Irrigators' Perception and Intention towards Water Re-allocation Policies in Southern Alberta

By

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ABSTRACT

A necessary precursor to irrigated agriculture in southern Alberta is the availability of massive quantities of water. Many suggest that water demand will rise substantially in the decades to come. These projections also come at a time of increasing environmental awareness in Alberta, leading some to advocate that more water should be secured for environmental purposes. The Alberta government enabled inter-sectoral water transfers as a way to re-allocate water in order to satisfy growing demand. This has raised skepticism among the irrigation community over the use of water transfers as a way to satisfy future demand. The research presented in this thesis approaches this issue by examining the factors that influence irrigators' perceptions towards using water transfers as a way to re-allocate water to other uses. The findings reveal that if the government is relying on water transfers as the primary way to re-allocate water in the future, it must address irrigators' skepticism, and create conditions that promote transfers as a preferable option.

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CHAPTER ONE

INTRODUCTION

With the closure of the South Saskatchewan River Basin for new license applications in 2006, water users have braced for the reality that new demand must be met by existing supply. The Alberta government has responded to this by allowing license holders to 'trade' or transfer some or all of their licensed allocations. Since most of the SSRB's water allocation is tied up with irrigation uses, it is expected that this will be a major source of water that will be re-allocated for environmental purposes and to satisfy the demand for new consumptive uses. Studies in the region have indicated a negative responses by many in the irrigation community towards the use of water markets to re-allocate water (Bjornlund *et al*, 2007; Nicol *et al*, 2008). Since the future prosperity and well-being of Albertans depends on finding ways of sharing the existing finite water resources, and irrigators have some of the most senior licenses with the largest allocations, it is important to understand irrigators' perceptions towards the current transfer system. This research intends to address irrigators' perceptions towards water transfers by: i) identifying the intentions of irrigators to trade or transfer water and the factors that influence those intentions; and ii) identifying irrigators' acceptance of policies to share water with other users including the environment.

1.1 Problem Context

The decision to farm the semi-arid expanses of southern Alberta was based on optimistic hopes over the region's water. In 1857 John Palliser led the British North American Exploring Expedition to conduct a survey of what was then Rupert's Land in order to find a possible route for the Canadian Pacific Railway (CPR). In 1863 upon reporting his findings to the British parliament he identified a triangular shaped area

between the US border and 52° N; and 100° to 114° W that he deemed unfit for agriculture. Since then that area has been named "Palliser's Triangle" (Marchildon *et al,* 2009). He recommended settlement further north along the mixed grasslands and parklands (Figure 1.1).

In the 1870s, a period of above average precipitation, John Macoun accompanied Sir Sandord Fleming's survey expeditions of the prairies as a field naturalist. He would later lecture on the agricultural possibilities in Palliser's triangle. The Dominion government, along with the CPR, used Macoun's findings as rationale for their ambitions to settle the region with farmers by building the main CPR line through Palliser's Triangle. Palliser's Triangle presently encompasses the largest expanse of agricultural land in Canada (Marchildon *et al*, 2009: 32).

After the construction of the CPR line there was a push by the government and private investors to expand agriculture in the region (Marchildon *et al,* 2009). In order to facilitate this, the Dominion government passed several pieces of legislation including the Northwest Irrigation Act in 1894. This act altered traditional riparian water law, which exclusively attached the right to use water with land ownership, and granted control of water to the federal crown. The Crown granted large diversions of water to what would become irrigation uses. In 1900 large scale irrigation was underway with the completion of a 184 kilometer canal from the St. Mary River to land near Lethbridge to deliver water for agricultural purposes. In 1903 the CPR constructed a weir on the Bow River near Calgary and a canal system to bring water to 80,000 hectares of farmland (IWMSC, 2002). In 1909 construction began on a diversion structure near Bassano and a canal system to irrigate roughly 160,000 acres near Brooks in the heart of Palliser's Triangle (IWMSC, 2002). Since then Canada's most extensive irrigation system was built in the South Saskatchewan River Basin (SSRB) providing water for roughly 600,000 hectares of land (IWMSC, 2002).

Licenses for irrigation now account for 77% of all water allocations in the SSRB (AMEC, 2009).

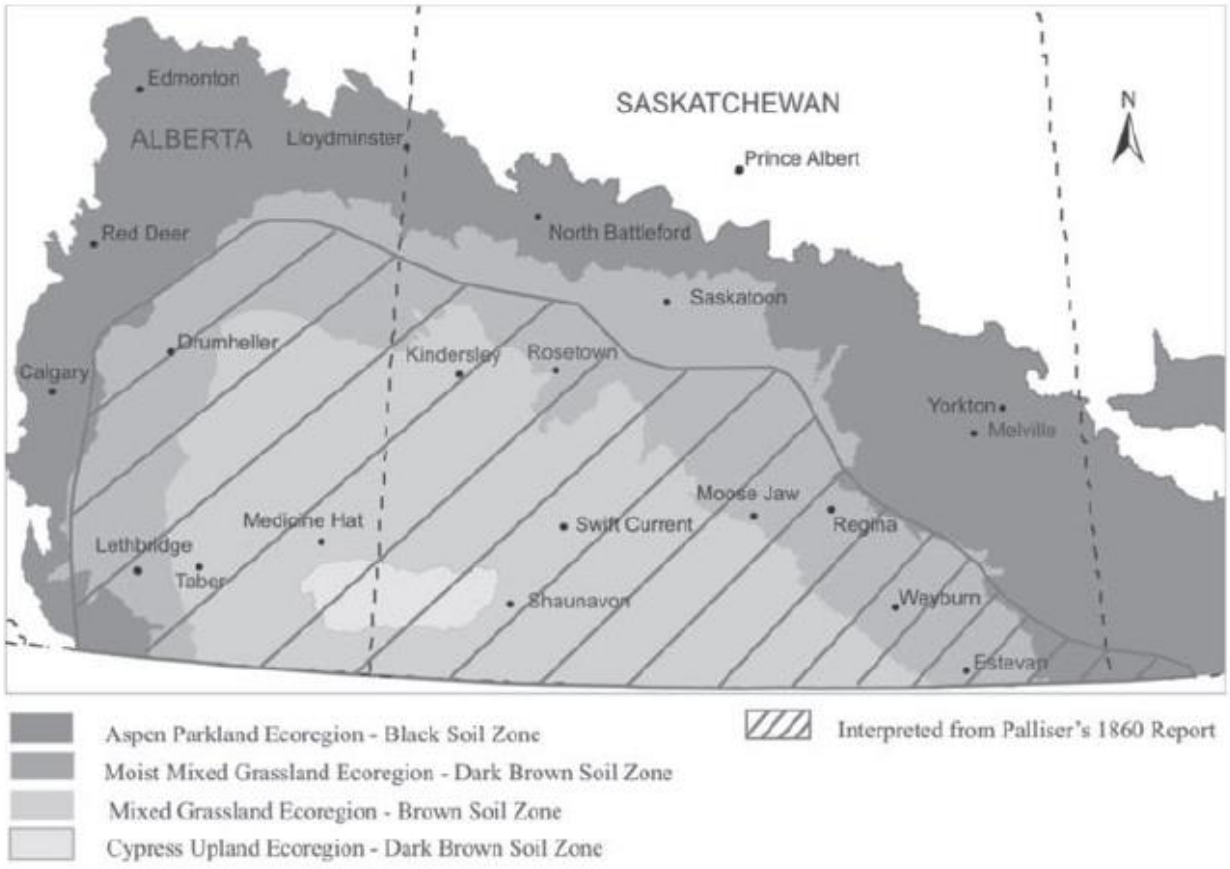

Figure 1.1 – Palliser's Triangle and Prairie Eco-Regions
(Marchildon *et al*, 2009: 2)

Many in the SSRB are now concerned that surface water in the basin is being over allocated, and are concerned that the present supply may not be enough to satisfy demand during times of drought (Christensen and Droitsch, 2008). This fear comes from projected growth in water demand that is expected from a rapidly growing population and increased demand from industrial and municipal users. A 2005 report by Alberta Environment projected that the population of the SSRB is expected to grow more than 2 million by 2021, and that demand from non-irrigation uses could increase 67% by 2021. By 2046, demand from non-irrigation uses may rise by 52-136% (Alberta Environment, 2005). These

projections come at a time of increasing environmental concerns regarding water quality and eco-system degradation due to low flows (Christensen and Droitsch, 2008). Considering these projections, in 2006 Alberta Environment stopped accepting applications for new water licenses in the Bow, Oldman, and South Saskatchewan River sub-basins (Figure 1.2). This means that existing licensed allocations must meet a rapidly growing demand for water in the SSRB.

In response to these concerns, the Alberta government released its Water for Life Strategy (WFL) in 2003. The WFL calls for a 30% increase water use productivity and efficiency over the 2005 levels by 2015. It is assumed that this water can be "freed" up from existing use and can then be transferred to satisfy new demand for environmental purposes via water conservation objectives (WCOs), and to other consumptive uses via water transfers. The current legislation gives license holders a large degree of agency in deciding whether or not to transfer all or a part of their licensed allocations. Since water for irrigation accounts for roughly 77% of the SSRB's water allocation, it is expected that this water will be a major source of water to meet future demand through market re-allocation.

The Water Act of 1999 allows license holders to "share" water via assignment agreements (Section 33), and to transfer licensed water allocations (Section 81) in order to satisfy demand with existing supply. License holders have the ability to trade water, or to sell some or part of their licensed volumes for financial compensation. Typically only transfers of users within the same sector have taken place, usually farmer to farmer (Levine *et al.*, 2007: 221). Participation in the transfer of permanent and long term licensed allocations has been low in southern Alberta, in part because irrigators have expressed skepticism towards transferring, or trading, water as a means for permanent re-allocation (Nicol & Klein, 2006; Bjornlund *et al*, 2007). A common sentiment expressed is that permanent transfers are too final, and may threaten the long term supply of current license

holders (Bjornlund *et al*, 2007). A 2006 study analysing responses from irrigation district managers and board members indicated a strong sense of skepticism in the irrigation community over the use of water transfers (Bjornlund *et al*, 2007). According to the study, only 8% agreed with the use of water transfers (Bjornlund *et al.*, 2007). This raises concerns of the effectiveness of water transfers as a means to re-allocate water to meet new demand.

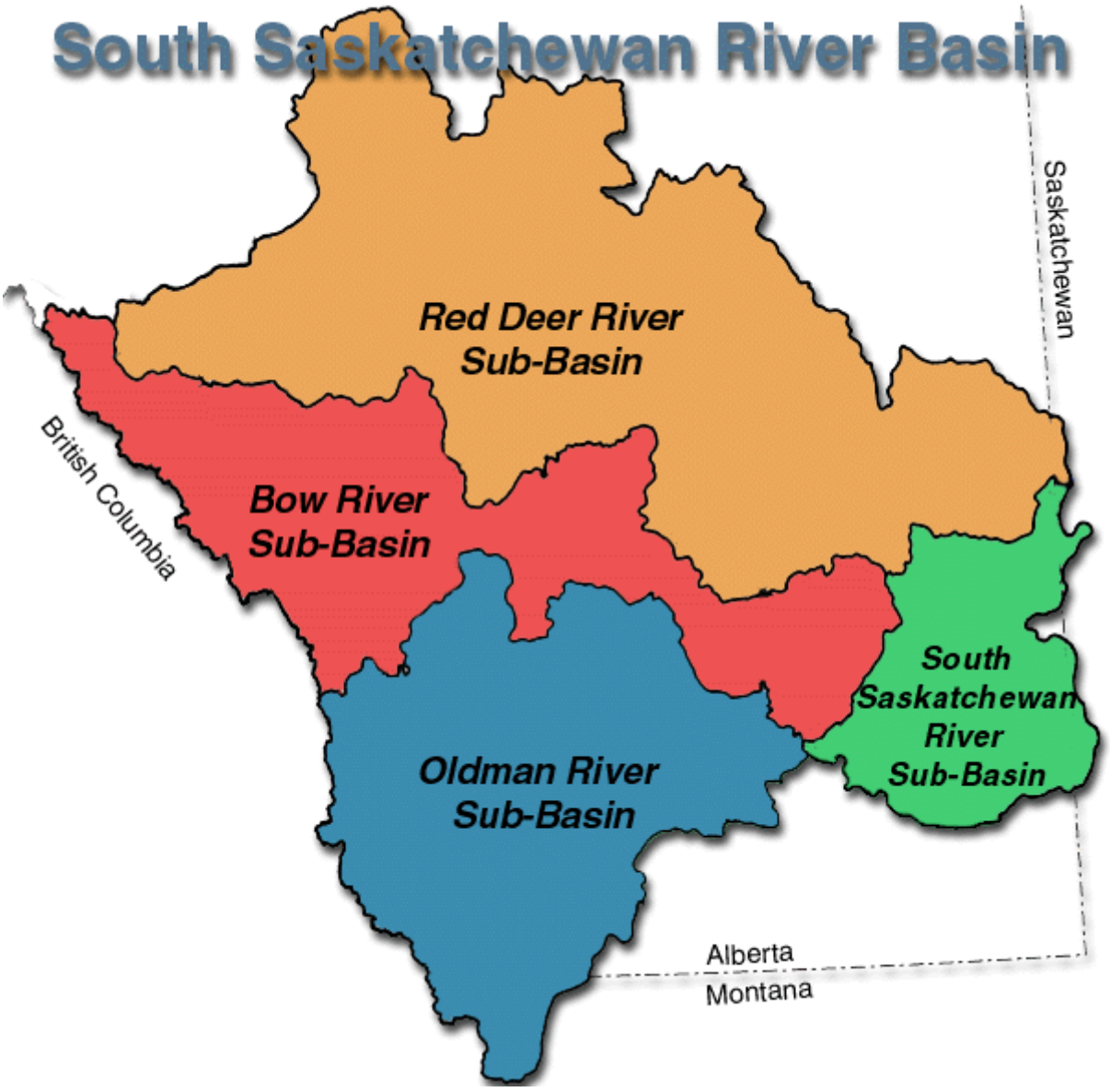

Figure 1.2 – South Saskatchewan River Basin of Alberta
(Alberta Environment and Sustainable Resource Development, 2014)

Several other studies suggest that the decision to transfer water is based on overriding social, cultural and economic factors (Rosegrant and Binswanger, 1994; Bauer, 1997; Solanes and Gonzales-Villarreal, 1999; Johansson *et al*, 2002; Levine *et al*, 2007; Meinzen-Dick, 2007; Bjornlund, 2010). This compliments research suggesting a diversity of motives and objectives that generally affect farmers' decision making (Gasson, 1973; Gasson, 1974; Austin *et al*, 1996; Vanclay *et al*, 1998; Willock *et al*, 1999a; Willock *et al*, 1999b; Beedell and Rehman, 1999; Beedell and Rehman, 2000; Falconer, 2000; Austin *et al*, 2001; Burton, 2004; Maybery *et al*, 2005; Vandermersch, 2006). However, no comprehensive study has rigorously analysed the effects of social, attitude and value influences towards irrigators' policy preferences or views towards water transfers in the SSRB. This study intends to fill this gap in the research by investigating the role of values and attitudes towards social influences, perceived risk and outside control, and perceived outcomes of water transfers; in forming irrigators' water trading intentions and policy preferences.

1.2 Research Question and Objectives

The central question that this thesis addresses is: '*what are the factors associated with irrigators' perceptions towards using water transfers as a way of re-allocating water to other users'.* In order to answer this research question, the following research objectives are specified:

i) Identify influences through a review of the attitude-behaviour and extractive commodity literature.

ii) Investigate the factors that influence irrigators' intentions to engage in water transfers in the SSRB.

iii) Investigate irrigators' policy preferences towards re-distributing water and the government's role in transfers.

iv) Explain the concerns raised by irrigators in the SSRB.

1.3 Structure of Thesis

Chapter two will provide the policy context within which the research is conducted. This is done by reviewing the literature pertaining to the institutional framework for water trading and water management in the SSRB (Chapter Two – Policy Context). The first objective will be achieved by reviewing the literature pertaining to farmers' decision making (Chapter Three – Literature Review). Chapter three outlines the conceptual foundation for a model that was used to achieve objectives two and three. Chapter four discusses the methodology that was used to gather the information to achieve objectives two and three. In particular, chapter four outlines both quantitative and qualitative methods that were used in combination with one another in order to answer the research question. The results are divided into two chapters for this reason: chapter five that analyses the results from a telephone survey; and chapter six that discusses results from personal interviews with key informants. Chapter seven is composed of discussion and conclusions that achieve objective four. This chapter discusses implications of the research, as well as proposed avenues for future research. The appendix provides copies of research instruments and additional information about the study.

CHAPTER TWO

POLICY CONTEXT

2.0 Introduction

A discussion of Alberta's "interrelated legal, administrative and political forces responsible for allocating water", or water institutions (Johansson *et* al, 2002: 187) is necessary to provide an understanding of the issues surrounding water re-allocation strategies in the SSRB. This chapter will discuss Alberta's water institutions within the context of the water policy and resource management literature. Water transfers, and their role in Alberta's water allocation system, are discussed along with the role of irrigators.

2.1 Role of Water Transfers

Irrigated agriculture now occupies 18% of total arable land globally, produces more than 33% of global agricultural production, and is the largest water user accounting for roughly 70% of water withdrawals (Johansson *et al*, 2002; FAO, 2010). Other areas of the world share the SSRB's problems, including the Colorado River watershed in the USA and Mexico (MacDonnell, 2005), watersheds of central and northeastern Mexico (Rosegrant and Binswanger, 1994), the Murray-Darling basin in Australia (Bjornlund, 2003a), and La Ligua River basin in Chile (Bauer, 1997; Budds, 2009). These regions use tradable water entitlements as a way to allocate water. Other regions, such as Pakistan and northwestern India, have a history of informal water markets between irrigators (Rosegrant and Binswanger, 1994; Easter *et al*, 1999).

Globally, the area under irrigation peaked in 1978 and has declined since then (Postel, 1999; FAO, 2010). During the late 1970s to early 1980s the cost of irrigation development has increased, coupled with rising government debt loads, growing inter-sectoral competition, and loss of land due to urban sprawl and salinization (Johannson, 2000). Public opposition towards certain irrigation projects and growing environmental

concerns began to change water institutions at the policy level (Bjornlund, 2004; Meinzen-Dick, 2007).

As Meinzen-Dick (2007) points out, from the 1970s onwards there was a trend among administrations to de-centralize irrigation systems as the limitations of their state-run systems was becoming apparent. This culminated with the use of water trading as a way to solve inefficiencies of water use in water stressed areas. Rosegrant and Binswanger's (1994) influential article laid out the case for tradable water rights to create incentives for water use efficiency. Rosegrant and Binswanger (1994) concluded that using tradable water rights can be very effective under certain circumstances, but their effectiveness depends on a host of factors including climate, levels of water scarcity, agricultural intensification, infrastructure, and government's ability to regulate impacts on third parties. This sentiment has been echoed by the World Bank and other development agencies (Dinar *et al*, 1997; Thobani, 1997; Easter *et al*, 1999).

In theory, the market moves the resource to its highest economic uses and avoids the problems associated with water being an open access resource (Ostrom and Gardner, 1993; Rosegrant and Binswanger, 1994; Dinar *et al*, 1997; Thobani, 1997). Nicol and Klein (2006b) identify in their literature review that irrigation water markets tends to move water from low to high valued uses; and water tends to be transferred from sellers who use relatively inefficient irrigation equipment to buyers who use relatively more efficient systems (Nicol and Klein, 2006b: 96). Market mechanisms are seen as useful for increasing overall water use efficiency (Howe *et al*, 1986; Rosegrant and Binswanger, 1994; Thobani, 1997).

Water markets are, however, difficult to implement as they require clearly defined property rights and a delivery and conveyance system that allows for water trading (Dinar *et al.*, 1997; Thobani, 1997; Bjornlund, 2003b). Administrative obstacles may also exist

once a market is implemented such as complex paperwork, high transaction costs, a lack of information, and lack of transparency (Dinar *et al.*, 1997; Bjornlund, 2003b). Many have concerns over social equity as well as the damaging ecological effects associated with water markets (Tisdell *et al*, 2001; Bakker, 2007; Christensen and Droitsch, 2008).

Much of the literature has warned against a 'one size fits all' approach to water policy. As Thobani (1997) points out: "…tradable water rights are not a panacea, and an effective system is not easy to introduce" (p. 177). The literature suggests tradable water entitlements may be a useful tool for allocating water during times of water scarcity in some regions, but may fall short of their goals in other regions (Bauer, 1997; Solanes and Gonzalez-Villarreal, 1999; Bjornlund, 2003b; Meinzen-Dick, 2007; Bjornlund, 2010). The successes and failures of market-based water allocation typically lie with the effectiveness of the water institutions governing them (Howe *et al*, 1986; Rosegrant and Binswanger, 1994; Thobani, 1997; Bjornlund, 2010). The literature suggests that in order for water institutions to successfully manage market based allocation, they must optimally coordinate geographical and environmental knowledge, political and legal structure, economic concerns, and socio-cultural concerns (Rosegrant and Binswanger, 1994; Dinar *et al*, 1997; Thobani, 1997; Bauer, 1998; Solanes and Gonzalez-Villarreal, 1999; Boelens and Zwarteveen, 2005; Meinzen-Dick, 2007; Bjornlund, 2010).

