordaan, Sarah M. "Land and Water impacts of Oil Sands Production in Alberta." *Environmental Science and Technology*. 46 (2012): 3613.

[48] "Athabasca River Water Management Framework." Alberta Environment and Sustainable Resource Development. Accessed August 19, 2013. http://environment.alberta.ca/01229.html.

[49] Griffiths, Mary, Amy Taylor and Dan Woynillowicz. "Troubling Water, Troubling Trends: Technology and Policy Options to Reduce Water Use in Oil and Oil Sands Development in Alberta." *The Pembina Institute*. (2006): 156.

[50] Ibid.

to implement innovative and large-scale changes to water use[51]. For this reason, the Pembina Institute suggests major reductions in water use cannot be achieved until a common understanding of the value of water for oil sands production is related to water uses from ecological support services to drinking water needs.

The National Roundtable on the Environment and the Economy (NRTEE) produced a report in 2010 addressing policy gaps and need for improvements to water management. The report shed light on water use in the natural resource sector and stated, "[Canada's] natural resource sector must think fresh on how to ensure strong water management so that use of this precious resource is made sustainable for our environment and economy"[52]. While oil sands activities use large amounts of water in the production stages, volumes of water extracted are still lower than in other areas such as agriculture. Due to population growth and increased oil sands development, however, "future water requirements will need to be considered carefully, and not just project by project, but from a cumulative, watershed basis"[53]. Furthermore, understanding the cumulative effects of oil sands water use on groundwater aquifers and surface water flow rates is important to further improvements in policy and management. Addressing these management issues early on would provide decision-makers with the valuation tools necessary for managing water use in Alberta's oil sands.

2.4 Municipal Water Use

Municipalities are responsible for providing clean drinking water to the communities they serve. In order to provide water resources, municipalities maintain 10-11 percent of water allocations in Alberta[54]. For example, the "City of Calgary holds the largest municipal water allocation in the Bow River basin at approximately 460 million m^3/ year"[55]. Despite this large water allocation, municipalities across the Province continue to return most water to the source. In the future, however, some of Alberta's smaller municipalities will be faced with significant water availability, conservation and collaboration challenges.

Challenges facing Alberta's municipalities were identified in a 2008 report written by Alberta Economic Development Authority (AEDA). To address these challenges, AEDA recommended a regional approach where, "the government encourages municipalities to consider regional water and wastewater systems, public-private partnerships, and contracting out of operations and maintenance"[56]. Implementing a regional approach where municipalities

[51] Ibid. Pg. 137.
[52] "Changing Currents: Water Sustainability and the Future of Canada's Natural Resource Sector." *National Roundtable on the Environment and the Economy*. (2010): 13
[53] Ibid. Pg. 92.
[54] "Sectoral Water Allocations." *Alberta Environment and Sustainable Resource Development*. Accessed August 19, 2013. http://environment.alberta.ca/01721.html
[55] Pernitsky, David J. and Natalie D. Guy. "Closing the South Saskatchewan River Basin to New Water Licenses: Effects on Municipal Water Supplies." *Canadian Water Resources Journal*. 35(2010): 80.
[56] Alberta Economic Development Authority. "Sustainable Water Management and Economic Development in Alberta." *AEDA Sustainable Development Committee.* (2008): 26.

of different sizes could collaborate on water use would address future population and resource development growth. Addressing Alberta's future growth is important for municipalities to consider because water licenses held by cities and towns will be the first to experience strains on water resources mainly because of an inflexible water transfer system and disagreements over various infrastructure options.

When the Government of Alberta closed SSRB in 2006, Calgary's population had grown to 1.1 million people. This growth has continued into 2013 across the region despite the remained closure of major rivers. Overall,

> … Rapid growth in the [Southern Alberta] region, coupled with the closing of the basin to new water allocations, has led to water supply issues for many communities, as their existing water licenses are not adequate for projected growth, or to attract industry[57].

An exception to this issue remains the City of Calgary, however, that holds a license large enough to sustain future growth. Nonetheless, conservation measures and collaboration with neighboring municipalities will be important for proper management of Alberta's water resources. Presently, municipal water facilities in southern Alberta are owned and operated by individual municipalities rather than the region as a whole. As a result, many of these municipalities such as Okotoks have small water licenses that cannot support increased population growth and development. Estimates show, "without water conservation measures, more than half of communities will face a water shortage by 2030. Even with a 30 percent reduction in per capita water use, several communities will exceed their existing allocations in the short-term"[58]. This presents a severe challenge to the future growth of our Province's infrastructure and ability to provide for new Albertans.