In order to effectively allocate water, water institutions must also have the ability to work within the confines of the local environment from which they serve (Howe *et al*, 1986; Rosegrant and Binswanger, 1994; Thobani, 1997). Meinzen-Dick (2007) discusses the negative effects of top-down bureaucratic policies that can be out of touch with local needs. This view is also expressed by others who stress the need for user based participation, and a grassroots approach to alleviating the effects of water scarcity

(Thobani, 1997; Solanes and Gonzalez-Villarreal, 1999; Meinzen-Dick, 2007; Bjornlund, 2010).

2.2 Water Allocation Systems

Water institutions are generally guided by overarching legislation that identifies the structure of water allocation systems which include distribution methods and water management techniques, such as pricing mechanisms. Property rights heavily influence water allocation systems. In most cases the legal system that establishes the guidelines from which water allocation is ran is based on the following legal traditions: i) public allocation; ii) riparian rights; and ii) prior appropriative rights (Rosegrant and Binswanger, 1994; Tarlock, 2001).

Public allocation involves the administration or government allocating and distributing the water (Rosegrant and Binswanger, 1994; Dinar *et al*, 1997). In western North America most major irrigation systems were initiated by government agencies, and the state has played an active role with water distribution systems (Reisner, 1993; Dinar *et al*, 1997; Tarlock, 2001; Meinzen-Dick, 2007). Water is viewed as a public good by many, and most governments have legislation protecting non-economic uses over economic uses (Bakker, 2007). Water distribution systems are often managed by user based or 'collective action' groups (Dinar *et al*, 1997).

'Collective action' groups, such as irrigation districts, are heavily involved with the conveyance and delivery of water (Dinar *et al.*, 1997). User based allocation has the ability to be extremely flexible with adapting to local water needs (Howe *et* al, 1986; Rosegrant and Binswanger, 1994; Dinar *et al*, 1997). There are, however, concerns about the difficulty in promoting inter-sectoral transfers of water, as one collective action group may conflict with another (Dinar *et al*, 1997). For example, an irrigation district's interests may conflict with that of a growing municipality creating a difficult atmosphere from which

voluntary transfers of water may be met with a large degree of resistance. Such an example has been very common throughout the literature (Rosegrant and Binswanger, 1994; Dinar *et al*, 1997; Bjornlund *et al*, 2007).

North American water laws determining water rights, or the right to divert and use water, are often based on riparian rights or prior appropriative rights (Rosegrant and Binswanger, 1994). Riparian rights originate from English common law and links ownership of water to adjacent or overlying lands (Rosegrant and Binswanger, 1994; Tarlock, 2001). Owners of these lands cannot sell these rights or transfer them separate from the land (Tarlock, 2001). Risk is shared between all water users during times of water shortage, as usually allotments are fixed in proportion to frontage on the water source (Tarlock, 2001).

Policy makers in 19th century Canada and USA found the riparian doctrine was ill suited for managing access to water in the arid west (Tarlock, 2001). Prior appropriative water rights became entrenched in several states' legislation since the Wyoming vs. Colorado Supreme Court case in 1872 (Tarlock, 2001). This case identified prior access to water as the defining feature of the right to use, as opposed to land ownership adjacent to water ways (Tarlock, 2001). This means that older license holders, or uses, receive priority of use which is in stark contrast to the riparian system from which water is accessed equally among users adjacent to a water body (Tarlock, 2001). This initially gave more water security to "tail-enders" of waterways, as their supply was not threatened by "head-enders" or up-stream users (Tarlock, 2001). This system is referred to as first-in-time, first-in-right (FITFIR).

2.2.2. First-in-Time, First-in-Right

Canadian policy makers adopted elements of the prior appropriation doctrine with the Northwest Irrigation Act of 1894 (Adamowicz *et al*, 2010). Although elements of

American prior appropriative water laws were used in this legislation, there are notable differences (Adamowicz *et al.*, 2010). In Alberta, the Crown, or provincial government, has control over the transfer process making inter-sectoral transfers an administrative decision. The Crown in this sense publically allocates the water, hence the term 'prior allocation'. This is very different to the prior appropriation system in the US where a user originally started to extract the water and then appropriated it via the courts; much the same way a miner stakes a claim. The FITFIR principle was originally based on the social values of fairness and justice, and to better maximize the economic efficiency of water (Tarlock, 2001). It attached water rights to use, which encouraged farmers to irrigate land as access to water was not threatened by others adjacent to the water source. This opened up rights to water for non-riparian landowners, which established the necessary conditions for large scale irrigation developments in the west (Tarlock, 2001).

FITFIR-based water rights were developed during a time when irrigated agriculture, stock watering and mineral extraction were seen as the most beneficial and economically valuable uses of water (Tarlock, 2001). They were also developed during a time when there was very little storage capacity in the west protecting users from drought conditions (Tarlock, 2001). A contentious issue in many western regions is that urban and industrial developments are now providing more economic output, yet priority of use lies with older and less valuable irrigation uses (Tarlock, 2001).

Zilberman and Shoengold (2005) contend that seniority-based water allocation systems impede water transfers because senior users have little incentive to conserve water and participate in the market. Furthermore, they contend that the corresponding lack of market activity may result in low prices which compound the problem as senior users have little financial incentive to sell any extra water they accrue from adopting water conserving technologies, such as from upgrading irrigation equipment (Zilberman and Shoengold,

2005). There is an argument that FITFIR does not rationalize the distribution of water as it does not base allocation on evolving socio-economic values or environmental vulnerabilities (Brandes *et al*, 2008). Others note that the system is irresponsible environmentally since "irrigated agriculture currently has priority regardless of how little water remains for in-stream flow needs when stream-flow is low" (Huffnaker *et al*, 2000: 267).

A recent suggestion in the SSRB is to replace the FITFIR doctrine with that or a proportional sharing doctrine (Droitsch and Robinson, 2009; Zilberman and Schoengold, 2005). Under a proportional sharing system water is allocated in proportion to the size of each license instead of according to the licenses' seniority. Under this system the historical practice of appropriative water licenses would continue, but these licenses would be effected substantially when water is scarce (He *et al*, 2012). According to a 2012 study that simulated economic gains in Alberta with a proportional sharing system, it out-performed the seniority based system in the following three scenarios: i) irrigation districts' permissible diversions being reduced in proportion to each district's licensed allocations; ii) the diversions being reduced in proportion with each district's past five-year average diversions; and iii) the diversions being reduced proportionately with each district's diversion in a single prior year (He *et al*, 2012). Nevertheless, the FITFIR system is still an entrenched water institution in the SSRB.

2.3 Alberta's Water Institutions

Alberta's water allocation systems are governed by the Water Act of 1999, Alberta Land Stewardship Act of 2009, and Irrigation Districts Act of 2000. The Water Act clearly identifies the rights and responsibilities of license holders and the provincial government (Crown). The Water Act vests ownership of water with the Crown (Section 3), and distributes water in the form of licensed allocations following a prior allocation system

using the FITFIR principle (Sections 30 and 32). During times of water scarcity senior license holders get access to water ahead of junior license holders. In the SSRB there is an ongoing debate whether the FITFIR principle is the appropriate allocation tool to meet the challenges of growing inter-sectoral demands (Huffnaker *et al*, 2000; He *et al*, 2012). As mentioned, some have suggested a share-based allocation system where water in excess of certain flows is allocated to users proportionally; that is the risk associated with uncertainty of supply is shared proportionally among users (Bjornlund, 2010; He *et al.*, 2012).

The Crown gives license holders the ability to share water with another license holder via assignments (Section 33), however, the buyer can only do that up to the volume of their own license. Therefore, this system cannot be used to expand production, only to maintain it. It also does not allow new non-license holders to start using water. In effect an assignment only transfers the priority of the seller's license to the license of the buyer. The Water Act also facilitates the transfer some or all of a licensed allocation to other users, both existing and new users (Section 81). In order to transfer a license the two participants must apply for Crown approval (Section 81). These transfers of water may be subject to a 10% holdback in volume traded at the discretion of the Crown to satisfy water conservation objectives (WCOs) (Section 83).

Before the Crown takes action under the Water Act, it must consider the goals of regional plans as outlined in the Alberta Land Stewardship Act of 2009 (Water Act Section 4.1). The Alberta Land Stewardship Act (ALSA) provides a regional land use framework in Alberta, from which long term development decisions are based (Section 2). Regional plans outline land-use planning goals, and serve as a way to align geographic, socio-cultural, economic and legal considerations in a region (Section 8). Regional plans may contain specific regulations concerning land-use restrictions that may affect water use

(Section 13). As of 2013 the South Saskatchewan Regional Plan (SSRP) is in the process of approval.

The Irrigation Districts Act of 2000 governs how irrigation districts operate and specifies their goals and responsibilities (Section 6). Most irrigation district hold senior licenses, and their licensed allocations are much larger than other users in the SSRB. Irrigation districts must act in accordance with ALSA regional plans, and must abide by their status as license holders under the Water Act. The Irrigation Districts Act enables transfers of irrigated acres between irrigators within each district, given district approval (Sections 25 and 26). As licence holders, irrigation districts also have the ability to trade their licensed allocations as stipulated under the Water Act. In order for a water transfer to occur, however, districts must hold plebiscites to which over half of the irrigators must vote in favour of the transfer (Section 11). Irrigation districts also have the ability to enter into water supply agreements with other users, including non-irrigators if the license allows this. This is typically done by amending licenses with the approval of Alberta Environment in order to supply users. This has traditionally been the desired sharing mechanism for irrigation districts because they still retain the licensed volume, whereas with a water transfer they lose the licensed allocation (Bankes and Kwasniak, 2005).

Regulations concerning WCO's, in-stream flow objectives, and watershed planning are outlined in Water Management Plans. WCO's, according to the Water Act (Section 83) are held by the Crown, and cannot be held by individual license holder, preventing environmental organizations and stewardship groups from holding water licenses for environmental purposes. The SSRB's Water Management Plan was approved in 2006, and closed the Bow, Oldman, and South Saskatchewan River sub-basins for new license applications (Alberta Environment, 2006). The SSRB's water management plan reinforces the role of the Crown in approving water transfers, and outlines matters that must be

considered before the approval of a transfer (Alberta Environment, 2006: 14). The over-arching goals of the Alberta government, affecting water management plans, are outlined in the *Water for Life Strategy* (WFL) of 2003.

2.3.1. Water for Life Strategy

The WFL has the following goals: i) provide safe, secure drinking water supply; ii) secure healthy aquatic ecosystems and iii) ensure reliable, quality water supplies for a sustainable economy (Alberta Environment, 2003). WFL calls for the overall efficiency and productivity of water use in Alberta to improve by 30 per cent from 2005 levels by 2015 (Alberta Environment, 2003). A long-term goal of the strategy is to "review the water allocation transfer system to ensure a viable market that moves water to support sustainable economic development" (Alberta Environment, 2003: 12). This expresses the WFL's objective to use water transfers, or trading, as an incentive to reallocate water gained by increasing overall efficiency.

As mentioned, some in the irrigation sector have expressed skepticism towards the goals of WFL. A 2006 survey irrigation district board members in the SSRB found that only half of the respondents believe the economic efficiency goal of 30% can be achieved and only 26% of respondents believe water use efficiency can be improved to meet the target (Bjornlund *et al*, 2007: 138). Many felt that the 30% goal is too ambitious, and that prices for commodity crops do not provide incentive for purchasing more efficient irrigation equipment (Bjornlund *et al*, 2007). Another study concluded irrigators who have their own private licenses are unlikely to invest in improving irrigation technologies and management practices (Nicol *et al*, 2010). A range of factors were identified, including geographic and financial constraints (Nicol *et al*, 2010).

Some also question the assumption that improvement in water use efficiency will lead to reduced water use (English *et al*, 2002; Whittlesey, 2003). Often the primary

purpose of adopting water saving technology is to increase yields, not to save water. Therefore, the adoption of more efficient technologies often increases, rather than decreases, water use (English *et al*, 2002; Whittlesey, 2003; Bjornlund *et al*, 2009). A 2009 study in the Taber and Raymond Irrigation Districts in the SSRB found that the main reason for implementing changes to irrigation were to improve crop yields and reduce energy costs (Bjornlund *et al*, 2009). The study re-affirmed an earlier 2006 study indicating that adoption of water saving technologies among SSRB irrigators has been high, and a further 30% improvement is questionable (Bjornlund *et al*, 2007).

Several irrigation districts have attempted to have portions of their licenses amended to enable them to supply water to non-irrigation users (Bjornlund *et al,* 2009). This would enable them to satisfy water demand under a number of arrangements other than the permanent transfer of the water right (Bjornlund *et al*, 2009). Some environmental groups argue that these types of amendments allow irrigation districts to operate as water brokers by obtaining authority to provide water to any person for virtually any purpose at whatever price is determined (Christensen and Droitsch, 2008). They also argue that this system circumvents the need for public oversight associated with transfers laid down in the Water Act. This concern was first raised in 2003 when the St. Mary Irrigation District (SMRID) got an amendment of one of its licenses allowing them to divert 270,000 ML for other, non-irrigation uses (Banks and Kwasniak, 2005). This trend continued when the Eastern Irrigation District (EID), and other districts, sought to amend two licenses, accounting for 940,000 ML in 2007 (Bjornlund *et al*, 2009). These amendments were vigorously opposed both administratively and in the courts by environmental groups. In January, 2013 the Queen's Bench of Alberta has ruled that there is no public standing at the Alberta Environment Appeal Board for those not directly affected by proposed

amendments (Fluker, 2013). Nevertheless, concerns amongst environmental lobby groups remain over these licensed amendments.

The opposition to these amendments represents concerns over water use. Historically, the EID has only used an average of 74% of its allocation (Christensen and Droitsch, 2008: 22). Amending a license could result in the use of more of that allocation augmenting the environmental impact of the current level of extraction. Although the director has the ability to only allow traded volumes that have been 'historically used' as opposed to total allocation; this leaves a policy gap where irrigators may be more inclined to sell water they are not using. This may actually increase water use which is contrary to the goals of WFL.

A potential solution to this problem was highlighted in the approved water management plan for the SSRB that proposed to "allow a part of a licence to be cancelled. The Water Act only permits cancellation of a full allocation. This is an obstacle to the desired objective of being able to match actual water needs with allocations." (Alberta Environment, 2006: 17). The need to rectify licensed volumes available for trade was also expressed by an advisory group in 2009 with the recommendation: "The minister [must] clarify the amount of water the licencee is entitled to transfer. The Water Act does not deal clearly with this and it must ultimately be resolved for the transfer system to achieve its full potential." (Alberta Environment, 2009: 4).

2.4 Water Trading Issues

The skepticism expressed towards WFL goals, and particularly towards the use of water trading, is in tune with the part of the literature highlighting institutional barriers to transfers. For example, Easter *et al* (1999: 102) pointed out that frequent problems associated with poorly regulated water markets include negative third party effects due to water trading, and reduction in return flows along with changes in water quality.

Additional problems with trading surface water may include increased costs of irrigation systems, unfair market power for large-scale buyers and sellers, and drop in land values (Easter *et al*, 1999: 102).

In order to mitigate the negative effects of poorly regulated markets, the following has been suggested: i) establish clearly defined and enforceable property rights and water entitlements; ii) ensure proper monitoring and evaluation of water use; iii) encourage reduced transactions costs associated with trade; iv) ensure transparency and readily accessible information for participants; and v) ensure proper protection for environmental and social needs (Thobani, 1997; Solanes and Gonzalez-Villarreal, 1999; Easter *et al*, 1999; Horbulyk, 2005; Chong and Sunding, 2006; Levine *et al*, 2007; Bjornlund, 2010).

A study conducted in 2004 examining permanent buyers and sellers of water in the SSRB concluded that that buyers and sellers had a hard time finding one another, and that price information was scarce leading to a high variability in price (Nicol *et al*, 2008). The researchers cited that, although comparatively administrative transaction costs are lower than the average, they were an impediment to trading that caused complaints by market participants (Nicol *et al*, 2008).

Another potential issue for water trading in the SSRB is environmental protection. Currently WCOs are defined under the current water management plan are 45% of natural flow, or the current in-stream objectives plus 10% whichever is greater. As mentioned the Director may hold back 10% of a traded volume and allocate it towards a WCO. This raises two concerns. First, WCOs still abide by the priority licensing system. WCOs acquire license priority just like any other transfer. So, for example, during the 2007 transfer between WID and the M.D. of Rocky View, the 10% holdback acquired a 1903 license, since that was the licensed volume being transferred. This does not pose much of an issue for WCOs acquiring senior priority. Many, however, believe that WCOs should be

held outside of the priority system to reflect their importance. In 2009 a minister's advisory group highlighted the inadequacy of this with their first recommendation regarding protected water stating that the current WCO system "…does not reflect the level of protection that would have been defined if the basin had not been so heavily allocated at the time that the Management Plan was completed." (Alberta Environment, 2009: 1).

Enabling the possibility of a 10% holdback also brings into question the incentive to trade water. The minister's advisory group recommended future studies of the possibility of a financial fee, or charge, as opposed to, or complimenting, a 10% holdback (Alberta Environment, 2009: 14). This comes with the realization that long term inter-sectoral transfers may be financially large, but the 10% holdback would provide very little to meet WCO's. The irrigation sector has expressed a negative disposition towards WCO's for this reason (Bjornlund *et al*, 2007).

Property rights are also a concern as water for irrigation is attached to land as elements of riparian law still exist in Alberta. Under section 58 of the Water Act licenses are "appurtenant to the land or the undertaking specified in the licence and are inseparable therefrom." This largely applies to irrigated land where water 'rights' are attached to the property and are transferred with the sale of property. The Water Act and Irrigation District Act does allow for licensed, or district allotted, water to be transferred from one piece of land to another, however the attachment of water to land has increased irrigated land values. This means that water prices must meet or exceed their difference in land values in order to encourage trading, particularly for long-term permanent trading. International experiences have shown that this is rare and is an impediment for trading water (Easter *et al*, 1999; Bjornlund, 2001).

2.5 Importance of Irrigation

Irrigation districts are "dominant economic and political players within the provincial water rights regime" (Bankes and Kwasniak, 2005: 6). There are thirteen irrigation districts in the SSRB that hold approximately 84% of irrigation allocations with the remaining 16% held by private irrigators (IWMSC, 2002). Most of the early water trading activity in the SSRB has been in the form of trading between irrigators with most trade occurring within irrigation districts (Nicol *et al*, 2008). Irrigation district water conveyance and distribution systems also serve communities and industries. As of 2002 Irrigation districts in the SSRB supplied water to approximately forty two thousand people in forty seven communities and to twelve industrial users (IWMSC, 2002).

Irrigation systems in the SSRB are important to agricultural producers as they have increased crop production and allowed for the production of specialty crops that would not grow under dryland conditions (Samarawickrema and Kulshreshtha, 2008). Most irrigation water in the SSRB is used for oilseed, cereal and forage production (IWMSC, 2002). Forage crops are mostly used to feed livestock, which of itself is a $4.4 billion industry in Alberta (IWMSC, 2002). Irrigated crop production in the SSRB has attracted major food processing industries that contribute billions of dollars in spinoffs to the provincial economy. One study estimated that increases in primary production from irrigation and the spin-offs in agri-food processing contribute over 18 % to the agri-food portion of gross domestic product for Alberta (IWMSC, 2002). A 2002 report highlighted that " the ratio between the value of agri-processing shipments and farm receipts from primary production is 2.65 in the irrigated south, compared with 1.05 for other parts of Alberta" (IWMSC, 2002: 141). These financial incentives, combined with the relative security of water supply and comparatively low cost of using it, strongly encourage irrigation use in southern Alberta.

Eighty-nine water bodies created as irrigation infrastructure provide recreational activities to southern Albertans (IWMSC, 2002). The recreational activities provided by these water bodies' impacts local economies as "it is estimated that tourists spend about $2 million a year on water-based recreation in southern Alberta. The monetary impact of recreational activities on the regional economy has been estimated to be in the order of $29 million a year" (IWMSC, 2002: 143).In addition to recreational activities, irrigation water supports over 35,000 hectares of wetlands habitat that preserves natural ecosystems (IWMSC, 2002).

The skepticism irrigators have towards water transfers is perhaps most apparent with the 2007 transfer of water from the Western Irrigation District (WID) to the municipality of Rocky View. This involved the permanent transfer of 2500ML of water in exchange of a $15 million payment to the WID to convert a leaky canal into an efficient pipeline. The pipeline saved more than 2500ML therefore gaining the district more access to water after the sale (Christensen and Droitsch, 2008; Bjornlund *et al*, 2009). Irrigators were concerned about the permanent loss of water, and there was widespread opposition to the sale. The plebiscite was passed, albeit by a very a narrow margin. This sale illustrates what the literature has already suggested: permanent inter-sectoral trades of water from irrigation to non-irrigation uses encounter opposition in the early phases of the market.

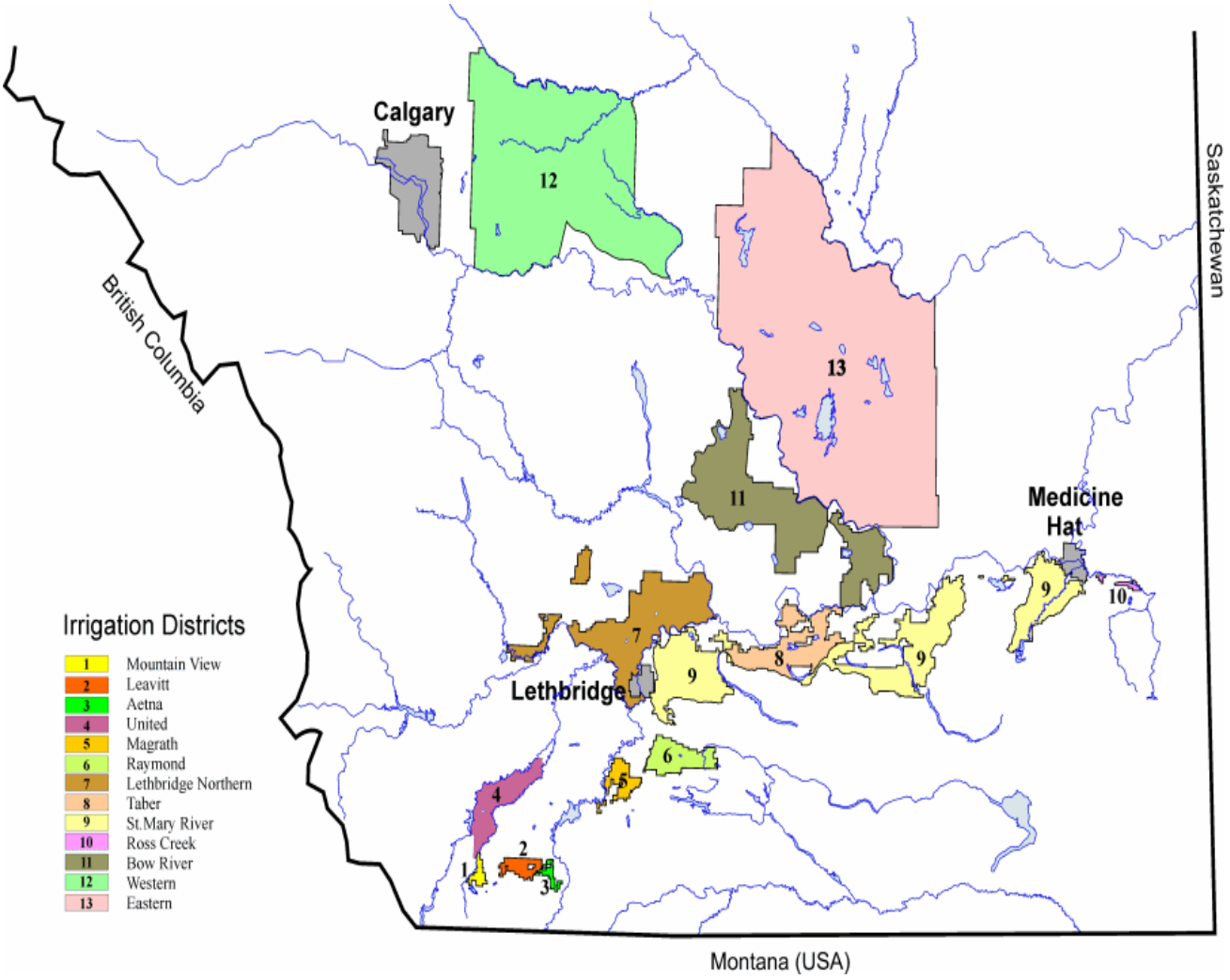

Figure 2.1 – Irrigation Districts of Alberta
(PSSRB, 2009: 107)

2.6 Summary

This chapter has highlighted the research problem by reviewing the role of water trading, and the barriers to water trading, given Alberta's current water institutions. Irrigation uses have been noted as particularly important in Alberta's water institutions, and their unwillingness towards using water transfers as a means to re-allocate water has been highlighted. The table below illustrates the barriers to trade that may contribute to this unwillingness:

Table 2.1 – Institutional Barriers to Water Transfers in Alberta

Barriers to Trade		Alberta Context	Supporting Literature
Property Rights	i) ii) iii)	Consumptive uses vs. Total allocations. Priority System (FITFIR). Attachment to Irrigated Land (Water Act Section 58) affecting land value.	Rosegrant and Binswanger, 1994; Thobani, 1997; Easter *et al*, 1999; Bjornlund *et al*, 2009
Lack of Information	i) ii)	Connecting buyers and sellers. Lack of knowledge of benefits or costs of trade.	Thobani, 1997; Nicol *et al*, 2008
Environmental Purposes	i)	WCO holdbacks	Rosegrant and Binswange,r 1994; Thobani, 1997; Meinzen-Dick, 2007;Bjornlund *et al*, 2007
Transaction Costs	ii)	Lengthy approval processes	Horbulyk, 2005; Nicol *et al*, 2008

Factors that influence water trading identified in the literature include: i) price (Brooks and Harris, 2008); ii) risk averse attitudes (Gomez-Limon and Riesgo, 2004); iii) farm income including off farm sources (Wheeler *et al*, 2008); iv) farm size (Bjornlund, 2006) and v) farm investments (Bjornlund and Rossini, 2005). Motivations to buy water are typically different to selling water (Gomez-Limon and Risego, 2004; Bjornlund, 2006; Loch *et al*, 2012). Motivations to buy water identified in the literature are associated with risk averse attitudes and weather uncertainties; whereas motivations to sell include having surplus water, and changing crop needs (Gomez-Limon and Risego, 2004; Bjornlund, 2006; Loch *et al*, 2012).

There is a wealth of literature suggesting that attitudes, values and social interactions also influence farmers' management decisions (Gasson, 1973; Gasson, 1974; Potter and Gasson, 1988; Fairweather and Keatng, 1994; Austin *et al*, 1996; Willock *et al*, 1999a; Willock *et al*, 1999b; Beedell and Rehman, 1999; Austin *et al*, 2001; Burton, 2004; Maybery *et al*, 2005; Vandersmensch, 1996; Kuehne *et al*, 2008). These influences may be particularly useful in explaining decisions to vote in an irrigation district plebiscite where individual irrigators within the district do not receive financial compensation for re-allocating water. Attitudes towards water use may also explain unwillingness towards re-allocating water for environmental purposes via WCOs. The next chapter reviews these influences by drawing from health psychology and extractive-commodity literature that tends to treat farmers as consumers or customers. This creates the conceptual framework that forms the foundation for the methods used in the research.

CHAPTER THREE

LITERATURE REVIEW

3.0 Introduction

This chapter addresses the second research objective: to identify influences of farmers' decision making through a review of the social psychology, economics and geography literature. In particular, attitude-behaviour connection and extractive commodity theory literature formed the foundation of the conceptual framework derived from this literature review. The first section is an overview of psychological motives for farming found in the literature. This is followed by a discussion of the importance of values and attitudes identified in the literature towards farmers' decision making. Next, there is a review of the literature regarding farmer heterogeneity and the common practice of categorizing farmers in order to understand the diversity of their intentions and influences.

3.1 Psychological Motives in the Literature

Landholder attitudes towards environmental policies have led to varying levels of political opposition and cooperation (Beedell and Rehman, 2000; Tisdell *et al,* 2001; Morris and McBeth, 2003; Maybery *et al,* 2005). Financial interests in land play a fundamental role in farmers' attitudes towards risk, water use, debt, and land (Gomez-Limon and Riesgo, 2004; Bjornlund and Rossini, 2005; Kuehne *et al,* 2008; Wheeler *et al,* 2008). This gives some credence to the extractive-commodity theory that assumes an intimate connection between individuals' occupations and place of residence with their environmental attitudes (Tremblay and Dunlap, 1978; Van Liere and Dunlap, 1980; Lowe and Pinhey, 1982; Samdahl and Robertson, 1989; Morris and McBeth, 2003).

3.1.1 Extractive Commodity Theory

Extractive commodity theory was developed by Tremblay and Dunlap (1978) in an attempt to explain concerns that rural residents in the United States had significantly different environmental concerns from the urban population. This theory was embraced by those who researched social determinants of environmental concern (Samdahl and Robertson, 1989) and the effects of demographical characteristics on environmental concern (Van Liere and Dunlap, 1980; Lowe and Pinhey, 1982). This theory has more recently been used to appeal to 'green consumerism' in marketing strategies (Straughan and Roberts, 1999; Laroche *et al*, 2001; Diamantopoulos *et al*, 2003).

Most uses of extractive-commodity theory have identified groups of people based on socio-demographic information (Van Liere and Dunlap, 1980; Lowe and Pinhey, 1982; Samdahl and Robertson, 1989; Morris and McBeth, 2003; Huddard-Kennedy *et al*, 2009). Pro-environmental groups, for instance, are more likely to be urban, with higher levels of education and income (Van Liere and Dunlap, 1980; Lowe and Pinhey, 1982; Samdahl and Robertson, 1989; Morris and McBeth, 2003; Huddard-Kennedy *et al*, 2009). This is partially because of varying information sources between urban and rural populations; and the different level of dependence on the land for economic purposes (Morris and McBeth, 2003). In one Montana study, the farmers who were less dependent on farming for household income were more likely to be supportive of environmental initiatives (Morris and McBeth, 2003). The study also found that farmers tended to trust information from agricultural organizations as opposed to environmental groups, which is markedly different from their urban counterparts (Morris and McBeth, 2003). Dependence on the land for income is likely also to influence goals and views towards the environment (Van Liere and Dunlap, 1980; Lowe and Pinhey, 1982; Samdahl and Robertson, 1989; Morris and McBeth, 2003; Huddard-Kennedy *et al*, 2009).

When analysing environmental concern, Van Liere and Dunlap (1980) hypothesize that age, sex, residence, social class, political leaning and education are all influential factors. The social connections that farmers have are often dictated by where they live, and what affiliations they have (Morris and McBeth, 2003). Morris and McBeth (2003) stressed the importance of agricultural and social group affiliations in relaying information to farmers.

Table 3.1 – Socio-Demographic Influences on Decisions

Socio-Demographic Variable	*Supporting Literature*
Off-farm and on-farm income	Van Liere and Dunlap, 1980; Samdahl and Robertson, 1989; Beus and Dunlap, 1990.
Age	"Age Hypothesis"- Van Liere and Dunlap, 1980.
Gender	"Sex Hypothesis" – Van Liere and Dunlap, 1980.
Education	Van Liere and Dunlap, 1980; Lowe and Pinhey, 1982; Samdahl and Robertson, 1989; Morris and McBeth, 2003; Huddard-Kennedy *et al*, 2009.
Location – Place of Socialization	"Residence Hypothesis" – Tremblay and Dunlap, 1978; Van Liere and Dunlap, 1980; Beus and Dunlap, 1990; Huddart-Kennedy *et al*, 2009.
Social Group Affiliations	Morris and McBeth, 2003.

Morris and McBeth's (2003) research uncovers a component of attitudes and values: the type of information people are receiving. This may shape views of the

environment between rural and urban populations. Berenguer *et al* (2005) discovered that rural populations tend to care about environmental issues more than urban populations, but that those concerns are primarily due to the economic dependence on the land. Stein *et al* (1999) conclude that rural and urban populations share similar values with their urban counterparts, but have different views of the environment. Rural populations tend to view environmental problems more specifically, such as with rivers, or farmland. Urban populations tend to view environmental problems on a more macro scale (Stein *et al,* 1999).

Table 3.2 – Farm characteristics influencing Irrigators' Decisions

Farm Characteristics	*Supporting Literature*
Dependence on Irrigation	Tisdell *et al,* 2001; Bjornlund, 2003a; Gomez-Limon and Riesgo, 2004; Kuehne *et al,* 2008
Crops Grown	Fairweather and Keating, 1994; Austin *et al,* 1996; Gomez-Limon and Riesgo, 2004; Bjornlund, 2006; Loch *et al,* 2012.
Farm Investments	Tisdell *et al,* 2001; Burton, 2004; Bjornlund and Rossini, 2005; Bjornlund *et al,* 2007
Location	Dent *et al,* 1995; Willock *et al,* 1999a; Meinzen-Dick, 2007

Water trading behaviour in southern Alberta may be explained by the level of the traders' dependence on the land for income. This is certainly in tune with the literature suggesting that farm income and farm investments are strong influences on water trading behavior (Gomez-Limon and Riesgo, 2004; Bjornlund and Rossini, 2005; Kuehne *et al*, 2008; Wheeler *et al,* 2008). It can be hypothesized, based on the extractive-commodity theory literature, that farmers in southern Alberta will likely fall into specific groups in part based on their socio-demographic differences; and that these groups will have different pro-environmental attitudes based on their economic dependence on the land (Tremblay and

Dunlap, 1978; Beus and Dunlap, 1990). There is literature suggesting that dependence on irrigation, level of farm investment, crop needs and locational characteristics (such as soil, water availability and heat units) all play significant roles in irrigators' decisions (Table 3.1.2).

3.1.2 Transactional Theory

It is thought that the socio-demographics that influence pro-environmental attitudes, also influence farmers' decision making, and that there is a tangible connection between the two (Willock *et al*, 1999a). In this body of literature it is often assumed that socio-demographics and external constraints influence farmers' values and attitudes towards farm decision making (Gasson, 1973; Austin *et al*, 1996; Willock *et al*, 1999a; Maybery *et al*, 2005; Kuehne *et al*, 2008). That is, they are antecedent to behaviours. This is known as the transactional theory (Willock *et al*, 1999a).

Transactional theory has its roots in methodological approaches to studying the psychological factors influencing volitional management behaviour (Kraus, 1995; Willock *et al*, 1999a). Historically, this stemmed from the demand for more quantitative behavioural studies which motivated researchers to adopt standardized models of behaviour to investigate psychological factors (Kraus, 1995). These models conceptually draw from past literature on the relationship between attitudes and behaviour. One such theory is transactional theory, which was originally devised by psychologists Lazarus and Folkman (1987). Transactional theory breaks down action and reaction relationships within behaviour. Antecedent variables, such as personal characteristics lead to mediating variables, such as attitudes, which then lead to behaviours. A multi-disciplinary agricultural research group from the UK conceptualized this theory into a model, as displayed in Figure 3.1 (Willock *et al*, 1999a: 6).

The use of transactional assumption is usually used to rationalize the study of psychological factors towards farming (Gasson, 1973; Potter and Gasson, 1988; Austin *et al*, 1996; Willock *et al*, 1999a; Willock *et al*, 1999b; Tisdell *et al*, 2001; Maybery *et al*, 2005). Research into the non-financial influences on irrigators decision making have been popular in countries such as Australia (Tisdell *et al*, 2001;Bjornlund, 2004; Kuehne and Bjornlund, 2008; Wheeler *et al*, 2008; Kuehne and Bjornlund, 2010); and the UK (Willock *et al*, 1999a; Willock *et al*, 1999b; Beedell and Rehman, 1999; Beedell and Rehman, 2000; Rehman *et al*, 2007). This body of literature embraces farming as a vocational behaviour that is influenced by psychological factors, such as values and attitudes, and not only as a profit maximising activity (Gasson, 1973; Gasson, 1974; Fairweather and Keating, 1994; Willock *et al*, 1999a). Ashby (1926) popularises this view: "if we want to know how or why a farmer acts in a certain way or how to induce him to act in a certain way, we have to enquire why men act, and especially why men act as they do when they live in the sort of social environment and general circumstances in which farmers live" (Ashby in Gasson, 1973: 521).

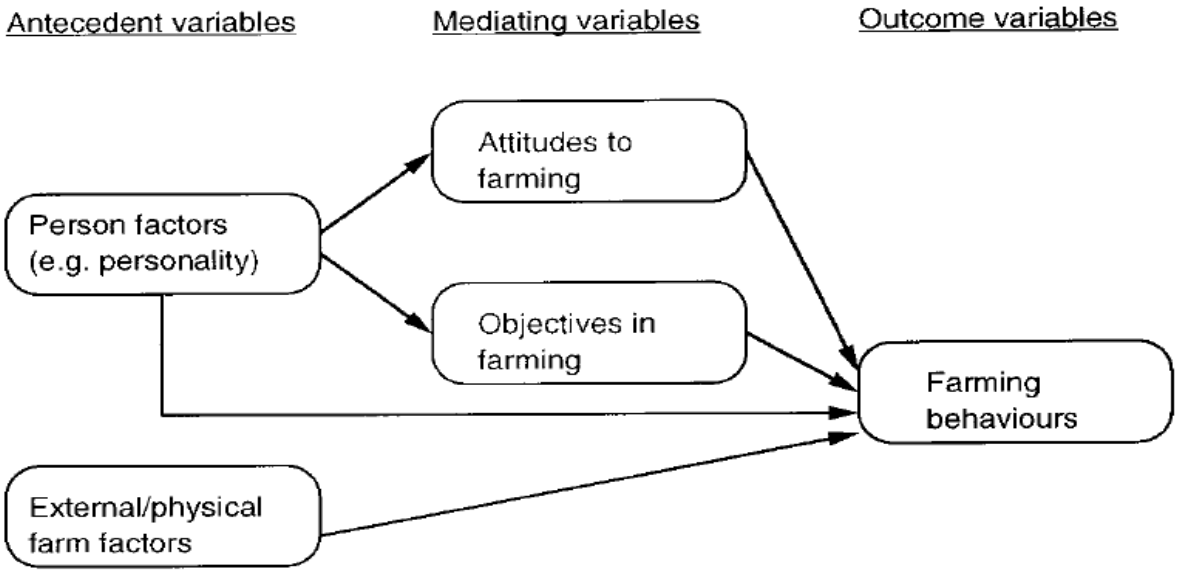

Figure 3.1 – Transactional Theory
(Willock *et al*, 1999a: 6).

Due to differing values and attitudes towards land, water, and farming practices; some suggest it is difficult to "[ensure] an equitable and fair distribution of water, [meet] environmental flow requirements, and [account] for local economic and social impacts" (Tisdell *et al*, 2001: 21). Farmers usually display a diversity in their long termed goals and objectives, which may or may not be aligned with environmental strategies (Fairweather and Keating, 1994; Austin *et al*, 1996; Tisdell *et al*, 2001; Maybery *et al*, 2005; Darnhofer *et al*, 2005; Kuehne and Bjornlund, 2008). A general conclusion is that these long termed goals and objectives are, at least partly, influenced by the values and attitudes that farmers hold towards farming (Gasson, 1973; Gasson and Potter, 1988; Beus and Dunlap, 1990; Fairweather and Keating, 1994; Willock et al, 1999b; Maybery et al, 2005; Kuehne et al, 2008).

Farmers seem to hold different values toward the family, farming as an occupation, and attitudes towards debt, the environment, and land use. That is, different value and attitude orientations have been identified in the literature, highlighting different farming motives and goals (Fairweather and Keating, 1994; Willock *et al*, 1999b; Bjornlund, 2004; Maybery *et al*, 2005; Kuehne and Bjornlund, 2008). These value orientations have been used to either identify groups of farmers based on some underlying trait; or to identify underlying factors related to farmers' decision making (Beus and Dunlap, 1990; Fairweather and Keating, 1994; Austin *et al*, 1996; Jackson-Smith and Buttell, 2003; Darnhofer *et al*, 2005; Maybery *et al*, 2005; Kuehne and Bjornlund, 2008).

3.2 Values

Grube, Mayton and Ball-Rokeach (1994) define values as "cognitive representations of individuals' needs and desires on the one hand, and of societal demand on the other… they are translations of individual needs into a socially acceptable form that can be presented and defended publicly" (p.155). They are desired end-states that establish

criterion for observing the world (Rokeach, 1973). According to Friedman (1987) "identifying values most cherished by an individual should enable a reasonable prediction of that individual's action…the root of the problem lies in the difficulty in identifying values independently of the actions they are supposed to inform" (p.56).

In agriculture a common value comparison is between conventional and alternative forms of farming (Beus and Dunlap, 1990). Conventional agriculture is "capital-intensive, large-scale, highly mechanized agriculture with monocultures of crops and extensive use of artificial fertilizers, herbicides and pesticides, with intensive animal husbandry (Knorr and Watkins, 1984: x in Beus and Dunlap, 1990: 594). Alternative agriculture, on the other hand, is "organic agriculture, [environmentally] sustainable agriculture, regenerative agriculture, eco-agriculture, permaculture, bio-dynamics, agro-ecology, natural farming, low-input agriculture, and others (Beus and Dunlap, 1990: 594). Beus and Dunlap (1990) conclude that over-riding values towards farming have diverged from a historically utilitarian (conventional) orientation towards a more eco-friendly (alternative) orientation. This, in turn, effects where farmers lie on a scale of conventional versus alternative (Beus and Dunlap, 1991).

Beus and Dunlap's (1990) influential research inspired other studies investigating the role of values towards the adoption of alternative forms of agriculture, particularly organic agriculture (Beus and Dunlap, 1994; Salamon *et al*, 1997; Corner *et al*, 1999; Abaidoo and Dickinson, 2002; Jackson-Smith and Buttel, 2003; Darnhofer *et al*, 2005; Maybery *et al*, 2005; Wheeler, 2008). Most have found that value orientations displayed by farmers are heterogeneous with different groups of farmers more or less willing to adopt alternative agricultural practices (Salamon *et al*, 1997; Corner *et al*, 1999; Maybery *et al*, 2005).