In the article written by Pernitsky and Guy, changes to municipal water management could include a 30 percent reduction in water consumption, license transfers that can acquire additional water supplies, limited outdoor water use, leak repairs, water metering infrastructure, increased public awareness on conservation, water transfer infrastructure such as water pipelines, and alternative water sources such as raw or treated water and groundwater sources[59]. In addition to these changes, an understanding of how Alberta's communities value their water will be important to decision-makers in the future. The recent Balzac mall development and Town of Okotoks water issues indicate that water supply has been increasingly difficult for smaller municipalities to secure making it difficult to manage competition to long term water rights.

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[57] Pernitsky, David J. and Natalie D. Guy. "Closing the South Saskatchewan River Basin to New Water Licenses: Effects on Municipal Water Supplies." *Canadian Water Resources Journal*. 35(2010): 80.

[58] Ibid. Pg. 86.

[59] Ibid. Pg. 88.

The Balzac mall is illustrative of this issue. In 2007, in an attempt to acquire water rights under existing constraints the Balzac mall development in the district of Rocky View signed an agreement with the Western Irrigation District to provide water through a water license transfer. While many farmers were opposed to the deal, "of the 328 members who voted, 57 percent approved of the $15 million agreement to exchange water for cash"[60]. In turn, this cash was intended for the Western Irrigation Districts to build improved infrastructure that conserved more water. This deal set a new precedent in Alberta where municipalities were collaborating to share water. Until the signing of this deal, the Balzac mall development was delayed and faced uncertainty due to the inability to secure a source of water. Proposals such as building a pipeline from the Bow River to Balzac and looking to the Red Deer River for water were met with great opposition and denied access. As a result, the district of Rocky View offered the nearby Western Irrigation District $15 million for 6,700 m^3 of water per day[61]. Rocky View's experience indicates an emerging trend in Alberta where water will be more difficult to secure for expansion projects. The Balzac mall development presented a crucial test for regional cooperation and collaboration as well as the need for enhanced water management in Alberta.

The Town of Okotoks in southern Alberta also faces severe water challenges. Due to limited water resources, low flow rates of the Highwood River and drought conditions, Okotoks has capped their population at 30,000 people unless the nearby Highwood and Sheep Rivers can accommodate increased growth. For Okotoks, water restrictions have become the norm, educational programs on reduced water use have been pursued, and there has been a request to the province for improved water management in the region. Presently, "Okotoks intends to investigate small license transfers and small, local groundwater resources to supply the town's needs and not proceed with a regional water supply pipeline from Calgary," however, "if future growth in Okotoks exceeds capacity of the available water resources, a pipeline from Calgary will be required"[62]. To address the water availability challenges facing Okotoks, a larger regional approach should be implemented. Municipalities in Alberta, especially in the Southern region, are finding it critical to collaborate in order to produce a system of water management that allows municipalities and water license holders to share their resources within an established water market. While Balzac remains one of the few examples of water sharing, there are many other opportunities for municipalities to collaborate for solutions to water scarcity such as in Okotoks. To reach this level of collaboration, however, an understanding of how water is valued by municipalities will be important for decision-makers to determine for further communication to occur.

[60] D'Aliesio, Renata. "Balzac Track Gets It Water: Western Irrigation District Members OK Deal." *Calgary Herald* 3 August 2007: Print.

[61] Ibid.

[62] "Water Challenges for the Town of Okotoks: the Quest for Supply Security." *Worley-Parsons Resources and Energy.* (2010).

3. Findings

3.1 Expert Interviews

To reinforce information gained in the literature review, I conducted interviews to gain a better understanding of first-hand issues with Alberta's water management policies. Fourteen different water experts across the province were identified and contacted. To ensure different perspectives would be achieved, each respondent was chosen to represent a different background and area of expertise. Interviews included discussions with individuals from NGO's, government, academia, industry, municipalities, and agriculture. In favour of facilitating a discussion based on each respondent's experience with water management, an interview template with general questions was used (see Appendix I and II). Respondents were encouraged to discuss the area of water management from the perspective of their own expertise. Also, each respondent was asked to highlight challenges they see in Alberta's water management practices and possible policy solutions such as water valuation principles. Despite varying backgrounds, respondents discussed consistent themes and identified policy gaps in water management. The following analysis describes seven major themes that emerged from the interviews process.