Table 3.3 – Farmer value classifications from the literature

Farmer Value Orientations	***Supporting Literature***
Instrumental, Social, Expressive and *Instrinsic*	Gasson (1973)
Conventional and *Alternative*	Beus and Dunlap (1990)
Dedicated producer, Flexible strategist and *Environmentalist*	Fairweather and Keating (1994)
Yeoman and *Entrepreneur*	Austin, Deary, Gibson, McGregor and Dent (1996)
Family Farmism, Environmentalism and *Farm Lifestyle*	Jackson-Smith and Buttel (2003)
Economic, lifestyle and *Conservation.*	Maybery, Crase and Gullifer (2005)
Committed conventional, Pragmatic conventional, Environment-conscious but not organic, Pragmatic organic and *Committed organic*	Darnhofer, Schneeberger and Bernhard (2005).
Providers, Lifestylers and *Investors*	Kuehne, Bjornlund and Cheers (2008)

There has been some interest in the Australian literature analysing the values of farmers in order to assess the success of environmental policy instruments (Maybery *et al*, 2005; Kuehne *et al*, 2008; Kuehne and Bjornlund, 2010). In Australia, over-allocation in the Murray-Darling Basin has led to water reforms aimed at cutting irrigation water entitlements so that environmental flow allocations can be increased (Kuehne *et al*, 2008). This, as discussed in the Policy Context, is similar to the goal of WCOs in Alberta. The difference is that state governments in Australia actively buy back entitlements for

environmental purposes, whereas that action has not yet been taken in Alberta. The Australians have found that policies solely relying on commercial incentives, such as market-based instruments to achieve landholder cooperation, only gains participation from those who are motivated by profit maximisation (Bjornlund, 2004; Maybery *et al*, 2005; Kuehne *et al*, 2008). They find that values offer some insight into the non-commercial motives of farmers.

3.3 Attitudes

Attitudes towards policies or management decisions are discussed far more often in the literature than farmer's over-riding values (Lowe and Pinhey, 1982; Beus and Dunlap, 1990; Petzrelka *et al*, 1996; Willock *et al*, 1999a; Willock *et al*, 1999b; Tisdell and Ward, 2003). This is because attitudes are more object or action specific (Rokeach, 1973). Attitudes are defined as "a positive or negative response(s) towards an attitude-object [person, idea, concept or physical object]" (Willock *et al*, 1999b: 287). Many beliefs underlie attitudes (Willock *et al*, 1999b). These are beliefs about the world shaped by social stimulus and behavioural conditioning (LaPiere, 1934; Rokeach, 1973). Attitudes are shaped by the level of known information and emotions (Rockeach, 1973).

Beginning in the 1920's there have been attempts to quantify attitudes through the use of scales (Thurstone, 1928; Likert, 1932). Advances in polling and sampling techniques around this time enabled representative surveys of wide-held attitudes (Kraus, 1934). This was quickly used to the benefit of marketers and advertisers; as well as the media and intelligentsia (Kraus, 1934). Early studies focused on reliability and assumed close relationships between attitudes and behavior (Wicker, 1969; Kraus, 1995).

Virtually the only use of attitudes as predictor variables for behaviours during this period was LaPiere's (1934) study of social attitudes. LaPiere (1934) studied the validity of social discriminatory attitudes in the United States. He toured the United States with a

couple of Chinese origin and monitored them as they asked for the services of 251 hotels and restaurants. His findings showed that although 97% of respondents indicated they would not serve people of Chinese origin, the couple was only refused service 2 %of the time (LaPiere, 1934).

More skepticism over an attitude-behaviour connection came with Wicker's (1969) review of 47 empirical studies exploring the connection. Wicker noted that there was "little evidence to support the postulated existence of stable, underlying attitudes within the individual which influence both his verbal expressions and his actions" (Wicker, 1969: 75). Kraus (1995) points out that after this review, researchers began to view inconsistencies in attitudes and behaviours as resulting from either methodological errors, or lack of moderator variables.

3.3.1 Theory of Reasoned Action

Azjen and Fishbein proposed that methodological errors were largely responsible for past attitudinal inconsistencies with behaviour. Instead of focusing on reliability, as most previous research had done, Ajzen and Fishbein dedicated most of their methodological research towards accurately measuring the validity of attitudes (Ajzen and Fishbein, 1970; Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1977; Kraus, 1995). This shifted the focus of their surveys and measurements of attitudes. Their empirical research in the 1970's showed the more precise the measure of intention was, correlations became more significant between intentions and behaviours (Ajzen and Fishbein, 1970; Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1977).

This research used a conceptual model that Fisbhein created that expanded on Dulany's theory of propositional control (Ajzen and Fishbein, 1970).

Fishbein's theory of reasoned action (TRA) claimed that behavioural intentions are antecedent to behaviour, and that attitudes and social influences are immediate antecedents

to behavioural intentions (Ajzena nd Fishbein, 1970). Social influences, or subjective norms, are subjective beliefs about the social influences of others (Ajzen and Fishbein, 1970). Attitudes and subjective norms are anchored by expectations of the outcome of the behaviour, social influences of a combination of normative beliefs and the motivation to comply with those beliefs (Ajzen and Fishbein, 1970).

The TRA immediately received attention in the academic community, particularly in the disciplines of health sciences (Pender & Pender, 1986; Charng *et al.,* 1988; Schlegel *et al.,* 1992); marketing and commerce (Shimp and Kavas, 1984; Hansen *et al,* 2004; Fitzmaurice, 2005); and social psychology (Madden *et al,* 1992; Rehman *et al,* 2007). The TRA was utilised to explain farming activities as well (Lynne *et al,* 1995; Willock *et al,* 1999b; Beedell and Rehman, 2000; Tisdell *et al,* 2001; Corbett, 2002; Rehman *et al,* 2003; Tisdell and Ward, 2003; Rehman *et al,* 2007).

The initial excitement over the TRA as a potential model to predict a range of behaviours gave way to conclusions of the overall strength of the theory. An influential meta-analysis by Sheppard, Hartwick and Warshaw's (1988) reviewed 87 previous studies using TRA research and proposed recommendations to modify the model. These studies came from a wide range of disciplines, some employing variations to the original TRA model. They concluded that while the TRA offered an important "starting point" for predictive studies, modifications to further standardize measurements of variables would be useful (Sheppard *et al*, 1988: 340).

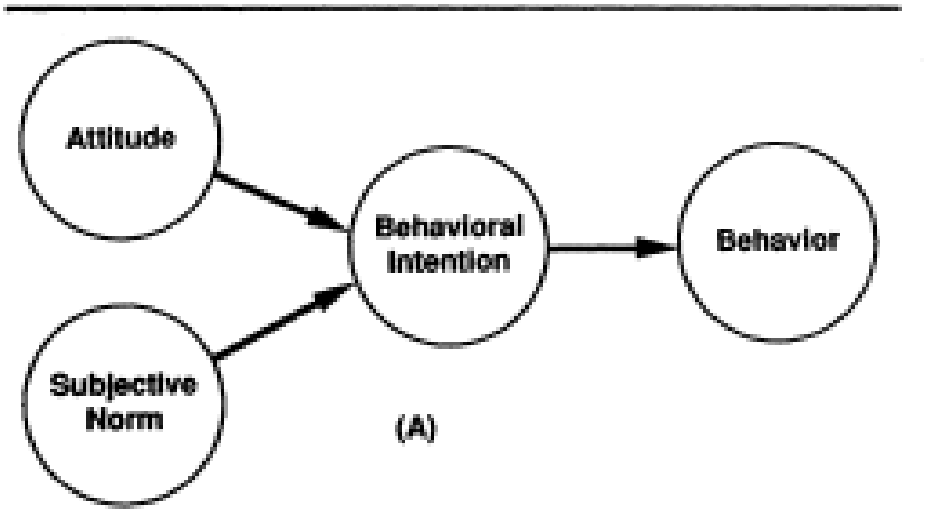

Figure 3.2 – Theory of Reasoned Action
(Madden *et al*, 1992: 4)

The primary critique of the TRA was that the theory was based on the assumption of volitional control (Sheppard *et al*, 1988). Volitional control refers to freedom of action of the individual without any external constraints. In farming volitional control may be limited because of outside forces such as commodity markets, input costs, crop/livestock needs, farm investments, and off-farm income sources (Gomez-Limon and Riesgo, 2004; Bjornlund and Rossini, 2005; Bjornlund, 2006; Brooks and Harris, 2008; Wheeler, 2008; Wheeler *et al*, 2008). Ajzen (1985) acknowledged the problem of volitional control by adding perceived behavioural control (PBC) variables to the theory. This new theory was called the Theory of Planned Behaviour (TPB).

3.3.2 – Theory of Planned Behaviour

Ajzen (1985) concluded that a more thorough analysis of control variables was needed in order to improve the explanatory power of the TRA. An example of how external, or behavioural, controls affect volitional behaviour was given: "A father's plan to take his children fishing on the forthcoming weekend, for example is best viewed as an intention… successful performance of the intended behavior is contingent on the person's

control over the various factors that may prevent it [preparing required equipment, securing a fishing licence, etc.] from happening" (Ajzen, 1985: 29).

The TPB was quickly used in marketing and advertising (Taylor and Todd, 1995; Kalafatis *et al*, 1999; Pavlou and Fygenson, 2006), health sciences (Norman *et al*, 1999; Conner *et al*, 2002; Armitage, 2005) and social sciences (Sparks and Shepherd, 1992; Chang, 1998; Terry *et al*, 1999; Carr and Sequeira, 2007). In agricultural studies the theory has been applied mostly by research into technology adoption and conservation actions (Beedell and Rehman, 1999; Beedell and Rehman, 2000; Corbett, 2002; Burton, 2004).

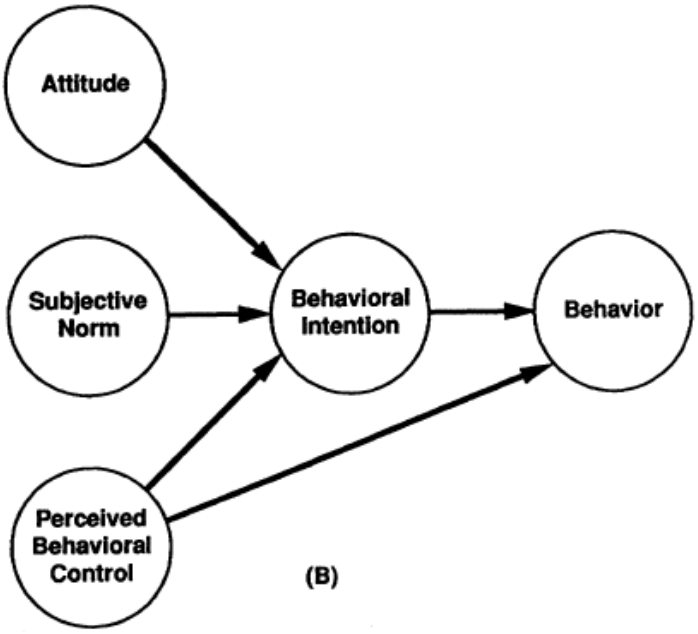

Figure 3.3 – Theory of Planned Behaviour
(Madden *et al*, 1992: 4).

Most conservation and water management studies that employ TPB models have studied its usefulness with predicting riparian zone conservation activities and adoption of water savings technology (Beedell and Rehman, 2000; Corbett, 2002; Lam, 2006; Fielding *et al*, 2008). Very little research has been conducted applying a TPB based model for the

purpose of understanding water trading behaviour. This is because government strategies and policies often have a wide range of potential outcomes. The explanatory power of TPB is maximized when actions tested are very specific (Ajzen and Fishbein, 1970; Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1977; Sheppard *et al*, 1998; Armitage and Conner, 2001).

Despite the relative success of the TPB in predicting certain behaviours, criticisms of TPB have been expressed (Armitage and Conner, 2001 Hardeman *et al*, 2002; Francis *et al*, 2004). Most of these criticisms express the following: i) the behavioural measurements used are derived from the participant's own estimates of his/her behaviour and are therefore open to acquiescence biases; ii) the behavioural measures are a snapshot in time of the participant's subjective interpretations; iii) questions must be worded very precisely in order to ensure internal consistencies that are crucial for the successful operation of the model; and iv) in order to measure an intention-action relationship a long follow-up period is needed which cannot always be guaranteed (Armitage and Conner, 2001; Hardeman *et al.*, 2002; Francis *et al*, 2004). Furthermore, the weights of each variable have been found in some studies to be of minimal importance. For example, the measurement of an attitude may not be influenced very much by the evaluation of that attitude, particularly in studies of policy acceptance and cooperation (Armitage and Conner, 2001). At the practical level this may lead to unnecessary long surveys and more of a risk for acquiescence bias (Armitage and Conner, 2001).

3.3.3 – Attitudes towards Water Re-Allocation

TRA and TPB have enjoyed some success in predicting behaviour because of their focus on the validity of attitudes and beliefs (Ajzen and Fishbein, 1970; Ajzen, 1985; Sheppard *et al*, 1988; Madden *et al*, 1992). Identifying predictor variables for permanent, out of district water re-allocation may be difficult considering the wide range of outcomes that can result from the sale. Nevertheless the literature suggests that specific attitudes

towards social impacts, economic risk and immediate impacts of re-allocation all play important roles in the decision to participate in re-allocation strategies (Gomez-Limon and Riesgo, 2004; Burton, 2004; Bjornlund, 2004; Darnhofer *et al,* 2005; Maybery *et al,* 2005; Kuehne *et al,* 2008; Wheeler *et al,* 2008). TRA and TPB type variables can measure attitudes towards water re-allocation, and offer a good starting point with regards to framing research questions. For the purpose of this research, TRA and TPB styled questions may provide a snapshot in time of irrigators' attitudes and motives.

Table 3.4 – Attitudinal Influences towards Water Transfers

Attitudes	*Supporting Literature*
Towards social acceptability and social influence	Potter and Gasson, 1988; Samdahl and Robertson, 1989; Beedell and Rehman, 2000; Tisdell *et al,* 2001; Jackon-Smith and Buttel, 2003; Burton, 2004; Kuehne *et al,* 2008.
Towards risk and economic factors	Dent *et al,* 1995; Petzrelka, 1996; Gomez-Limon and Riesgo, 2004; Darnhofer *et al,* 2005; Bjornlund, 2006; Brooks and Harris, 2008
Towards long termed impacts of re-allocation	Bjornlund, 2002; Tisdell and Ward, 2003; Burton, 2004; Bjornlund and Rossini, 2005.

The TRA and TPB literature has displayed the value in identifying accurate measures of attitudes towards a specific outcome. They have displayed the value of views towards social acceptance and influence and how attitudes towards social acceptability can influence behaviour. The literature investigating water trading motives has shown that farmers tend to consider the direct impacts of re-allocation, such as where the water is being re-allocated and how that will affect their local communities (Bjornlund, 2002; Tisdell and Ward, 2003). Along with this, license holders analyse the risks associated with

the sale, and attitudes on the importance of various controls such as commodity markets and energy costs (Dent *et al*, 1995; Petzrelka, 1996; Gomez-Limon and Riesgo, 2004).

3.4 Categorising Farmers

Farmers' values and attitudes towards the potential outcomes of water transfers, a topic far too broad to directly test with TRA and TPB variables alone; are expected to differ between cases based on the literature suggesting farmer heterogeneity (Tremblay and Dunlap, 1978; Fairweather and Keating, 1994; Petzrelka *et al*, 1996; Salamon *et al*, 1997; Corner *et al*, 1999; Schoon and Grotenhuis, 2000; Darnhofer *et al*, 2005; Maybery *et al*, 2005). Drawing from extractive commodity theory (Tremblay and Dunlap, 1978), transactional theory (Willock *et al*, 1999a), and the attitude-behaviour literature (Ajzen and Fishbein, 1970; Beedell and Rehman, 2000; Rehman *et al*, 2007), a conceptual framework can be used to identify irrigators' motives and influences in the SSRB (Figure 3.4).

The conceptual framework (figure 3.4) draws heavily from Willock *et al* (1999a) transactional theory. Willock *et al* (1999a) was not actually in favour of classifying farmers via typology. Willock *et al* (1999a; 1999b) found that although categorising farmers into groups may be useful, it was difficult to do and that farmers should be treated as individuals. They championed using structural equation modelling as a way to identify farmers' influences. This conclusion largely came from Austin *et al* (1996) response to Salamon 's (1995) work classifying farmers to "yeoman" and "entrepreneur". Austin *et al* (1996) concluded that farmers' typologies tend to ignore more complex influences, and that groups of farmers are virtually assured through the correct survey instrurments. Neverntheless, they found that measuring the difference between "yeomans" (lifestyle and family oriented farmers) and "entrepreneurs" (business minded farmers primarily concerned with profit motives) was useful when identified as factors (Austin *et al*, 1996).

Antecedent Variables Mediating Variables Outcome Variables

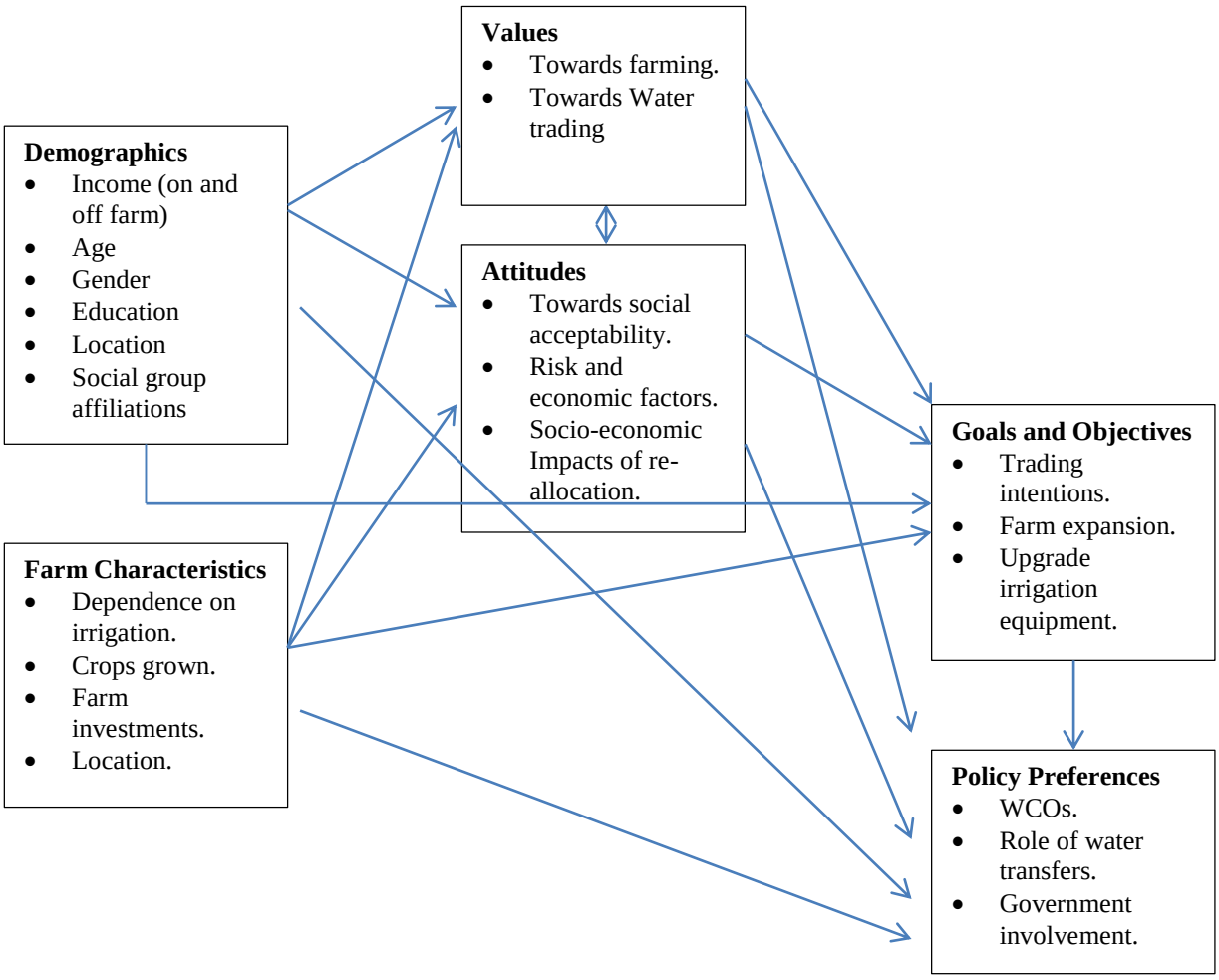

Figure 3.4 – Conceptual Framework for Irrigators' Decision Making

The mediating variables, or attitudes and values, have most often been subject to common factor or component anlaysis in order to identify underlying themes in the data (Fairweather and Keating, 1994; Austin *et al*, 1996; Petzrelka, 1996; Austin *et al*, 2001; Maybery *et al*, 2005). This is because, in these surveys, underlying themes were expected to be founded based on instrumetnal value or attitude constructs. Under these circumstances, separate factors can be used to explain variation in the data sets.

Others have turned to grouping cases, as opposed to variables, in order to address groups of attitudes and values (Schoon and Grotenhuis, 2000; Bjornlund, 2002; Gomez-

Limon and Riesgo, 2004; Vandermersch, 2006; Kuehne *et al*, 2008). This usually involves cluster analysis,a profiling technique that is most often found in marketing studies (Straughan and Roberts, 1999; Laroche *et al*, 2001; Diamantopoulos *et al*, 2003). As Austin *et al* (1998a: 207) points out "The existence of distinct types of farmer would have implications for agricultural policy, since a range of strategies, each targeting a different group of farmer, could be developed." Groups of cases discovered by profiling can provide beneficial information for exploring different irrigator types, based on either demographic information or their values and attitudes (Tremblay and Dunlap, 1978; Van Liere and Dunlap, 1980; Beus and Dunlap, 1990; Schoon and Grotenhuis, 2000; Bjornlund, 2002; Gomez-Limon and Riesgo, 2004; Vandermensch, 2006; Kuehne *et al*, 2008).

3.5 Conclusions and Identifying the 'Knowledge Gap'

Although there have been studies in the SSRB analysing irrigators' farming intentions and water trading history (Horbulyk, 2005; Nicol *et al*, 2006b; Bjornlund *et al*, 2007; Nicol *et al*, 2008; Bjornlund *et al*, 2009; Nicol *et al*, 2010), there has not yet been research into either the non-profit maximising motives behind irrigators decisions that have been seen as important for long-term goals and objectives (Van Liere and Dunlap, 1980; Beus and Dunlap, 1990; Austin *et al*, 1996; Austin *et al*, 1998a; Willock *et al*, 1999a; Willock *et al*, 1999b; Gomez-Limon and Riesgo, 2004; Maybery *et al*, 2005; Kuehne *et al*, 2008). Nor have irrigators been profiled according to their demographics and farm characteristics in such a context (Schoon and Grotenhuis, 2000; Bjornlund, 2002; Gomez-Limon and Riesgo, 2004; Vandermersch, 2006; Kuehne *et al*, 2008). Furthermore, the values and attitudes that have been observed from irrigators in the SSRB have not been specifically geared towards water transfers. TRA and TPB research has pointed out that specifically framed attidue questions towards anticipated outcomes usually yields the most interpretable and valid results (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1977).

The first research objective is to identify factors that influence irrigators' perceptions towards using water transfers through a review of the attitude-behaviour and extractive commodity literature. This literature has determined that analysing irrigators' value and attitudes towards water transfers, and farm characteristics and demographics, is important for identifying irrigators' motives and goals (Figure 3.4). As such, this research attempts to address this 'knowledge gap' by identifying irrigators': i) farm characteristics and demographics; and ii) their values and attitudes towards water tranfers, farming, social acceptance and the socio-economic impacts of transfering water.

CHAPTER FOUR

METHODOLOGY

4.0 Introduction

This chapter outlines the methods and approaches used to investigate: i) how the factors identified in the Literature Review influence irrigators' intentions to engage in water transfers are in the SSRB; ii) what irrigators' policy preferences are for re-allocating water for; and iii) how they see government's role in transfers. Ethics clearance was granted for both the personal interviews and telephone survey by the University of Lethbridge Ethics Committee.

4.1 Research Hypotheses

In order to analyse Southern Alberta's irrigators' motives and preferences, the following needs to be identified: i) irrigators' farm characteristics and demographics; and ii) irrigators' values and attitudes towards water tranfers, farming, social acceptance and the socio-economic impacts of transfering water. In order to identify these variables, the following hypotheses will be tested:

Table 4.1 – Hypothesis One

Hypothesis 1	*How to Test*
Irrigators' values and attitudes are associated with different trading or transfer intentions, and policy preferences. (Beus and Dunlap, 1990; Gasson and Errington, 1993; Fairweather and Keating, 1994; Austin *et al*, 1996; Salamon *et al*, 1997; Beedell and Rehman, 1999; Willock *et al*,1999a; Willock *et al*, 1999b; Stern, 2000; Austin *et al*, 2001; Tisdell *et al*, 2001; Jackson-Smith and Buttel, 2003; Gomez-Limon and Riesgo, 2004; Darnhofer *et al*, 2005; Maybery *et al*, 2005; Kuehne and Bjornlund, 2007;	Factor Analysis was conducted to identify underlying trends in the data (Fairweather and Keating, 1994; Austin *et al*, 1996; Petzrelka, 1996; Austin *et al*, 2001; Maybery *et al*, 2005). Categorize factor score components, and use cross tabulation to determine any signficant correlations between values and attitudes; and intentions and policy preferences.

Rehman *et al,* 2007; Brooks and Harris, 2008; Kuehne *et al*, 2008).	

Table 4.2 – Hypothesis Two

Hypothesis 2	*How to Test*
Irrigators can be grouped based on their farm characteristics and demographics. (Tremblay and Dunlap, 1978; Van Liere and Dunlap, 1980; Lowe and Pinhey, 1982; Petrzelka *et al,* 1996; Salamon *et al,* 1997; Corner *et al,* 1999; Bjornlund and Rossini, 2005; Maybery *et al,* 2005; Keuhne and Bjornlund, 2008; Kuehne *et al,* 2008; Wheeler *et al,* 2008; Loch *et al,* 2012).	Hierarchical agglomerative cluster analysis was performed using: - Farm Characteristics • Irrigated land vs. dry land farmed. • Crops grown. • Farm investments, such as irrigation equipment. - Demographics • Income from farming. • Education. • Age.

Table 4.3 – Hypothesis Three

Hypothesis 3	*How to Test*
Different groups of irrigators will stress importance on different values towards farming and water trading; and attitudes towards social acceptance, risk and impacts of re-allocation. (Gasson, 1973; Gasson, 1974; Potter and Gasson, 1988; Fairweather and Keating, 1994; Willock *et al,* 1999b; Gomez-Limon and Riesgo, 2004; Maybery *et al,* 2005; Bjornlund, 2006; Bjornlund *et al,* 2007; Bjornlund *et al,* 2009; Kuehne *et al,* 2008; Nicol *et al,* 2008; Wheeler *et al,* 2008; Loch *et al,* 2012).	Cross tabulate irrigator groups created through cluster analysis with values and attitudes.

Table 4.4 – Hypothesis Four

Hypothesis 4	*How to Test*
Different groups of irrigators will have different long-term goals and objectives for their farms. (Gasson, 1973; Gasson, 1974; Potter and Gasson, 1988; Fairweather and Keating, 1994; Willock *et al*, 1999b; Gomez-Limon and Riesgo, 2004; Maybery *et al*, 2005; Bjornlund, 2006; Bjornlund *et al*, 2007; Bjornlund *et al*, 2009; Kuehne *et al*, 2008; Nicol *et al*, 2008; Wheeler *et al*, 2008; Loch *et al*, 2012).	Cross tabulate different irrigator groups with: • Intentions to buy or lease more dry land and/or irrigated acres. • Intentions to trade water. • Intentions to upgrade irrigation equipment.

Table 4.5 – Hypothesis Five

Hypothesis 5	*How to Test*
Different groups of irrigators will have different re-allocation policy preferences regarding water re-allocation. (Beus and Dunlap, 1990; English *et al*, 2002; Whittlesey, 2003; Jackson-Smith and Buttell, 2003; Gomez-Limon and Riesgo, 2004; Bjornlund and Rossini, 2005; Zilberman and Schoengold, 2005; Bjornlund, 2006; Bjornlund *et al*, 2007; Meinzen-Dick, 2007; Kuehne *et al*, 2008; Nicol *et al*, 2008; Bjornlund *et al*, 2009; Schwarz *et al*, 2009).	Cross tabulate different cluster solutions with: • Re-allocation preferences and policy options.

4.2 Study Area

The area under investigation is the area defined by the draft South Saskatchewan Regional Plan (SSRP) (Figure 4.2.2). This area includes thirteen irrigation districts and

approximately 1367 private irrigation license holders (Nicol *et al* 2010, Hohm, 2012). According to Holm (2012) there were roughly 7,000 irrigation users in southern Alberta in 2012, although that number is very difficult to quantify because of land transfers. Since irrigated acres are more of an accurate representation of irrigation in southern Alberta, it is important to identify the amount of irrigated land in the basin. According to Alberta Agriculture and Rural Development, as of 2013 there was approximately 525,000 hectares of irrigated land within the irrigation districts, while irrigation on land held by private licensed holders was approximately 100,000 hectares (AARD, 2013).

The annual discharge may vary substantially from year to year with the Southern tributaries of the Oldman River sub-basin displaying the highest variability (AMEC, 2009). Total water allocations in the SSRB are approximately 5,454,039 dam^3 accounting for roughly 58% of the average annual discharge (AMEC, 2009). The majority of irrigation water is used for forage and cereals (Woods and Winter, 2012).

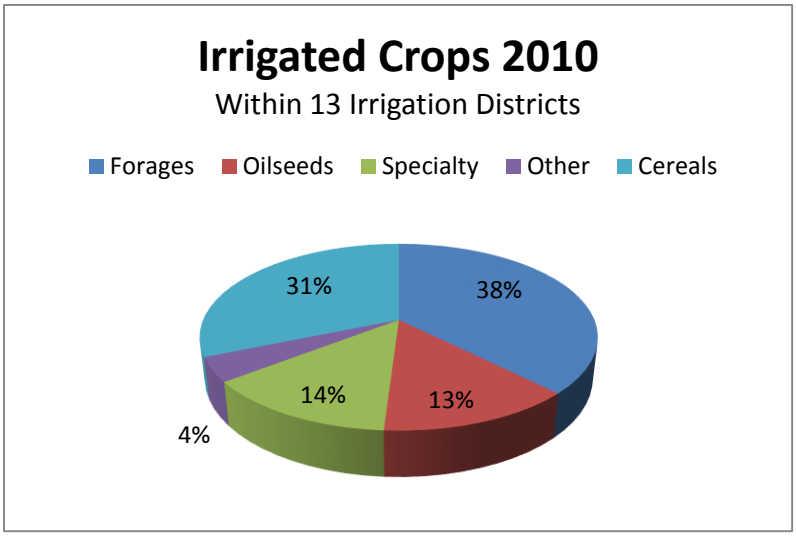

Figure 4.1 – Irrigated Crops in Irrigation Districts, 2010
(Woods and Winter, 2012).

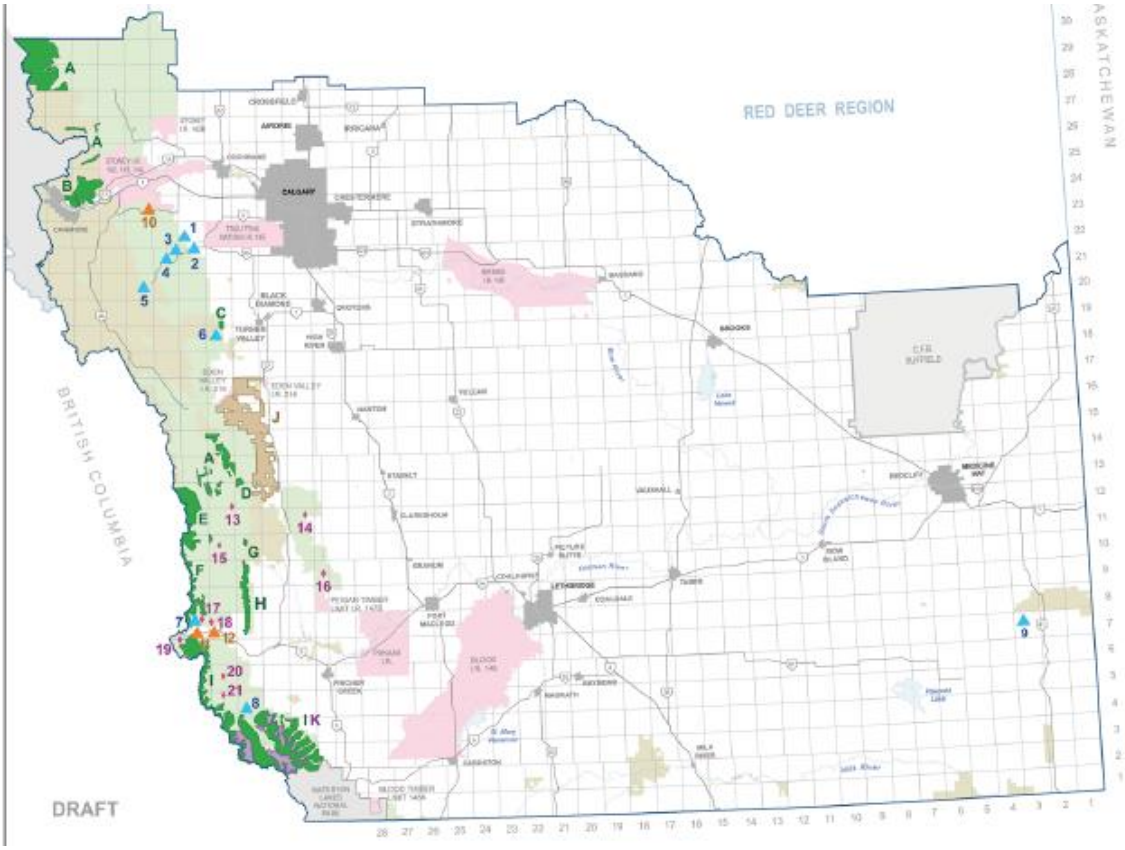

Figure 4.2 – Study Area
(Government of Alberta, 2013: 157).

4.3 Research Tools

Both personal interviews and a survey instrument were used to test the hypotheses. Combining qualitative and quantitative research techniques serves to avoid over-generalizations. Investigating local factors that may have not been explored in the existing literature may be crucial in understanding the research problem, as well as adding detail to quantitative data (Corbin and Strauss, 2007). Combining qualitative and quantitative research methods is a common research strategy using focus groups, follow-up interviews or personalized interviews (Gasson, 1973; Beus and Dunlap, 1991; Fariweather and Keating, 1994; Salamon *et al*, 1997; Corner *et al*, 1999; Darnhofer *et al*, 2005; Maybery *et al.*, 2005; Loch *et al*, 2012). Qualitative interviews before the development of the survey instruments provides a greater conceptual understanding of the issues at the irrigator level

which is essential when creating an effective survey instrument (Corbin and Strauss, 2007). Irrigators were interviewed to help create attitude and value statements for the survey instrument used for this research (Section 4.4).

Nine key informants were interviewed during June and July of 2011. The key informants were irrigation farmers from the Western Irrigation District (WID), Lethbridge Northern Irrigation District (LNID), the Eastern Irrigation District (EID) and the Saint Mary River Irrigation District (SMRID). They were chosen through personal and professional leads. All key informants had to agree, either in writing or verbally before the interview, to the consent form approved of by the University of Lethbridge Committee on Human Subjects Research (Appendix B). The consent form ensures the anonymity of the key informants, and for this reason, names are not given. The ensuing interviews were loosely based on a series of questions (Appendix A). Of the nine key informant interviews, citations from five key were used creating value and attitude statements (Section 4.4). The four who were not used did not provide attitude and value specific knowledge. Instead they informed the researcher by providing a better understanding of farming as a vocation and lifestyle.

The interview guide used for the key informant interviews was designed to explore: i) importance of irrigation to the farmer; ii) attitudes and values towards water allocation and WFL strategies; and iii) personal demographics and farm characteristics (Appendix A). These questions frequently lead to other topics, and they were not strictly followed during the interviews. The focus of the preliminary round of interviews was to gain a local understanding of the issue, not to conduct a rigorous qualitative analysis of the sample population. The core focus of the methodology is to test a representative sample of the irrigator population, via survey, so that findings from the literature can be tested adequately.

In order to achieve the second and third research objectives identified in Chapter One, both a survey questionnaire and a second round of qualitative interviews were used. The survey was designed to identify irrigators' influences towards water transfers by identifying several characteristics such as attitudes, values, intentions to expand, and other farm characteristics (Appendix C). The survey instrument was primarily used to test the five research hypotheses, and the differences of irrigators' intentions towards water trading and long-termed water transfers. The results of the survey are outlined in Chapter Five. After the survey results were analysed, a second round of qualitative interviews was conducted with irrigation district board members, government officials, and other members of the irrigation community. This round of interviews substantiated the survey results by addressing officials and professionals in the field. The results from the second round of interviews are discussed in Chapter Six.

The survey was chosen as a primary data collection technique for its ability to address large segments of the population. A telephone survey method was chosen after considering literature that suggests telephone surveys provide greater accuracy, decreased risk of response bias, increased flexibility and, typically, increased response rates; over mail out surveys (Dillman, 1978; Dillman, 1991; Sellers, 2000). Telephone interviews also have the benefit of being conducted by trained interviewers, as opposed to mail out surveys being dependent on the participant carefully following the directions of the survey (Sellers, 2000). While mail-out surveys typically have a cost-savings benefit and may capture the most enthusiastic responses; the performance of telephone surveys often outweighs the performance of mail-out surveys (Dillman, 1978; Dillman, 1991). The telephone survey option was tested on two irrigators and one employee of a calling company. The telephone survey was tested for length and clarity. Incentives were offered to encourage participation in the form of inclusion in a draw for two cash prizes of $500 each. The draw was

conducted by a calling company hired to conduct the survey by randomly selecting two of the respondents.

Telephone numbers were chosen based on postal codes within the SSRB within which irrigation was practiced. This was done in order to reach the proper geographic coverage within the study area. This information was derived from available postal code maps and written information from Canada Post and Statistics Canada. Once these postal codes were identified, a list of residents living in these postal codes, with name address and phone number, was purchased from a list provider. Members of the list with town addresses and business names clearly not related to farming were removed from the list. More phone numbers were obtained from a list of water license holders provided by Alberta Environment. Many of these license holders had licenses for irrigation use.

The calling company was then told to recruit respondents from this list using a random sampling technique. A first screening question was used asking the respondents if there were over 18, and were either part of an irrigation district or had their own license for irrigation uses. If they did not the interview was terminated and the number deleted from the list. A second screening question asked if the participant was the long-term decision maker for their farm. This was asked because long-termed decision makers who own the land must approve of a water transfer or transfer or irrigated acres, under the Water Act and Irrigation Districts Act. The remaining screening questions addressed farmers' locations, water sources, and what the priority dates on their licenses were if they were private license holders. These were asked to get location-specific information, and to understand how representative the survey was. A discussion of the response rate is in Section 4.7.

4.4 Survey Structure

The telephone survey was administered to both private and district irrigators. As discussed in the Policy Context, there are major differences between district irrigators and

private license holders who are allocated water for irrigation purposes. Private irrigators are in charge of the construction and maintenance of their own delivery and conveyance systems, and have the right to directly transfer some or all of his/her license via transfers. District irrigators cannot sell water rights to different license holders via a transfer agreement. As private irrigators were asked slightly different questions than district irrigators (Appendix C), the survey was therefore divided into two separate data sets reflecting private irrigator and district irrigator responses. A series of screening questions in part two of the survey was responsible for separating the data set (Appendix C).

The survey instrument was used to collect data in order to test all five hypotheses. As such, the survey instrument needed to gather irrigators' farm characteristics and demographics; and irrigators' values and attitudes towards water tranfers, farming, social acceptance and the socioeconomic impacts of transfering water; as well as their policy preferences. The following sub-sections provide the components of the survey that gathered this information.

4.4.1 – Value Statements

Parts three and four of the survey gathered information about respondents' values towards farming and water trading. The goal of these value statements is to identify farmers' values concerning both farming as a vocational behavior; and towards water transfers as a mechanism to re-allocate water. The value statements were created based on the concepts in the literature, and from the key informant interviews. Following the literature suggesting farmers hold economic, lifestyle and conservation motives to varying degrees the following value statements were created. Values statements were asked on a scale of 1 strongly disagree to 7 strongly agree. All value and attitude statements were based on a 7 points likert scale, directly following recommendations in the TRA and TPB literature (Ajzen and Fishbein, 1970; Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1977).