3.2 Common Themes Derived from the Interview Process

While each respondent represented a different approach to water management, seven common themes emerged from the interviews process. These themes were the *economic, social and environmental value* of water, the need for *collaboration, conservation, education,* and *cumulative effects management*. Figure 3.1 highlights these major findings and the responses from specific water experts. The following table identifies the area of employment of each water expert. In response to the questions asked, each respondent discussed specific strategies to water management based on their experience and knowledge. As a result, the table identifies each respondent's emphasis on specific management tools, however, please note that emphasis on each theme was reflected in individual interviews but may not reflect the participants overall views of water management. Also, I have not identified respondents in the interviews by name, only by their category in order to preserve anonymity and limit a potential bias. While all seven themes were discussed throughout the interview process, the majority of interviews focused on the connection or fragmented relationship between economic, social, and environmental values of water. Interestingly, many of the respondents felt water management policies required a more integrated approach that joined the needs of the environment, social license, and economic viability. This outcome agrees with the conclusions observed within the literature review where an integrated approach to water management was heavily advocated. The following analysis will highlight the seven themes that emerged from the interview process.

Figure 3.1 Outcomes of Interviews

Employment Area of each Water Expert	Economic Value	Social Value	Environmental Value	Collaboration between Interest groups	Conservation of ecosystem	Public Education	Cumulative Effects Management
NGO	•	•	•	•			
Academic	•	•					•
Government				•		•	
NGO	•	•	•				•
Municipal	•			•			
Government		•			•		
Government			•				•
NGO		•	•				
Academic			•	•	•		
Industry	•	•	•				
Academic	•		•				
Municipal	•	•	•			•	
Government	•	•				•	•
Academic	•				•		

3.2.1 Economic Value of Water

For each respondent, the economic value of water presented a different opportunity for water management. Dominant economic tools discussed included the need for more quantifiable data to ensure conservation, increased economic incentives for water users, and incurred costs to more closely reflect social and environmental values. For example, one industry professional stated, "government policies should recognize the role of ecosystems and the cost structures should be left up to regional interests"[63]. In essence, trade-offs must occur between the ecosystems' water needs and the industrial, municipal, and agricultural uses of water, then individual water users can allocate and conserve water based on the needs of their regions or industries. To achieve this, the respondent also suggested decision-makers and water users must understand the cost to their industries and regions of not having available water resources. In doing so, an understanding of economic value can be achieved to further provide incentives for water to be used as efficiently as possible. Pursuant to basing economic values on regional interests, a municipal official stated, "to put a market value on water that is the same price for everyone is impossible because different people have a different willingness to pay"[64] further implying the need for decision-makers to be equipped with an understanding of regional water interests and needs. Overall, nine respondents encouraged the use of economic instruments to conserve and efficiently allocate water resources, however, participants also identified the need for economic values of water to be integrated with social and environmental values to further achieve a balanced approach to water management.

[63] Anonymous. Personal Interview. 27 June. 2013
[64] Anonymous. Personal Interview. 12 June. 2013.

3.2.2 Social and Environmental Value of Water

In order to achieve integrated water resources management, economic values of water must exist alongside social and environmental values. Figure 3.1 shows that eight of the fourteen respondents discussed social and environmental values of water respectively. For the purpose of this project, environmental value refers to a shared understanding of the ecosystems' water needs and minimal flow rates required in Alberta's rivers. By comparison, social value refers to the need for an improved sense of *social license*[65] where water users understand impacts of their water use on communities, the environment, and our economy. These approaches to water management further reinforce the belief that "we will not survive as a civilization unless the rights of people are balanced with the rights of nature"[66]. Addressing these values, one representative of the NGO community stated, "two questions need to be answered: how much water needs to be left in the river to conserve the ecosystem? And what is socially responsible water use?"[67] The majority felt these fundamentally important questions continue to be inconsistently applied in Alberta's water policies and legislation, therefore, decision-makers must develop an understanding of ecosystem water needs to further determine industrial and regional water use. In the interview process, respondents advocating for improved environmental and social standards typically implied that water allocations should not continue until a full understanding of how much water is needed to sustain the environment and people is gained. In general, both government officials and the NGO representatives addressed the trade-off between environmental and economic needs in relation to the *Water Act* (1999). One government official explained, "in the *Water Act*, there is too much protection for licensed water users rather than protection for the environment"[68]. Comparatively, another water expert stated, "the *Water Act* is impactful for allocation, however, there is too much discretionary language where problems that could be solved are not due to Ministerial discretion"[69]. Thus, environmental and social values of water remain inconsistently addressed in Alberta's current water management policies. For many participants, future water management must include minimal ecosystem flows and subsequent restrictions on diversions and rates of extraction by industry and regions. To achieve this, integrating an understanding of human impacts on water systems will be important to changing the way we allocate water.