Table 4.6 – Economic Value Statements

Value Statement	***Academic Relevance***	***Key Informant Support***
A1-a: *A maximum annual financial return from your farm is your most important goal.*	"Dollars and cents is what farming is all about" - Maybery *et al*, 2005 "Financial gain is the only reason for my involvement in farming" - Keuhne *et al*, 2008	
A1-d: *Increasing the asset value or net worth of your farming operation is very important to you.*	"Important/Unimportant: Increasing the asset value or net worth of the farm" - Austin *et al*, 1996	
A1-g: *You view your farming operation as first and foremost a business investment.*	"I view my farm as first and foremost a business enterprise" - Maybery *et al*, 2005	
A1-l: *When faced with decisions that affect the way you manage your farm financial concerns tend to outweigh lifestyle considerations.*	"My land is just something I use to generate an income" - Kuehne *et al*, 2008	
A1-m: *When faced with decisions that affect the way you manage your farm financial concerns tend to outweigh environmental concerns.*	"My land is just something I use to generate an income" - Kuehne *et al*, 2008	
B2-d: *Irrigation water should not be transferred to non-agricultural users*	Skepticism towards water transfers as identified in: - Nicol *et al*, 2008	

B2-f: *Temporary leases of water are ok, but permanent sales of water are not.*	Reluctance of re-allocation as expressed in WID 2007 transfer to M.D. of Rockyview. - Described in Policy Context Chapter Market activity and reluctance for re-allocation as described in: - Bjornlund *et al*, 2007; Nicol *et al*, 2008	
B2-k: *Permanent water transfers between farmers are ok but trading water out of agriculture is not.*	Market activity and reluctance for re-allocation as described in: - Bjornlund *et al*, 2007; Nicol *et al*, 2008	

Table 4.7 – Lifestyle Value Statements

Value Statement	***Academic Relevance***	***Key Informant Support***
A1-c: *The lifestyle that comes with living in a rural area is very important to you.*	"The lifestyle that comes with being on the farm is very important to me" - Maybery *et al*, 2005	
A1-e: *For you, a rural environment is a better place to live than an urban environment.*	"Farming communities are a great place to live" - Maybery *et al*, 2005	
A1-h: *Rural communities are a great place to live and raise a family.*	"A rural environment is a great place to raise children" - Maybery *et al*, 2005	
A1-j: *You make farm decisions based on how they will affect future generations farming on your land.*	"Motives: 'Following in the family tradition'" - Austin *et al*, 1996	

	"'Custodian'" motives: replicate the farm, with children all owning farm" – Kuehne and Bjornlund, 2008	
A1-k: *Having land to pass down to future generations is more important than selling it for profit.*	"Motives: 'Following in the family tradition'" - Austin *et al*, 1996 "'Custodian'" motives: replicate the farm, with children all owning farm" – Kuehne and Bjornlund, 2008	

Table 4.8 – Conservation Value Statements

Value Statement	***Academic Relevance***	***Key Informant Support***
A1-b: *Managing environmental problems on your land is a high priority.*	"Managing environmental problems on my farm is a very high priority" - Maybery *et al*, 2005 "Humans must live in harmony with nature in order to survive" - Sullivan *et al*, 1996	
A1-f: *Your right to do what you want with your water allocation has to be balanced against wider environmental concerns.*	"We should restrain consumption of natural resources now to protect future generations" - Petzrelka *et al*, 1996 Based on Stern's (2000) "biospheric values"	
A1-i: *Having enough water in rivers and streams to support healthy ecosystems is important to you.*	Based on Stern's (2000) "biospheric values"	

A1-n: *When faced with decisions that affect the way you manage your farm,environmental concerns tend to outweigh lifestyle considerations.*	"Land stewardship by farmers is more important than anything else about farming" - Maybery *et al*, 2005	
B2-J: *Re-allocating water from irrigation to water conservation objectives is beneficial to society.*		"I think it's pretty much justified but the only thing is if I transferred acres to my son I wouldn't want to see no 10% there, but I think you can live with 10%" - Key Informant 2, 2011
B2-a: *Rivers and streams of southern Alberta are environmentally degraded due to low flows.*		"…The spinoffs created by irrigation are huge!...All I know about this irrigation stuff is if we had more dams and off stream storage over the last four years we would have enough irrigation water for the next 20 years" - Key Informant 3, 2011

4.4.2 – Attitude Statements

Attitude statements were meant to measure attitudes towards socio-economic impacts of water transfers. In order to do this the potential outcomes of water transfers were created in attitude statements, along with the social acceptance of the use of water transfers, and attitudes towards risk factors that may affect the decision to re-allocate water. These attitude statements are identified in parts four, five, six and seven of the survey (Appendix C). Attitude statements were partially based on the TRA and TPB literature analysing attitudes as dispositions towards certain outcomes (Ajzen and Fishbein, 1970; Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1977). As a result, a scenario was given to both private and district irrigators:

> *A non-agricultural user has approached your irrigation district with a proposition to permanently purchase water. The irrigation district is going to hold a*

plebiscite to approve the sale of water to the non-agricultural user. The irrigation district plans to spend the money made from the sale to upgrading its infrastructure to result in increased water use efficiency.

- For District Irrigators; and

A non-agricultural user has approached you to buy some of your water rights.

- For Private Irrigators

These scenarios were given in order to measure attitudes directed towards the socio-economic outcomes of water re-allocation via transfers. These statements were created considering TRA and TPB literature recommending that attitudes constructs are placed around as specific a topic as possible (Ajzen and Fishbein, 1970; Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1977; Ajzen, 2011). The first set of attitude statements (C1) measures the attitudes towards various outcomes of water transfers. This addresses the literature suggesting that attitudes towards socio-economic impacts of re-allocation affect trading behaviour (Bjornlund, 2002; Tisdell and Ward, 2003; Burton, 2004; Bjornlund and Rossini, 2005). These attitudes were asked on a scale from 1 extremely negative to 7 extremely positive (Appendix C).

Table 4.9 – Attitudes towards outcomes of transfers

Outcome of Transfer	***Academic Relevance***	***Key Informant Support***
C1-a: *Move water away from agriculture.*	Fears from irrigators over permanent water re-allocation strategies. - Bjornlund *et al*, 2007; Nicol *et al*, 2008; Bjornlund *et al*, 2009.	When asked about having less water for agriculture: "It would have to be a win-win [for irrigation districts and municipalities or industries]. We can't reduce supply in the districts" - Key Informant 5, 2011
C1-b: *Satisfy the water demands of a municipality*		"It's the city people that think 'forget the farmers we need the water'. They say that but if that happens then good look finding food to eat. We need to protect the irrigated land out here" - Key Informant 2, 2011
C1-c: *Satisfy the water demands of an industry*		"Well, if referring to oil drilling, no I don't think it should be. I mean if it is used for environment I have no issues, but for drilling I think they already use enough water" - Key Informant 3, 2012
C1-d: *Increase water use efficiency*	Typical outcome of enabling tradable water rights. - Based off Nicol and Klein, 2006b literature review	
C1-e: *A 10% holdback of the traded volume to meet water conservation objectives.*	Skepticism over WCOs. - Bjornlund *et al*, 2007	"I think it's pretty much justified but the only thing is if I transferred acres to my son I wouldn't want to see no 10% there, but I think you can live with 10% " - Key Informant 1, 2011
C1-f: *Less water for irrigation.*		"It's the city people that think 'forget the farmers we need the water'. They say that but if that happens then good look finding food to

		eat. We need to protect the irrigated land out here" - Key Informant 2, 2011
C1-g: *Irrigation infrastructure improvements* (For District).	Identifying how much this outcome matters to irrigators. This is asked given irrigators in the WID expressing opposition towards the 2007 transfer to the M.D. of Rockyview. - Bjornlund *et al*, 2009.	"Well, I know that there are pros and cons to it. The pros are that they are moving the water now through a main closed line so they are not losing as much. Water that we are losing is going to Balzac, so kind of a win-win situation. If there someone just pulling water out of the well canal system I think I would have an issue with that" - Key Informant 1, 2011
C1-h: *Money made from sale* (For Private).	Potential financial outcome and incentive for private irrigators to trade water. - Nicol *et al*, 2010	
B2-c: *There is an increasing demand for water from municipalities and industries in southern Alberta.*	Measuring the importance of ***C1-b*** and ***C1-c***. Taken from weighted outcome variables expressed in TRA and TPB literature. - Ajzen and Fishbein, 1975; Ajzen and Fishbein, 1977; Ajzen, 1985	
B2-b: *You are aware of your abilities to buy or sell water with other farmers.*	Lack of knowledge of benefits or costs of trade as market barrier due to lack of information: - Thobani, 1997; Nicol *et al*, 2008	When asked about his knowledge of water transfers, or water trading: "You know what, I really don't know. I couldn't even give you a guess on that. Never been approached or approached anyone myself. From what I can tell everyone is using their pivots this year" - Key Informant 4, 2011

B2-g: *More water should be set aside for irrigation.*		"It's the city people that think 'forget the farmers we need the water'. They say that but if that happens then good look finding food to eat. We need to protect the irrigated land out here" - Key Informant 2, 2011
B2-e: *Irrigation water should only be permanently sold to non-agricultural users if the money made from the sale goes towards increasing agricultural water use efficiency (for example, fixing canals or installing pipelines resulting in a net savings of water).*		"Well, I know that there are pros and cons to it. The pros are that they are moving the water now through a main closed line so they are not losing as much. Water that we are losing is going to Balzac, so kind of a win-win situation. If there someone just pulling water out of the well canal system I think I would have an issue with that" - Key Informant 1, 2011
B2-i: *Re-allocating water from irrigation to municipalities and non-agricultural users is beneficial to society.*	Analysing attitudes towards transferring water to municipalities and non-agricultural users. Skepticism towards this mentioned in: - Bjornlund *et al*, 2007	

The second set of attitude statements (C2) measure perceived social acceptability towards water transfers. This addresses the literature suggesting that there are strong social influences associated with farming and water transfers (Potter and Gasson, 1988; Samdahl and Robertson, 1989; Beedell and Rehman, 2000; Tisdell *et al*, 2001; Jackon-Smith and Buttel, 2003; Burton, 2004; Kuehne *et al*, 2008). These attitude statements were asked on a scale of 1 strongly disagree to 7 strongly agree.

Table 4.10 – Attitudes towards Social Acceptance

Social Acceptance Statement	***Academic Relevance***	***Key Informant Support***
C2-a: *Members of your family would think it's a good idea.*	Attitudes and values towards social acceptability: Family influences as mentioned in: - Gasson, 1973; Potter and Gasson, 1988; Fairweather and Keating, 1994;Tisdell *et al*, 2001; Kuehne *et al*, 2008 Statement created to mirror social affects as displayed by TRA and TPB literature on social affects: - Ajzen and Fishbein, 1975; Ajzen and Fishbein, 1977; Ajzen, 1985; Beedell and Rehman, 1999; Beedell and Rehman, 2000; Corbett, 2002	
C2-b: *Members of your community would think it's a good idea.*	Attitudes and values towards social acceptability: Community influences as mentioned in: - Potter and Gasson, 1988; Tisdell *et al*, 2001; Morris and McBeth, 2003; Kuehne *et al*, 2008. Statement created to mirror social affects as displayed by TRA and TPB literature on social affects: - Ajzen and Fishbein, 1975; Ajzen and Fishbein, 1977; Ajzen, 1985; Beedell and Rehman, 1999; Beedell and Rehman, 2000; Corbett, 2002	
C2-c: *The government would think it's a good idea.*		When asked about how the government would feel about a possible 10% holdback for a WCO: "I'm sure they would think it's a good idea. But not too many folks outside of that

		group would think it's a good idea" - Key Informant 5
C2-d: *Your neighbours and friends would think it's a good idea.*	Social influences as mentioned in: Fairweather and Keating, 1994; Beedell and Rehman, 2000; Tisdell *et al,* 2001; Maybery *et al,* 2005; Kuehne *et al,* 2008.	
C2-e: *Members of agricultural communities and organizations would think it's a good idea.*	'Effects of social group affiliations' - Morris and McBeth, 2003; Kuehne *et al,* 2008.	
C2-f: *Recreational users of rivers and streams would think it's a good idea.*		All informants expressed that they use reservoirs for recreation. As described by one: "…they have a lot of investments out there on the lake (reference to Lake McGregor) and it's important to keep that going. But it is water for irrigation and that's its purpose" - Key Informant 2
C2-g: *Professionals, scientists and members of environmental groups would think it's a good idea.*	Taken from environmental concerns expressed by some in the environmental scientific community and environmental lobby groups. - Christensen and Droitsch, 2008 Analysing the effects of that attitude on behaviour as highlighted in the social influences of TRA and TPB literature. - Ajzen and Fishbein, 1975; Ajzen and Fishbein, 1977; Ajzen, 1985	
C2-h: *Other irrigators around where you live would think it's a good idea.*	Social influences as mentioned in: - Fairweather and Keating, 1994; Beedell and Rehman, 2000; Tisdell *et al,* 2001; Maybery *et al,* 2005; Kuehne *et al,* 2008	

C2-i: *Your irrigation district would think it's a good idea* (For District).	Measuring the effect of location, and professional and agricultural affiliations: - Dent *et al*, 1995; Willock *et al*, 1999a; Tisdell *et al*, 2001; Meinzen-Dick, 2007; Kuehne and Bjornlund, 2008.	
B2-h: *Municipalities and other non-agricultural users should be more efficient with their water*.		"I don't see a lot of unnecessary use of water from the farmers. The [urban] grass growers tick me off. I think the city needs to regulate that better. Then we wouldn't have guys stripping the topsoil and watering so much. That in itself would be a big boost. It is very water intensive. Some years when it's dry people use a lot of water" - Key Informant 5, 2011
C3-g: *Growing water demands from industries*	Measuring how strong the influence of growing demand for industries is on irrigators' decision to transfer. Taken from analysing TRA and TPB literature on social affects: - Ajzen and Fishbein, 1975; Ajzen and Fishbein, 1977; Ajzen, 1985.	"Well, if referring to oil drilling, no I don't think it should be. I mean if it is used for environment I have no issues, but for drilling I think they already use enough water" - Key Informant 3, 2011
C3-i: *Growing water demands from communities*	Measuring how strong the influence of growing demand from communities is on irrigators' decision to transfer. Taken from analysing TRA and TPB literature on social affects: - Ajzen and Fishbein, 1975; Ajzen and Fishbein, 1977; Ajzen, 1985.	
C3-j: *Environmental water demands*		"Let's not worry about all the environmentalism right away. Look at the Oldman dam, everyone complained about it before it happened. Now look at it. The environment is fine and we

		have water! … It's about ensuring supply" - Key Informant 3, 2011

The third and final set of attitude statements (C3) are based on points made in the literature suggesting that attitudes towards risk and economic factors influence farming decisions and water transfer decisions (Dent *et al,* 1995; Petzrelka, 1996; Gomez-Limon and Riesgo, 2004; Darnhofer *et al,* 2005; Bjornlund, 2006; Brooks and Harris, 2008; Wheeler *et al,* 2008). These risk factors were measured by asking the survey participants if the factors were 1 not all important to 7 very much important.

Table 4.11 – Attitudes towards risk factors

Risk Statements	***Academic Relevance***	***Key Informant Support***
C3-a: *Uncertainty about the costs and benefits associated with the trade*	Lack of knowledge of benefits or costs of trade as market barrier due to lack of information: - Thobani, 1997; Nicol et al, 2008	
C3-b: *Plans to expand your farming operation*	Farm size and investments affecting water trading behaviour: - Bjornlund and Rossini, 2005; Bjornlund, 2006.	
C3-c: *Annual precipitation patterns.*		"It really came in 2004, and since then it has been too wet all the time, so irrigation hasn't really helped that much. It has helped in that you can fertilize an 80 bushel crop instead of worrying about the rain to grow such a large crop" - Key Informant 2, 2011
C3-d: *Rising or declining commodity prices.*	Commodity prices affecting on-farm income and crop production. - Bjornlund *et al,* 2007; Wheeler *et al,* 2008;	

C3-e: *Rising or declining operations costs.*	Farm size and investments affecting water trading behaviour: - Bjornlund and Rossini, 2005; Bjornlund, 2006.	
C3-f: *Uncertainty about the future of your farm.*		"I think it's pretty much justified but the only thing is if I transferred acres to my son I wouldn't want to see no 10% there but I think you can live with 10%" - Key Informant 1, 2011
B2-l: *You would feel more comfortable transferring your unused allocations rather than water you are actually using.*	Addressing about property rights and consumptive use vs. total allocations as described by: - Rosegrant and Binswanger, 1994; Thobani, 1997; Easter *et al*, 1999; Bjornlund *et al*, 2009 Recommendation Five "The minister must clarify the amount of water the licensee is entitled to transfer. The Water Act does not deal clearly with this and it must ultimately be resolved for the transfer system to achieve its full potential" - Minister's Advisory Group, 2009	

The attitude and value statements were used to test hypothesis one: 'irrigators will hold a diversity of values towards farming and water trading; and diverse attitudes towards social acceptance, risk, and socio-economic impacts of re-allocation.' The remaining hypotheses were tested through gathering information on goals, intentions and objectives; policy preferences; demographics; and farm characteristics. The survey questions gathering this information are in parts eight and nine of the survey (Appendix C).

4.4.3 – Goals, Intentions and Objectives

Goals and objectives towards trading water, farm expansion and upgrading irrigation equipment were asked (**D1, D2, E17, E18, E19**). This information was useful for testing hypothesis four, that irrigators will have different long term goals and objectives for

their farms. It is expected that buyers will have different characteristics than sellers (Nicol *et al*, 2008; Loch *et al*, 2012); irrigators will have different trading histories, and those who have traded in the past will likely trade in the future (Gomez-Limon and Risego, 2004; Bjornlund, 2006; Loch *et al*, 2012); and there will be limited room for efficiency gains through irrigation equipment upgrades (Nicol *et al*, 2010).

Table 4.12 – Trading or Transfer intentions and past behaviour

Intentions	***Past Behaviour***
D1-a: *Purchase a lease of water.*	**D2-a:** *Leased out water?*
D1-b: *Permanently buy water.*	**D2-b:** *Permanently sold water?*
D1-c: *Sell a lease of water.*	**D2-c:** *Purchased a lease of water?*
D1-d: *Permanently sell some of your water allocation.*	**D2-d:** *Permanently bought water?*
D1-e: *Vote 'yes' in a plebiscite to permanently sell some district water to outside of the district* - District only.	**D2-e:** *Has your irrigation district held a plebiscite in the last five years regarding a sale of water, and if so, what did you vote in that plebiscite?* - District only

Table 4.13 – Intentions to upgrade irrigation equipment

Intentions to upgrade over next five years	***Past upgrades over last five years***
E17-a: *Convert from flood/gravity to wheel move.*	*Converted from flood/gravity to wheel move.*
E17-b: *Convert from wheel move to pivot irrigation.*	*Converted from wheel move to pivot.*
E17-c: *Convert from flood/gravity to pivot irrigation.*	*Converted from fllod/gravity to pivot.*
E17-d: *Convert from high pressure pivot system to low pressure pivot system.*	*Convert from high pressure pivot system to low pressure pivot system.*
E17-e: *Purchase a computer panel for your pivot system.*	*Purchased a computer panel for pivot system.*

In order to assess the effects of succession on farm decision making, respondents were also asked if they had a successor lined up for the farm (**E5**). This is a specific variable that will not make up the clusters or the factors, but will rather be compared to each cluster created from the demographic data. This question about succession borrows from the literature suggesting that successor-ship plays a major role in long term farm decision making, of which water rights are a part of (Gasson, 1973; Potter and Gasson, 1988; Fairweather and Keating, 1994; Bjornlund and Rossini, 2005; Kuehne *et al*, 2008).

4.4.4 – Demographics

Demographic data were used to test hypothesis two: 'groups of irrigators will be identified based on their farm characteristics and demographics'. This borrows from extractive-commodity research suggesting that socio-demographics have an influence on attitudes towards the environment (Van Liere and Dunlap, 1980; Lowe and Pinhey, 1982; Samdahl and Robertson, 1989; Morris and McBeth, 2003; Huddard-Kennedy *et al*, 2009).

Table 4.14 – Demographic Data

Demographic Data	***Academic Relevance***
E2- Age	"Age Hypothesis" – Van Liere and Dunlap, 1980 Used in other research concerning farmers values and attitudes (Fairweather and Keating, 1994; Tisdell *et al*, 2001; Darnhofer *et al*, 2005; Maybery *et al*, 2005; Kuehne *et al*, 2008).
E6- Education	Extractive-commodity literature regarding attitudes and preferences (Van Liere and Dunlap, 1980; Lowe and Pinhey, 1982; Samdahl and Robertson, 1989; Morris and McBeth, 2003; Huddard-Kennedy *et al*, 2009).
E7, E8- Net Household Income - Percentage coming from farming and land use	Extractive commodity literature highlighting importance of off-farm and on-farm income as influencing environmental views and preferences (Van Liere and Dunlap, 1980; Samdahl and Robertson, 1989; Beus and Dunlap, 1990). Dependence on irrigation as a farm characteristic influencing irrigators' trade decisions (Tisdell *et al*, 2001; Bjornlund, 2003a; Gomez-Limon and Riesgo, 2004; Kuehne *et al*, 2008).

Other demographic questions were asked that were not used to directly test hypothesis two. This is done in order to embrace model parsimony and include variables that are most specific to irrigation uses. Punj and Steward (1983) contend that cluster analysis should be used with variables that have a strong conceptual background and that will not skew results. A more detailed discussion of the use of cluster analysis is provided in section 4.7. Demographic data such as **E1** gender (Van Liere and Dunlap, 1980), **E3** marital status, **E4** number of children, **E20, E21, E22** social group affiliation (Morris and McBeth, 2003; Kuehne *et al*, 2008), and **E10** generations living on the farm (Tremblay and Dunlap, 1978; Van Liere and Dunlap, 1980; Beus and Dunlap, 1990; Huddart-Kennedy et al, 2009) will be collected to observe differences between the clusters.

4.4.5 – Farm Characteristics

Farm characteristics were used in conjunction with demographics in order to test hypothesis two. It was hypothesized that different groups of irrigators will have different dependencies on irrigation (Tisdell et al, 2001; Bjornlund, 2003a; Gomez-Limon and Riesgo, 2004; Kuehne et al, 2008) and will have different irrigation equipment (Tisdell *et al*, 2001; Burton, 2004; Bjornlund and Rossini, 2005; Bjornlund *et al*, 2007). As Nicol and Klein (2006b) point out, traded water tends to move water from lower valued crops to higher valued crops. It is hypothesized that dependence on crops that need large amounts of irrigation water will coincide with a higher level of dependence on irrigation and therefore the use of more efficient types of irrigation equipment (Bjornlund, 2002; Bjornlund *et al*, 2007; Kuehne *et al*, 2008; Nicol and Klein, 2006b; Nicol *et al*, 2008).

A farm characteristic that will not be included in the cluster analysis is **E14** inquiring if the farm supports a livestock operation. This is of interest in order to see how much water was attached to cattle production, and to see if the findings mimic Nicol's (2010) study indicating most private irrigators used irrigation water to support a larger livestock operation. Responses between cattle producers and other types of farmers may therefore be of interest.