3.2.3. Collaboration

Collaboration and the process of communication was another important theme that emerged from the interview process and literature review. Four of the fourteen respondents promoted collaboration between dominant water users as a way for Alberta to achieve

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[65] Social License is described as the ongoing public acceptance or approval of a specific project. See http://socialicense.com/definition.html for more information.

[66] Sandford, Robert William and Merrell-Ann S. Phare. "Ethical Water: Learning to Value what Matters Most." *Rocky Mountain Books*: Toronto. (2011): 52.

[67] Anonymous. Personal Interview. 26 June. 2013.

[68] Anonymous. Personal Interview. 18 June. 2013.

[69] Anonymous. Personal Interview. 7 June. 2013.

sustainable and impactful water management schemes. In Alberta, collaboration requires the agricultural and energy sectors as well as municipalities to communicate and work together on water management. Similar to the *nexus approach*, greater collaboration would allow for water users to consider different circumstances and opportunities for water use and conservation. One government official endorsed this concept: "prioritization might make us think of pricing more in the future, but for right now, we should focus on collaboration"[70]. Thus, while some water experts advocate for economic incentives to allocate water, others suggest collaboration as a stepping-stone to implementing new water management tools. An academic also stressed collaboration in his statement, "because it is impossible to start over again, we must focus on outcomes at the basin level that are better than what we have today, therefore, we can get lots of people working together"[71]. To achieve proper collaboration between Alberta's dominant water users, emphasis on a regional approach to collaboration would develop grassroots understanding of Alberta's water issues and possible solutions. In all, respondents agreed that collaboration between different water uses is the key to successful water management. To achieve effective collaboration, interactions between key users such as agriculture and municipalities that often use the same water systems should be encouraged and possibly facilitated by decision-makers.

3.2.4 Conserving Alberta's Water Resources

Conservation of Alberta's water resources emerged as a theme necessary to support other initiatives such as implementing an environmental value of water or encouraging greater public education. As Alberta's population and industries continue to grow, conservation practices are imperative to the continued allocated uses of water. While only three of the fourteen participants directly discussed conservation measures, their concern for implementing a habit for conservation was also reflected in the literature review. For one academic, a conservation approach means that "we need to change the conversation to be about conservation markets that would include water, land and industry, therefore, we can begin to determine what incentives would be needed to regulate water management"[72]. In contrast, an NGO representative approached conservation in a different way stating, "we simply need to use less water and we need to change the way we think about water"[73]. In either approach, conservation remains a central theme supporting other water management tools.

3.2.5 Public Education

In relation to the conservation approach, three respondents discussed the need for greater education in the area of water use, management and conservation. A municipal official highlighted his experience with education at the Calgary Water Centre in his statement, "at first, water metering was met with great opposition, but then people got more used to the idea

[70] Anonymous. Personal Interview. 7 June. 2013.
[71] Anonymous. Personal Interview. 3 July. 2013.
[72] Anonymous. Personal Interview. 3 July. 2013.
[73] Anonymous. Personal Interview. 7 June. 2013.

and warmed up to it, as a result, by 2014, all Calgary homes will have water meters- a change that took nearly 30 years"[74]. The implementation of water metering in Calgary indicates the relationship between greater public education and conservation measures to achieve efficient water use. Taken together, conservation strategies and educational programs were discussed by water experts as excellent methods of grassroots advocacy that are capable of making long term and impactful changes in water use.