Table 4.15 – Farm Data

Farm Data	***Academic Relevance***
B3: Amount of water allocation used.	"Percentage of water right used" as a variable in Bjornlund (2002). Dependence on irrigation as influencing motives and farm decisions (Bjornlund, 2002; Tisdell *et al*, 2001; Bjornlund, 2003a; Gomez-Limon and Riesgo, 2004; Kuehne *et al*, 2008).

E11, E12- Irrigated land vs. Dry land	Dependence on irrigation as influencing motives and farm decisions (Bjornlund, 2002; Tisdell *et al*, 2001; Bjornlund, 2003a; Gomez-Limon and Riesgo, 2004; Kuehne *et al*, 2008).
E13- Crops Grown	Crop needs as important influences on trading activity (Fairweather and Keating, 1994; Austin *et al*, 1996; Gomez-Limon and Riesgo, 2004; Bjornlund and Rossini, 2005; Bjornlund, 2006; Nicol and Klein, 2006b).
E16- Irrigation Systems	Farm investments as important influences on trading activity (Tisdell *et al*, 2001; Burton, 2004; Bjornlund and Rossini, 2005; Bjornlund *et al*, 2007).

4.4.6 – Policy Preferences

The final set of questions focused on policy preference statements that were used to test hypothesis five. The policy preference statements were drawn from the Policy Context, highlighting current issues being debated in Alberta towards water policy. Most of these issues concern recommendations made by the Minister Advisory Group in 2009 regarding protected water and WCOs. The other statements inquired about other institutional barriers to trade in Alberta as highlighted in the Policy Context, such as the FITFIR system, and the role of government intervention in the water market (Rosegrant and Binswanger, 1994; Thobani, 1997; Easter *et al*, 1999; Horbulyk, 2005; Nicol *et al*, 2008; Bjornlund *et al*, 2009).

Table 4.16 – Policy Preference Statements

Policy Preference Statement	***Academic Relevance***
B1-a: *The government, rather than market forces, should get to decide who uses Alberta's water.*	Chong and Sundig (2006) making reference to conflicting public interests being an impediment to trading.

	Social equity concerns over market allocation (Tisdell *et a*l, 2001; Bakker, 2007; Christensen and Droitsch, 2008).
B1-b: *If an irrigation district or private license holder is not using all of their water allocation, the government should be able to take that water for environmental purposes, without any compensation.*	Approved water management plan's proposal to "allow a part of a licence to be cancelled. The present Water Act only permits cancellation of a full allocation. This is an obstacle to the desired objective of being able to match actual water needs with allocations." (Alberta Environment, 2006: 17).
B1-c: *Minimum flows of water should be set for all rivers and streams, and only the water above those minimum flows should be used for economic purposes such as irrigation.*	Analysing skepticism towards WCOs and in-stream flow objectives (Bankes and Kwasniak, 2005; Bjornlund *et al*, 2007). Global experience suggesting it is difficult to balance economic, social and ecological goals and objectives (Thobani, 1997; Bauer, 1997; Solanes and Gonzalez-Villarreal, 1999; Tisdell *et al*, 2001; Bjornlund, 2003b; Meinzen-Dick, 2007; Bjornlund, 2010).
B1-d: *Private groups and individuals should be able to hold water licenses for environmental purposes.*	Policy literature highlighting the effects of user-based participation in managing water (Thobani, 1997; Solanes and Gonzalez-Villarreal, 1999; Meinzen-Dick, 2007; Bjornlund, 2010). Minister's Advisory Group (2009) concerning recommendation 2 over protected water: "assess[ing] the potential role of water trusts as a vehicle for acquiring licenses through the transfer process for WCO purposes on an arms' length basis."
B1-e: *Water that is saved through improved water use efficiency should be used to increase economic activity.*	Intentions from the literature suggest increases in water use efficiency may lead to increases in water use (English et al, 2002; Whittlesey, 2003; Bjornlund *et al*, 2009). Irrigators' intentions to increase crop yields and reduce energy costs, as opposed to re-allocating water to rivers (Bjornlund *et al*, 2007; Bjornlund *et al*, 2009). Minister's Advisory Group

B1-f: *The government should buy water from current license holders, like irrigation districts, so that more water can be left in the rivers.*	In reference what is happening in Australia (Kuehne *et al,* 2008). Minister's Advisory Group (2009) advising the government use a number of actions to ensure WCO targets including "acquiring water allocations (preferably senior) in the name of the Province through the transfer process to meet specific WCO purposes."
B1-g: *The seniority of a water license must be honored under all circumstances.*	Attitudes towards FITFIR system as being very strong amongst irrigation users (Rosegrant and Binswanger, 1994; Tarlock, 2001; Zilberman and Shoengold, 2005; Adamowicz *et al,* 2010). Attitudes towards FITFIR as compared to proportional shares based allocation (Huffnaker *et al,* 2000; Horbulyk, 2005; Bjornlund, 2010; He *et al,* 2012).
B1-h: *Public funds should be used to improve irrigation systems only if the water that is saved is left in rivers.*	In reference to the current pay ratio of 75:25 between the Province and irrigation districts. Some environmental lobbyists see this as justification to take efficiency gains and put them in the rivers (Christensen and Droitsch, 2008). Concerning irrigators' intentions to use efficiency gains to irrigate more crops instead of re-allocating water (including to environmental purposes). - English et al, 2002; Whittlesey, 2003; Bjornlund *et al*, 2009
B1-i: *If water is to be traded among irrigation districts and/or municipalities, the government should set the price.*	Social equity concerns over market allocation (Tisdell *et a*l, 2001; Bakker, 2007; Christensen and Droitsch, 2008). Attitudes towards public allocation vs. market allocation (Rosegrant and Binswanger, 1994; Dinar et al, 1997; Tarlock, 2001; Bjornlund *et al,* 2007; Meinzen-Dick, 2007; Kuehne *et al,* 2008).

Based on the literature review it was anticipated that most irrigators will have negative views of WCOs, and a negative view of water transfers (Bjornlund *et al,* 2007; Nicol *et al,* 2008). It is also hypothesized that the majority of irrigators will want to use

water saved from efficiency gains, rather than to sell it or re-allocate it for environmental purposes (English *et al*, 2002; Whittlesey, 2003; Bjornlund *et al*, 2009).

4.5 Data Analysis

Once the survey data was collected two statistical methods were applied: factor analysis was applied to the value and attitude constructs, while cluster analysis was applied to the farm characteristic and demographic data. In order to test hypotheses three, four and five, cross tabulation using Chi-Square was used with the appropriate cluster solution and the variables under investigation. This section discusses factor analysis, cluster analysis, and cross tabulation methods and their applicability towards the research.

4.5.1 – Factor Analysis

The focus of exploratory factor analysis is to "…identify the fewest possible constructs needed to reproduce the original data" (Gorusch, 1997: 533). In other words, factor analysis provides the ability to identify trends in the data, or to reduce a complex data set into general factors that can be used to explain underlying trends. Factor analysis avoids the problems associated with using broad attitude and value constructs to classify types, especially with several types of attitudes and values being present (Austin *et al*, 1996). With factor analysis, the individuals involved are not of intrinsic interest except for the variance they contribute to the defining factors (Reinmann, 2008; Padgett, 2011). Concerning the attitude and value statements, factor analysis identifies underlying factors that explain the variance in the data. This method has been used extensively to analyse value and attitude data (Fairweather and Keating, 1994; Austin *et al*, 1996; Petzrelka, 1996; Austin *et al*, 2001; Maybery *et al*, 2005). It is mentioned by Willock *et al* (1999a; 1999b) and Austin *et al* (1998a; 1998b) as a eddential step in analysing major constructs in psychological data.

As mentioned previously, it is expected thatirirgators will express a diversity of attitudes and values. This makes it difficult to conceputally separate individuals based on attitude and values. This is highlighted by Austin *et al* (1998a) and Willock (1999a) as a reason why it is difficult to classify irrigators. This is why they suggested to identify factors, as opposed to types, and to treat irrigators individually instead of collectively.

The suitability of the data for factor analysis was determined by the Kaiser-Meyer-Olkin (KMO) statistic. The KMO compares correlation and partial correlation coefficients (Kaiser, 1974). Kaiser (1974) developed a scale measuring the general acceptability of a KMO statistic from below 0.50 as being unacceptable to 0.90 as being marvellous.

Barlett's test of sphericity was also examined. This tests the null hypothesis that the variables in the population correlation matrix are uncorrelated (Foster *et al,* 2005). When it is significant, the test indicates that the data is suitable for factor analysis. In addition, a Pearson's Correlation Matrix analysing the variables was also examined. This was to make sure that the statistical significance was not confused with practical significance (de Winter *et al,* 2009). Analysing a correlation matrix is useful for identifying variables that have poor correlations with others (Reinmann *et al,* 2008; de Winter *et al,* 2009). DeVaus (2002) suggests the strength of correlations for social sciences be used on a scale from 0-0.09 being trivial to over 0.70 as being very strong.

Internal consistence was measured using Cronbach's alpha coefficient, and by analysing the inter-item correlations (Reinmann *et al,* 2008). The Cronbach's alpha scores have been described by Reinmann *et al* (2008) from less than 0.5 being unacceptable to 0.9 as being excellent.

With smaller sample sizes, or small numbers of items, analysing the mean of inter-item correlations is a good test of reliability (de Winter *et al,* 2009). An inter-item correlation mean of over 0.2 usually indicates satisfactory reliability in the sample (de

Winter *et al,* 2009). The factor extraction method used was principal components. Padgett (2011) notes that Varimax orthogonal axis rotation method is common because it focuses on making as many values in each column of the factor loading coefficient table as close as possible to zero, thereby providing a simple explanation of the latent factors. Varimax orthogonal axis rotation was therefore used to simplify the task of interpreting the factor components (Padgett, 2011).

The number of factors was chosen by a number of criteria including: i) Kaiser's eigenvalue-greater-than-one rule; ii) Cattell's scree test; iii) analysis of rotated sum of squares loadings and what the percentage of variance explained is by each factor (Costello and Osborne, 2005; Courtney, 2013). It is also good practice to stop including factors when they stop making conceptual sense (Courtney, 2013). Very simple structure criterion could not be applied to the data because it was not available on the version of SPSS used by the researcher. The factor extraction process was, therefore, partially subjective as both the eigenvalues and the scree plot were analysed in order to decide on the number of factors. This decision was based on the importance of using a variety of factor extraction techniques, as Kaiser's commonly used eigenvalues-greater-than-one rule may lead to over-factoring or under-factoring of the data (Courtney, 2013). Items used in the Varimax orthogonal rotated solutions needed a minimum factor loading of 0.5 in order to be assigned to corresponding factors. This is well above the recommended minimum factor loading of 0.32 as discussed by Costello and Osborne (2005).

4.5.2 – Cluster Analysis

Cluster analysis was used with farm data and demographic data in order to test hypotheses two, three, four and five. Exploratory cluster analysis was used as a tool to analyse and explain irrigators' intentions, attitudes, values and policy preferences. As mentioned in the Literature Review and in the hypotheses section, clustering demographics

is common in the extractive-commodity and marketing literature (Straughan and Roberts, 1999; Schoon and Grotenhuis, 2000; Laroche *et al,* 2001; Bjornlund, 2002; Diamantopoulos *et al,* 2003; Gomez-Limon and Riesgo, 2004; Vandermersch, 2006; Kuehne *et al,* 2008).

Agglomerative hierarchical clustering is often the most preferred method because it is easy to interpret, and clusters can be chosen based on intuitive sense and by a number of cluster validation techniques (Punj and Stewart, 1983; Adams, 2003). Using this method, the number of clusters to include is decided by: i) viewing a dendrogram; ii) internally valide the clusters by cross tabulating the variables creating the clusters with the different cluster groups; and by iii) validating the data externally by cross tabulating variables that did not make the clusters with various cluster solutions (Punj and Stewart, 1983). This forms the basis for comparing the most well defined clusters when testing hypotheses three, four and five.

The Ward's Minimum Variance Cluster Analysis with Squared Euclidean Distance was chosen as it is one of the most commonly used algoritihms (Reimann *et al,* 2008; Padgett, 2011). Ward's method usually forms groups in a manner that limits loss of information (Adams, 2003; Reimann *et al,* 2008). It is, however, sensetive to the effects of outliers (Reinmann *et al,* 2008).

Some have criticized the use of cluster analysis for lacking statistical vigor (Adams, 2003; Dolnicar, 2003). It is most often used as a data mining technique, and with hiearchical cluster analysis, various clusters will always be found regardless of how well they actaully relate to one another. This research takes the conceptual approach of clustering irrigators according to demographics and farm charctiersitcs, which are well cited in the literature as being defining factors for irrigators' water transfer decisions (Tables 4.4.9 and 4.4.10). As such, the use of exploratory cluster analysis is acceptable in this case, with the proper

internal and external validation (Punj and Stewart, 1983). As Punj and Stewart (1983: 146) explain "ideally, only a small number of variables should be required to classify individuals. This classification should then have implications beyond the narrow set of classification variables." This validation will be done with the use of cross tabulation.

4.5.3 – Cross Tabulation

Cross tabulation is a popular method to investigate comparisons between two categorical variables (De Vaus, 2002). The Chi-Square statistical test was used to test the strength of association in the cross tabulations. As an inferential technique, the Chi-Square test offers an estimate of the likelihood that an association observed in the sample data exists in the population from which the sample was drawn. This test indicates the strength of the relationship between the variables. Chi-Square tests have a requirement that no more than 20% of cells have expected counts of less than five (Miller *et al*, 2002). Cross tabulation was used to test hypotheses two, three, four and five; in particular to validate the clusters internally and externally (Punj and Stewart, 1983). Cramer's V test was also used as an additional measure of association. For a Cramer's V test 0 indicates the absence of association, where 1 indicates perfect association (De Vaus, 2002).

4.6 Response Rate

In total there were 9,648 numbers that were called and approximately 1230 respondents that qualified for the survey (were farmers who had irrigated land). Out of the 1230 respondents that qualified, 319 completed the survey giving a response rate of 25.9%. Out of the 319 that completed the survey, 89 were private irrigators and 230 were district irrigators. The 8,419 that did not qualify, did not do so as they: i) did not farm irrigated land; ii) were under the age of 18; and/or iii) did not have a water license. The status of those who did not qualify may be ambiguous because many refused to answer whether or not they were irrigators.

Not everyone completed the entire survey. For the private irrigators, there are a low of 85 responses for some variables used for factor analysis. Given there are over 1,000 private licenses for irrigation use (Nicol *et al,* 2010; AARD, 2013), the private survey data has a margin of error greater than 5%, and a confidence level of less than 95% (Raosoft, 2014). However, approximately 14,791ha of irrigated land was held by private irrigators who account for approximately 15.5% of all land held by private irrigators in the province (AARD, 2013). From a land-use perspective, this data has a margin of error less than 5% and a confidence level of more than 95% (Raosoft, 2014).

There were 230 responses from district irrigators; however, as for the private irrigators not everyone completed the entire survey. There were a low of 222 responses for some of the variables used in factor analysis. In total, the district irrigators controlled 73,450ha of irrigated land (Table 4.7.1). From a land use perspective, the district irrigator sample has a margin of error less than 5% and a confidence level of more than 95% (Raosoft, 2014). Private and district irrigators were grouped together for the factor analysis and cluster analysis. The amount of land represented by complete cases in the cluster analysis was 77,025 hectares by 263 cases. This is because many refused to answer questions surrounding crop types, and land represented by crop types in 2011.

As a result of the sample size, and composition of the survey data, caution should be taken when assuming it is completely representative. While a significant proportion of irrigated land is represented, both in the private and district data, it may not represent the total amount of cases to a 95% confidence level. It is difficult to establish the exact number of farmers that use water for irrigation purposes because it is attached to land, and land is bought, leased and sold all the time (Hohm, 2012). This is why it is important to represent a significant sample of the irrigated land. This also likely means that large private landowners are more represented than smaller ones as the 89 private irrigators in the data

represents over 15.5% of all privately irrigated land. The difference between total number of cases, and irrigated land area is important when interpreting the results.

Table 4.17 – Irrigated hectares represented from Irrigation Districts

Irrigation District	***Total Irrigated Hectares***	***Sample Irrigated Hectares***	***% of Irrigation District***
Western Irrigation District	27,375	1,631	5.96%
Eastern Irrigation District	111,267	14,515	13.05%
Bow River Irrigation District	80,209	14,403	17.96%
Lethbridge Northern Irrigation District	49,526	9,764	19.71%
St. Mary River Irrigation District	138,712	22,662	16.34%
Mountain View Irrigation District	426	182	42.72%
Leavitt Irrigation District	1,862	951	51.07%
Aetna Irrigation District	781	340	43.53%
Magrath Irrigation District	4,528	1168	25.80%
United Irrigation District	6,992	522	7.47%
Raymond Irrigation District	13,065	3,123	23.90%
Taber Irrigation District	31,110	4,189	13.47%

Ross Creek Irrigation District	427	0	0.00%
Total	**466,280**	**73,450**	**15.75%**

*Irrigated hectares from AARD, 2013: 8.

As is identified in table 4.17, some districts are proportionally over-represented in the sample, while others are under-represented. In particular, the smaller irrigation districts such as Aetna, Leavitt, and Mountain View have a high degree of representation in the sample. Some of the larger irrigation districts, particularly the Western and Eastern irrigation districts, have proportionally lower representation in the sample. A reason for this is the size differences between each district. Nevertheless, it is important to point out that each district is not equally represented in the sample.

4.7 Concluding Remarks

This chapter has described the methods that were employed to achieve the research objectives. The bulk of this chapter described the survey instrument that was used. This method was the primary data extraction technique. As discussed, a second round of qualitative interviews was conducted with five key informants representing Alberta Environment, Alberta Agriculture and Rural Development, the Alberta Irrigation Projects Association, the Eastern Irrigation District and the St. Mary River Irrigation District. The next chapter focuses on the survey instrument, and how the data matches the literature by testing the research hypotheses. Chapter six investigates the responses of the key informants to describe the survey results.

CHAPTER FIVE

SURVEY RESULTS

5.0 Introduction

The goal of this chapter is to report on the information collected from the telephone survey. This was done by testing the research hypotheses outlined in the Methodology chapter. These findings contribute to achieving the second and third research objectives, which are to: i) Investigate the factors that influence irrigators' intentions to engage in water transfers in the SSRB; and ii) Investigate irrigators' policy preferences towards re-distributing water and the government's role in transfers. Groups of farmers are also identified based on their farm characteristics and demographics.

5.1 Omitted Variables

As discussed in the Methodology chapter, outliers are a serious issue concerning factor analysis and cluster analysis (Anderberg, 1973; Padgett, 2011). The data were therefore analysed to determine levels of skew-ness. If variables had over 85% of the responses leaning one way, or another, they were considered outliers and were excluded from the factor analysis. The cut-off point of 85% was decided upon after reviewing literature pertaining to outlier detection techniques (Hodge and Austin 2004; Costello and Osborne, 2005; Padgett, 2011). Categories were compressed from a seven point likert scale to a three point scale, in order to identify levels of skew-ness. Categories 1 to 3 in the likert scale were combined to represent one category; category 3 was left alone; and categories 4 to 7 were combined to represent the third category. Factor analysis was, however, conducted using the seven point scale as it displays more variance than the compressed three point scale.

Table 5.1 – Omitted Variables

Omitted Variable	***District Responses (%)***	***Private Responses (%)***
A1-b: *Managing environmental problems on your land is a high priority.*	DA – 3.9 N – 4.8 A – 91.3	DA – 4.5 N – 9 A – 86.5
A1-c: *The lifestyle that comes with living in a rural area is very important to you.*	DA – 2.6 N – 3.9 A – 93..5	DA – 2.2 N – 2.2 A – 95.5
A1-d: *Increasing the asset value or net worth of your farming operation is very important to you.*	DA – 3.1 N – 6.1 A – 90.8	DA – 4.5 N – 10.1 A – 85.4
A1-e: *For you, a rural environment is a better place to live than an urban environment.*	DA – 2.2 N – 4.8 A – 93	DA – 1.1 N – 1.1 A – 97.8
A1-h: *Rural communities are a great place to live and raise a family.*	DA – 2.6 N- 3.9 A – 93.5	DA – 2.2 N – 3.4 A – 94.4
A1-i: *Having enough water in rivers and streams to support healthy ecosystems is important o you.*	DA – 2.2 N – 1.3 A – 96.5	DA – 1.1 N – 9 A – 89.9
A1-j: *You make farm decisions based on how they will affect future generations farming on your land.*	DA – 3.1 N – 4.4 A – 92.5	DA – 3.4 N – 5.6 A – 91
A1-k: *Having land to pass down to future generations is more important than selling it for profi*t	DA – 5.7 N – 9.3 A - 85	DA – 5 N – 10 A – 85
B2-c: *There is an increasing demand for water from municipalities and industries in southern Alberta.*	DA – 3.9 N – 8.7	DA – 3.4 N – 10.1

	A – 87.4	A – 86.5
B2-h: *Municipalities and other non-agricultural users should be more efficient with their water.*	DA – 1.3 N- 10.9 A – 87.8	DA – 4.5 N – 5.7 A – 89.8

DA- Disagree, N – Neutral, A – Agree, NG – Negative, P- Positive.