3.2.6. Cumulative Effects Management

The final theme that emerged from the interview process was the concept of *cumulative effects management* (CEM). Discussed by four water experts, CEM uses "various tools, resources and relationships [to] work together to comprehensively manage activities that affect the environment, economy, and society in a particular place"[75]. Applied to water management, CEM considers different uses of water in Alberta to further determine effects of these multiple uses on the environment, society, and economy. From this, CEM provides decision-makers with the tools necessary for determining the best and highest uses of Alberta's water resources. A former provincial politician explained, "basing the land-use regions on watersheds was the best thing the government could do [in 2008] despite strong opposition"[76], as connecting various uses of land within Alberta's water sheds would encourage improved water use. Looking ahead, further application of CEM would connect Alberta's dominant water users and encourage more sustainable water use. To achieve this, decision-makers must utilize their understanding of water's values, collaborate with other water users, and commit to implementing strong water conservation measures. Full implementation of CEM is required alongside other actions to change the culture and attitude around water use in Alberta that would be based on strong integrated water resource management.

As a result of the interview process, research and information gained from conversations with water experts in Alberta resulted in findings that often overlap with information obtained from the literature review. Concepts such as integrated resource management, greater collaboration, and developing an understanding of the various values of water emerged as coinciding themes. Also, insights were provided into areas of limitation and potential for improving Alberta's water management policies from a level of personal experience.

4. Policy Recommendations

The literature review and interviews with water experts provided information on areas of water management that require greater attention in Alberta. From this research, I have identified three main policy recommendations to address gaps in Alberta's current water

[74] Anonymous. Personal Interview. 10 June. 2013.
[75] "Cumulative Effects Management." *Alberta Environment and Sustainable Resource Development*. Accessed July 31, 2013. http://environment.alberta.ca/0891.html
[76] Anonymous. Personal Interview. 30 May. 2013.

management framework. The following recommendations are intended to increase the opportunities for improved water management and reduce potential water availability challenges in Alberta's future.

Recommendation 1: Economic incentives should be used by decision-makers to guide Alberta's energy and agricultural sectors to use water more wisely.

Specific Actions:

- Decision makers could provide economic incentives through the use of tools such as water pricing for oil companies, with the intent of encouraging wise water use, and;
- The Government of Alberta could implement regulations that guide the agricultural sector towards a system of water license trading that promotes cooperation and sharing of resources amongst users.

Throughout the literature review and interview process, emphasis on adapting an economic value of water was continually suggested. As Alberta's population and industrial activity continue to grow, concerns such as reduced water supply, water shortages, costly events such as floods and droughts, and ecosystem water needs will emerge. As a result, Alberta's policy-makers must implement economic instruments to mitigate and address these issues. Ted Horbulyk, an economics professor at the University of Calgary, addressed the need for a variety of economic solutions by stating, "what is required is the consideration and appropriate exploitation of the full range of economic and water management instruments in a coordinated manner"[77]. Water experts interviewed for this project also emphasized the need for a range of economic tools that reflect specific industry and regional needs rather than one, over-arching policy.

In Alberta, the agricultural sector would benefit from a regulated system of water-license trading that has, in some ways, emerged as a result of the 2006 SSRB closure. Alberta's policy-makers should continue to encourage the transfer of senior water rights between water users, because the "market transfer of water rights, as an economic instrument and resource management tool [can be used] to reallocate water from low to high valued uses, such as in times of scarcity"[78]. Despite the jurisdictional concerns and logistical questions of implementing water rights trading, policy-makers have the opportunity to regulate a system of water-license trading. In contrast, the energy industry requires a different management approach due to their cumulative use of water for specific energy projects such as in-situ oil sands production. One water expert discussed water pricing or incentive tools as important for encouraging the energy industry to limit water use, however, he noted, "there is no magical dollar amount that people will pay for their water because they all value it differently"[79]. For the energy industry, an economic incentive that helps companies limit water use would enable this industry to use

[77] Horbulyk, Theodore M. "Markets Policy and the Allocation of Water Resources Among Sectors: Constraints and Opportunities." *Canadian Water Resources Journal*. 30 (2005): 58.
[78] Ibid. Pg 59.
[79] Anonymous. Personal Interview. 27 June. 2013.

water more wisely. For this reason, policy-makers should evaluate the energy industry's use of water to further determine an incentive such as water pricing that would limit water use.

Recommendation 2: Environmental and social values of water are not captured in Alberta's current water legislation, therefore, our understanding of ecosystem and human needs must be integrated into future water management policies.

Specific Actions:

- Increase the scientific knowledge around minimal ecosystem needs by encouraging the academic and NGO community to study this area and provide the results in useful form to policy-makers;
- By working with the scientific community, water users should increase their knowledge of the connection between surface and groundwater sources in Alberta, and;
- All water users must realize that environmental protection and economic growth go hand in hand.

Alberta's ecosystem sustains the agricultural sector, energy industry, and municipalities that in turn support our population. Due to significant growth expected in these industries and in Alberta's population, attention must be paid to the capacity of our environment. Prioritization of the ecosystem's needs suggests,

> …We may need to consider water as something inherently unique and irreplaceable, as something that has legal status or at least the right to exist in the quality and quantity necessary to sustain natural functions upon which we also depend[80].

Presently, environmental and social values are largely unaccounted for in Alberta's current water management frameworks. Both the *Water Act (1999)* and *Water for Life* policy provide only descriptive measures for protecting ecosystem flows and human water needs, leaving a large gap in addressing environmental and social values of water. Participants in the interview process discussed the lack of accountability in Alberta's current water management policies as the reason for the limited approach environmental and social values of water. Therefore, an opportunity exists for Alberta's policy-makers to capture our understanding of ecosystem and human needs of water and integrate this information in future water management policies.

Environmental and social values of water must be determined and guide future water management policies to fully achieve the *nexus approach*. Decision-makers representing dominant water using industries and municipalities, as well as government officials and environmental experts should collaborate on measures that can be taken to incorporate ecosystem and human water needs into future policies.

[80] Sandford, Robert William and Merrell-Ann S. Phare. "Ethical Water: Learning to Value what Matters Most." *Rocky Mountain Books*: Toronto. (2011): 52.

Recommendation 3: To achieve integrated water resources management and proper use of valuation tools, improved communication must occur between different water users.

Specific Actions:

- Improve education and awareness amongst water actors of the different uses of water in Alberta by encouraging communication across sectors. This includes a better understanding of watersheds and downstream effects of water use,
- The provincial government should act as the facilitator to encourage communication between dominant water users, and;
- Encourage a culture of collaboration where water users can communicate to understand specific uses of water and methods of conservation.

To achieve integrated water management in Alberta, collaboration must occur between different interest groups and government. While "participants in the discussion offer various prescriptions and alternative pathways to solve the water problems we face, there is emerging agreement that water governance as it currently exists is simply not effective"[81]. Therefore, Alberta's dominant water users including the agricultural sector, energy industry and municipalities can communicate and utilize their specific perspectives to find a common water management solution. Furthermore, government representatives and environmental specialists should participate and communicate with water users to share their experiences with water management. The provincial government should act as the facilitator to ensure that communication occurs between dominant water users. In doing so, an integrated solution could be reached that addresses the interests of all involved groups.

Reducing barriers and enhancing communication between different sectors and regions can achieve collaborative solutions that further reflect the interconnectedness of the *nexus approach*. Furthermore, integrating various uses of water into one understanding would accomplish management goals in all sectors while mitigating competitive tendencies that often block progress in pursuing collaborative approaches.

5. Conclusion

Water is our most valuable resource. It sustains life, the environment and our economy. To properly manage this precious resource, Alberta's decision-makers and dominant water users must collaborate to produce policies and best practices that ensure water resources are maintained for future generations.

Alberta's legislative history shows that water management has been integral to our province even before Confederation. Water management legislation and policies, such as prior allocation, show Alberta's attempts to manage, conserve and protect our limited water resources. As Alberta's population continues to grow and demands on our energy, agricultural and water systems increase, our province will need to effectively respond to subsequent

[81] Ibid. Pg. 21.

challenges. For this reason, an integrated approach to water management that recognizes the connection water has to communities, industry, the agricultural sector and the environment will be necessary.

The three proposed policy recommendations provided in this report combine the findings produced in both the literature review and interview process. Each recommendation attempts to fill a gap present in Alberta's current water management policies and equip decision-makers with necessary tools to understand the value of water in Alberta. Moving forward, economic, social and environmental values of water should be understood by Alberta's decision-makers, therefore, specific policy tools such as economic incentives and ecosystem standards can be implemented. To achieve this standard of water management, however, water users and decision-makers must purposefully collaborate to produce effective policies capable of long-lasting conservation and effective public education. As a result of these measures, a new approach to water management could be achieved that is capable of addressing contemporary water issues.

Bibliography

Alberta Economic Development Authority. "Sustainable Water Management and Economic Development in Alberta." *AEDA Sustainable Development Committee.* (2008): 1-73.

"Athabasca River Water Management Framework." Alberta Environment and Sustainable Resource Development. Accessed August 19, 2013. http://environment.alberta.ca/01229.html.

Bankes, Nigel. "Policy Proposals for Reviewing Alberta's Water (Re)Allocations Systems." *Journal of Environmental Law and Practice*. 20 (2010): 81-126.

Bizikova, Livia, Dimple Roy, Darren Sawnson, Henry Venema and Matthew McCandless. "The Water-Energy-Food Security Nexus: Towards a Practical Planning and Decision Support Framework for Landscape Investment and Risk Management." *International Institute for Sustainable Development*. (2013): 1-24.

Bjornlund, Henning. "The Competition for Water: Striking a Balance among Social, Environmental and Economic Needs." *C.D. Howe Institute*. 302 (2010): 1-24.

Burt, Michael. "The Regional Economic Impacts of Oil Sands Production." *The Conference Board of Canada*. (2013): 1-75.

Changing Currents: Water Sustainability and the Future of Canada's Natural Resource Sector." *National Roundtable on the Environment and the Economy*. (2010): 1-164.

Corkal, Darrell R. and Philip E. Adkins. "Canadian Agriculture and Water." *Agriculture and Agri-Food Canada.* (2008): 1-15.

"Cumulative Effects Management." *Alberta Environment and Sustainable Resource Development*. Accessed July 31, 2013. http://environment.alberta.ca/0891.html

D'Aliesio, Renata. "Balzac Track Gets It Water: Western Irrigation District Members OK Deal." *Calgary Herald* 3 August 2007: Print.

Donahue, W.F., and D.W. Shindler. "An Impending Water Crisis in Canada's Western Prairie Provinces." *PNAS*. 103 (2006): 7210-7216.

Droitsch, Danielle, and Barry Robinson. "Share the Water: Building a Secure Water Future for Alberta." *Water Matters and EcoJustice* (2009): 1-31.

"Facts about Water in Alberta." *Alberta Environment and Sustainable Development.* (2010): 1-65.

"Focus on Groundwater Use." *Alberta Environment and Sustainable Resource Development*. (2011): 1-5.

Irrigation Districts Act. Revised Statues of Alberta. cI-11.7 s2. Alberta. 2000. Alberta Agriculture and Rural Development. Web. 12 July 2013.

"Global Risks 2011 Sixth Edition: An Initiative of the Risk Response Network." *World Economic Forum*. (2011): 1-137.

Griffiths, Mary, Amy Taylor, Dan Woynillowicz. "Troubled Waters, Troubling Trends: Technology and Policy Options to Reduce Water Use in Oil and oil Sands Development in Alberta." *The Pembina Institute*. (2006): 1-171.

Hanlon, Peter, Robin Madel, Kai Olson-Sawyer, Kyle Rabin, and James Rose. "Food, Water and Energy: Know the Nexus." *Grace Communications* (2013): 1-30.

Hoff, Holger. "Understanding the Nexus: Background Paper for the Bonn2011 Nexus Conference." *Stockholm Environment Institute*. (2011): 1-52.

Horbulyk, Theodore M. "Markets Policy and the Allocation of Water Resources Among Sectors: Constraints and Opportunities." *Canadian Water Resources Journal*. 30 (2005): 55-64.

"Irrigation Districts Act and Regulations." *Alberta Agricultural and Rural Development*. Accessed July 12, 2013. http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/acts6120

Jordaan, Sarah M. "Land and Water impacts of Oil Sands Production in Alberta." *Environmental Science and Technology*. 46 (2012): 3611-3617.

"Legislative History of Water Management in Alberta." *Alberta Environment and Sustainable Resource Development*. Accessed July 8, 2013. http://environment.alberta.ca/02265.html

National Energy Board. "Canada's Energy Future: Energy Supply and Demand Projections to 2035." *Government of Canada.* (2011): 1-79.

Nicol, Lorraine, Henning Bjornlund and K.K. Klein. "Challenges in implementing economic instruments to manage irrigation water on farms in Southern Alberta." *Agricultural Water Management*. 92 (2007): 131-141.

Pernitsky, David J. and Natalie D. Guy. "Closing the South Saskatchewan River Basin to New Water Licenses: Effects on Municipal Water Supplies." *Canadian Water Resources Journal*. 35(2010): 79-91.

Ploeg, Casey G. Vander. "From H20: Turning Alberta's Water Headache to Opportunity." *Canada West Foundation.* (2010): 1-114.

Sandford, Robert William, and Merrell-Ann S. Phare. "Ethical Water: Learning to Value What Matters Most." Rocky Mountain Books: Toronto. (2011): 1-151.

"Sectoral Water Allocations." *Alberta Environment and Sustainable Resource Development.* Accessed August 19, 2013. http://environment.alberta.ca/01721.html

Series of Personal Interviews recorded as Anonymous at their request from May 30 to July 3, 2013. Those interviews were from agricultural, municipal, industrial, academic, and NGO employment areas.

Solomon, Steven. “Water: the Epic Struggle for Wealth, Power, and Civilization.” Harper Collins. New York (2010): 1-596.

Statistics Canada. “Population Projection for Canada, Provinces and Territories 2009 to 2036.” *Government of Canada* (2010): 1-246.

Walberg, Rebecca. “Looking Beyond Oil: these three industries will drive growth in Alberta.” *Financial Post. March 5, 2013. Web. Accessed August 28, 2013.*

“Water Challenges for the Town of Okotoks: the Quest for Supply Security.” *Worley-Parsons Resources and Energy.* (2010).

“Water Conservation and Allocations Guideline for Oilfield Injection.” *Government of Alberta* (2006): 1-56.

“Water for Life Strategy.” *Alberta Environment and Sustainable Resource Development.* Accessed July 8, 2013. http://www.waterforlife.alberta.ca/

“Water Rights Trading” *Water -Matters Society of Alberta*. Accessed July 11, 2013. http://www.water-matters.org/topic/water-rights-trading

“Water Used for Irrigation.” *Alberta Environment and Sustainable Resource Development*. Last updated March 2011. Accessed July 14, 2013. http://environment.alberta.ca/01723.html

“Water Use by Thermal *In Situ* Oil Sands: Backgrounder.” *Water Matters Society of Alberta*. (2009): 1-5.

“Water Use in Canada’s Oil Sands.” *Canadian Association of Petroleum Producers*. (2012): 1-8.

“Western Irrigation District: Where Water is Life.” *Western Irrigation District.* Accessed July 12, 2013. http://www.wid.net/history.html

Appendix I: Questions used in the Interview Process

My Capstone project addresses water quantity (and subsequent water quality) problems in Alberta. By discussing energy and agricultural uses of water I plan to show the relevance of water valuation principles and other policies to address Alberta's supply issues.

1. How long have you been interested in water issues and policies? Why did you get into this area?

2. What government policies do you find the most impactful on Alberta's water supply? Least impactful?

3. Do you feel water policies in Alberta are sufficient? What changes should be made to improve these policies?

4. Do you have knowledge of other water policies in Canada or abroad that address quantity or distribution issues?

5. What policies should be used to guide and encourage water use efficiency and address quantity and distribution issues in Alberta?
    a. Applied to energy use of water (ex. produced water that cannot be returned to the water cycle)

    b. Applied to agricultural use of water (ex. lack of water in the southern basin)

6. Is there value in establishing an authority or regulatory body that addresses water quantity issues? Could Alberta's new energy regulator (AER) maintain this role?

7. How could water valuation principles help or hinder decision makers and their role in evaluating water decisions?
    a. Water valuation as a way to ensure efficient uses of water by monetizing risk
    b. This includes industry leaders, agricultural leaders and political leaders

Appendix II: Date and Category of Interviews Conducted

Date	Category
May 6, 2013	NGO Representative
May 13, 2013	Academic
May 30, 2013	Academic
June 7, 2013	Government Official
June 7, 2013	NGO Representative
June 7, 2013	Government Official
June 10, 2013	Municipal Representative
June 12. 2013	Agricultural Representative
June 18, 2013	Oil Sands Representative
June 26, 2013	NGO Representative
June 26, 2013	Academic
June 27, 2013	Industry Representative
June 28, 2013	Municipal Representative
July 3, 2013	Academic