Before running factor analysis, the data were tested for reliability using a correlation matrix identifying inter-item correlations. Variables that did not have any correlation with another item of at least 0.3 were eliminated from the factor analysis as they contribute little towards explaining the variance in the data set (Costello and Osborne, 2005; Padgett, 2011). Items with weak inter-correlations are not usually good indicators of factors as they are considered "noise" in the data that alters the results of factor analysis (Costello and Osborne, 2005). During two rounds of reliability tests, a total of 14 statements were removed because their inter-correlations were lower than 0.2. One statement was removed because it did not correlate with at least 0.3 with any other item in the correlation matrix (Table 5.1.2).

Table 5.2 – Items Removed due to Low Correlation

Item Removed	***Inter-Item Correlation***
A1-a: *A maximum annual financial return from your farm is your most important goal.*	0.141
A1-g: *You view your farming operation as first and foremost a business investment.*	0.189
A1-l: *When faced with decisions that affect the way you manage your farm environmental concerns tend to outweigh lifestyle considerations.*	0.174
A1-m: *When faced with decisions that affect the way you manage your farm financial concerns tend to outweigh environmental concerns.*	0.175
B2-b: *You are aware of your abilities to buy or sell water with other farmers.*	0.159

B2-d: *Irrigation water should not be transferred to non-agricultural users*	-0.078
B2-e: *Irrigation water should only be permanently sold to non-agricultural users if the money made from the sale goes towards increasing agricultural water use efficiency (for example, fixing canals or installing pipelines resulting in a net savings of water).*	0.2 (Did not correlate with at least 0.3 with any item).
B2-f: *Temporary leases of water are ok, but permanent sales of water are not.*	0.104
B2-g: *More water should be set aside for irrigation.*	0.184
B2-k: *Permanent water transfers between farmers are ok but trading water out of agriculture is not.*	0.053
C1-a: *Move water away from agriculture.*	0.189
C1-f: *Less water for irrigation.*	0.152
C2-c: *The government would think it's a good idea.*	0.030
C2-f: *Recreational users of rivers and streams would think it's a good idea.*	0.092
C2-g: *Professionals, scientists and members of environmental groups would think it's a good idea.*	0.117

Furthermore, statements **a1_n-** "*When faced with decisions that affect the way you manage your farm environmental concerns tend to outweigh lifestyle considerations"* and **b2_l-** "*You would feel more comfortable transferring your unused allocation rather than water you are actually using"* had low communalities of 0.253 and 0.230 respectively. Costello and Osborne (2005) recommend items with communalities less than 3.5 be removed from the data in order to achieve robust results. Most of the removed statements were value statements. These statements, showing near unanimously weak inter-item correlations may hint that the data is better structured for two factor analyses as opposed to one. To test this possibility, reliability tests were ran on the value data only. After numerous rounds of reliability tests, the highest Cronbach's alpha that was achieved was 0.643 for seven statements, which is considered low by most standards (Costello and

Osborne, 2005; Reinmann *et al*, 2008; Padgett, 2011; Courtney, 2013). The failure of these variables to fit in the model effectively removed the majority of the value statements from the factor analysis. This low fit is most likely due to the high amount of value statements with extreme response bias being taken out of the reliability test (Costello and Osborne, 2005).

Factor analysis was conducted with the remaining 23 statements. After one round of factor analysis it was discovered that that **c3-a – "***uncertainty about the costs and benefits associated with the trade"* and **c3-j -** "*Environmental water demands"* were cross-loaders having high correlations with two factors. Costello and Osborne (2005) note that cross-loaders can skew the results significantly, and that if possible should be removed from the analysis.

The remaining 21 statements were tested for reliability and produced a Cronbach's alpha of 0.860. The KMO statistic for the remaining statements reached 0.828, and the Bartlett's test of sphericity was significant indicating that the data was suitable for factor analysis. All item communalities were over 0.4 as recommended by Costello and Osborne (2005). The 21 statements were therefore deemed acceptable and factor analysis was conducted.

5.2 Factor Analysis

The factor analysis performed on the 21 statements indicated 5 factors with an eigenvalue of higher than 1.0 accounting for 62.44% of the data (Table 5.2.1). It was, however, decided after analysing the factor loadings and Scree plot that 4 factors would be extracted (Figure 5.2.1). This follows the advice of Costello and Osborne (2005) and Padgett (2011) suggesting that the most appropriate rule about when to stop accepting additional factors is when they stop making sense conceptually. The four factor solution

made much more conceptual sense than the five factor solution. The four factors account for 57.43% of the variation taken by the factors in the data (Table 5.3).

Table 5.3 – Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.77	27.49	27.49	5.77	27.49	27.49	4.06	19.32	19.32
2	2.65	12.61	40.10	2.65	12.61	40.10	3.55	16.90	36.22
3	2.20	10.49	50.59	2.20	10.49	50.59	2.30	10.98	47.19
4	1.44	6.84	57.43	1.44	6.84	57.43	2.15	10.24	57.43
5	1.05	5.01	62.44						
6	0.90	4.31	66.75						
7	0.76	3.60	70.35						
8	0.74	3.51	73.85						
9	0.71	3.37	77.23						
10	0.63	3.02	80.25						
11	0.58	2.75	83.00						
12	0.53	2.52	85.52						
13	0.51	2.41	87.93						
14	0.47	2.24	90.17						
15	0.42	2.02	92.19						
16	0.39	1.87	94.06						
17	0.37	1.78	95.84						
18	0.28	1.35	97.19						
19	0.25	1.18	98.37						
20	0.20	0.97	99.34						
21	0.14	0.66	100.00						

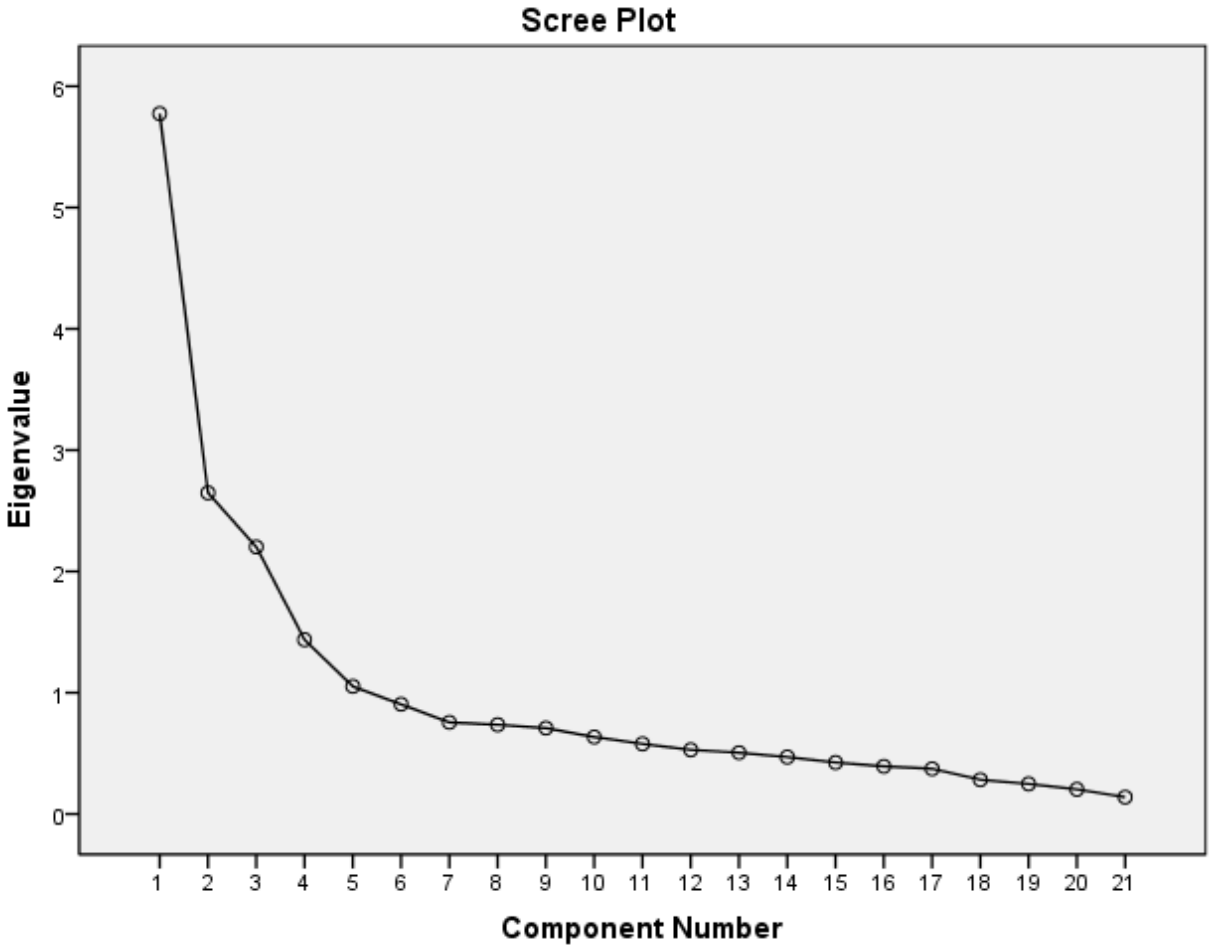

Figure 5.1 – Scree Plot

All variables had a factor loading above 0.5 with one of the four factors (Table 5.4). The first factor accounts for 19.32% of the variance in the rotated data (Table 5.3). This factor corresponds with risk attitudes, citing that decisions to transfer water are based on uncertainty over input costs, the future of the farm, and the future demand for water from communities or industries. This factor is named ***risk-averse attitude*** to highlight this. The second factor accounts for 16.9% of the variance in the rotated data, and very closely corresponds with the importance of the social acceptance of water transfers. This factor is named ***social acceptance attitude*** to reflect this. The third factor, accounting for 10.98% of the variance in the rotated data, indicates ***pro-sharing attitude***. The components of this factor mainly reflect favourable attitudes towards satisfying the water demands of a

municipality and/or industry. These factor components also include favourable views towards increasing water use efficiency, indicating a desire to "expand" the resources by increasing use efficiency and thereby provide increased supply for their own or others use.

Table 5.4– Rotated Components Matrix

	Component			
	1	2	3	4
a1_f –Your right to do what you want with your water allocation has to be balanced against wider environmental concerns: Level of agreement from strongly disagree to strongly agree.	.012	.037	.040	.653
b2_a – Rivers and streams of Southern Alberta are environmentally degraded due to low flows: Level of agreement from strongly disagree to strongly agree.	.177	.068	-.137	.574
b2_i -- Re-allocating water from irrigation to municipalities and non-agricultural users is beneficial to society: Level of agreement from strongly disagree to strongly agree.	-.015	.145	.564	.426
b2_j -- Re-allocating water from irrigation to water conservation objectives is beneficial to society: Level of agreement from strongly disagree to strongly agree.	.091	.052	.281	.688
c1_b -- Satisfy the water demands of a municipality: Level of agreement from extremely negative to extremely positive.	.146	.045	.870	.049
c1_c -- Satisfy the water demands of an industry: Level of agreement from extremely negative to extremely positive.	.206	.176	.775	.022
c1_d -- Increase water use efficiency Level of agreement from extremely negative to extremely positive.	.065	.126	.581	.101
c1_e -- A 10% holdback of the traded volume to meet water conservation objectives: Level of agreement from extremely negative to extremely positive.	.119	-.050	.230	.648
c2_a -- Members of your family would think it's a good idea: Level of agreement from strongly disagree to strongly agree.	.167	.780	.172	.038
c2_b -- Members of your community would think it's a good idea: Level of agreement from strongly disagree to strongly agree.	.057	.784	-.001	.107
c2_d -- Your neighbours and friends would think it's a good idea: Level of agreement from strongly disagree to strongly agree.	.155	.863	.106	.006
c2_e -- Members of agricultural communities and organizations would think it's a good idea: Level of agreement from strongly disagree to strongly agree.	.124	.809	.127	.040
c2_h -- Other irrigators around where you live would think it's a good idea: Level of agreement from strongly disagree to strongly agree.	.136	.853	.128	-.012
c3_b -- Plans to expand your farming operation: How much this factor influences decision to approve of a transfer of water from not at all to very much.	.566	.066	.093	-.235
c3_c -- Annual precipitation patterns: How much this factor influences decision to approve of a transfer of water from not at all to very much.	.656	.077	.168	.096
c3_d -- Rising or declining commodity prices: How much this factor influences decision to approve of a transfer of water from not at all to very much.	.781	.220	.055	.077
c3_e -- Rising or declining operations costs: How much this factor influences decision to approve of a transfer of water from not at all to very much.	.825	.198	.037	.071
c3_f -- Having a successor lined up for your farm: How much this factor influences decision to approve of a transfer of water from not at all to very much.	.711	.043	.012	.039
c3_g -- Growing water demand from industry: How much this factor influences decision to approve of a transfer of water from not at all to very much.	.635	.049	.129	.276
c3_h -- Uncertainty about the future of your farm: How much this factor influences decision to approve of a transfer of water from not at all to very much.	.744	.070	.058	.109
c3_i -- Growing water demand from communities: How much this factor influences decision to approve of a transfer of water from not at all to very much.	.584	.117	.079	.354

The final factor is composed of ***pro-environmental values*** indicating a belief that Alberta's rivers and streams are degraded, WCO holdbacks are good, and that land use must accommodate demands environmental purposes.

The attitude and value factor scores were assigned to each respondent in order to test research hypothesis 3: 'different groups of irrigators will stress importance on different values towards farming and water trading; and attitudes towards social acceptance, risk and impacts of re-allocation.' The factor scores were transformed into categorical variables so that they could be cross-tabulated with the cluster groups (Section 5.4). After analysing their distribution, it was decided that factor scores should be categorized based on one-half standard deviation from the mean. As such, each factor score was categorized in the following four ranges: 1=lowest to -0.4999; 2=-0.5 to 0; 3=0-0.4999; and 4= 0.5 to highest factor score. These scores were categorized to eliminate problems with minimum cell counts that may render chi-square tests invalid (Miller *et al,* 2002; Padgett, 2011).

5.3 Value and Attitude Associations with Trading or Transfer Intentions and Policy Preferences

In order to test the first research hypothesis, cross tabulation and chi-square tests were used to test for significant association between the value and attitude factors, and intentions and policy preferences. This does not assume causality between the two. To assume causality between such constructs may highlight problems associated with endogeneity bias (Duncan *et al,* 2004). The Literature Review chapter highlights problems described in the attitude-behaviour connection literature with assuming causality between values, attitudes and behaviour (Ajzen and Fishbein, 1977). The parameters set in the survey provide a case that trading intentions may just as easily affect values and attitudes, as values and attitudes affect trading intentions. Instead of assuming causality between these constructs, the purpose of this research is exploratory, taking a 'snap shot in time' of

irrigators' values, attitudes, intentions and policy preferences. Significant relationships between these constructs observed by chi-square tests simply identify associations between values and attitudes and certain trading or transfer intentions, and policy preferences. Responses towards trading intentions re-iterate skepticism found in the literature towards using market mechanisms to re-allocate water from agricultural purposes to non-agricultural purposes (Bjornlund *et al,* 2007; Nicol *et al,* 2008) (Table 5.3.1).

Table 5.5- Trading or Transfer Intentions Responses

Intentions		***Frequency***	***Percentage***
d1_a -- Purchase a Lease of Water	Unlikely	148	48.8%
	Neutral	44	14.5%
	Likely	111	36.6%
d1_b--Permanently Buy Water	Unlikely	139	45.9%
	Neutral	41	13.5%
	Likely	123	40.6%
d1_c--Sell a Lease of Water	Unlikely	242	79.9%
	Neutral	25	8.3%
	Likely	36	11.9%
d1_d--Permanently Sell Water	Unlikely	254	83.8%
	Neutral	27	8.9%
	Likely	22	7.3%
d1_e—Vote 'Yes' in a Plebiscite	Unlikely	179	81.0%
	Neutral	32	14.5%
	Likely	10	4.5%

Only value and attitude statements that were shown to have significantly different associations with trading intentions are reported in Tables 5.6, 5.7 and 5.8. The level of risk-averse attitude, social acceptance attitude and pro-environmental values were significantly associated with some intentions to trade or transfer water. Both risk-averse attitude and social acceptance attitude have significant associations with intentions to purchase a lease of water. High risk-averse attitude tends to display neutral or likely

intentions to purchase a lease of water over the next five years, whereas a low risk-averse attitude tends to associate with a low level of intentions to purchase a lease of water (Table 5.6).

Table 5.6 – Risk-Averse Attitude and Trading or Transfer Intentions

Trading Intention		***Risk Averse Attitude***			
		1	2	3	4
d1_a -- Purchase a lease of water. */*	Unlikely	30.9%	19.9%	20.6%	28.7%
	Neutral	14.3%	16.7%	19.0%	50.0%
	Likely	28.4%	12.7%	27.5%	31.4%
d1_b -- Permanently buy water.	Unlikely	29.9%	21.3%	19.7%	29.1%
	Neutral	22.5%	20.0%	17.5%	40.0%
	Likely	26.5%	10.6%	27.4%	35.4%
d1_c -- Selling a lease of water.	Unlikely	28.6%	17.4%	21.9%	32.1%
	Neutral	16.0%	8.0%	32.0%	44.0%
	Likely	28.1%	18.8%	21.9%	31.3%
d1_d -- Permanently sell some of your water allocation.	Unlikely	28.0%	16.5%	24.2%	31.4%
	Neutral	14.8%	14.8%	14.8%	55.6%
	Likely	38.9%	22.2%	16.7%	22.2%
d1_e -- Vote 'yes' in a plebiscite to permanently sell some district water to outside of the district (*District Only*).	Unlikely	26.7%	17.0%	21.2%	35.2%
	Neutral	26.7%	10.0%	33.3%	30.0%
	Likely	44.4%	22.2%	22.2%	11.1%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

This finding indicates that variance in the perceptions towards risk factors, such as weather patterns, input costs, and farm uncertainties; are associated with different intentions to purchase a lease of water. This may indicate that purchasing a lease of water is used by irrigators as a way to offset risks associated with variable input costs, crop needs, and other farm uncertainties. This is consistent with the literature suggesting that motivations for permanent sales are different than motivations for temporary ones (Bjornlund, 2002; Bjornlund, 2003a; Bjornlund, 2003b; Bjornlund and Rossini, 2005; Nicol and Klein, 2006b; Kuehne and Bjornlund, 2008). Social acceptance attitude, on the other hand, tends to have the opposite effect (Table 5.7). Low social acceptance attitude, or

views that social groups would disapprove of re-allocation, had a higher association with intentions to purchase a lease of water than high social acceptance attitudes.

Table 5.7 – Social Acceptance Attitude and Trading or Transfer Intentions

Trading Intention		***Social Acceptance Attitude***			
		1	2	3	4
d1_a -- Purchase a lease of water. **/**	Unlikely	32.4%	22.8%	14.7%	30.1%
	Neutral	47.6%	7.1%	7.1%	38.1%
	Likely	37.3%	11.8%	21.6%	29.4%
d1_b -- Permanently buy water.	Unlikely	31.5%	21.3%	18.1%	29.1%
	Neutral	47.5%	12.5%	7.5%	32.5%
	Likely	37.2%	12.4%	16.8%	33.6%
d1_c -- Selling a lease of water.	Unlikely	36.6%	16.5%	16.1%	30.8%
	Neutral	40.0%	8.0%	12.0%	40.0%
	Likely	31.3%	21.9%	18.8%	28.1%
d1_d -- Permanently sell some of your water allocation.	Unlikely	38.6%	16.9%	16.1%	28.4%
	Neutral	29.6%	7.4%	18.5%	44.4%
	Likely	16.7%	22.2%	11.1%	50.0%
d1_e -- Vote 'yes' in a plebiscite to permanently sell some district water to outside of the district (*District Only).*	Unlikely	35.8%	17.6%	15.2%	31.5%
	Neutral	50.0%	10.0%	20.0%	20.0%
	Likely	22.2%	11.1%	33.3%	33.3%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

Pro-environmental value displayed the most significant associations with intentions (Table 5.8). High pro-environmental values are associated with low intentions to purchase a lease of water, whereas low pro-environmental values are associated with more of an intention to purchase a lease of water. The same holds true with intentions to permanently buy water. Higher pro-environmental values also correspond with higher intentions to re-allocate water via plebiscite. This value seems to be associated with intentions to consume less water.

This finding is consistent with the extractive-commodity literature and studies pertaining to the categorisation of farmers based on their values (Beus and Dunlap, 1990; Beus and Dunlap, 1994; Maybery *et al,* 2005; Kuehne *et al,* 2008). The pro-environmental

value that exists seems to encourage less water used for consumptive agriculture, and more water being conserved.

Table 5.8 – Pro-Environmental Value and Trading or Transfer Intentions

Trading Intention		***Pro-Environmental Value***			
		1	2	3	4
d1_a -- Purchase a lease of water. **/**	Unlikely	21.3%	19.9%	15.4%	43.4%
	Neutral	35.7%	16.7%	23.8%	23.8%
	Likely	34.3%	16.7%	25.5%	23.5%
d1_b -- Permanently buy water. ***/***	Unlikely	22.8%	16.5%	18.1%	42.5%
	Neutral	30.0%	32.5%	10.0%	27.5%
	Likely	33.6%	15.0%	26.5%	24.8%
d1_c -- Selling a lease of water.	Unlikely	28.6%	17.9%	19.2%	34.4%
	Neutral	24.0%	32.0%	20.0%	24.0%
	Likely	28.1%	9.4%	28.1%	34.4%
d1_d -- Permanently sell some of your water allocation.	Unlikely	28.0%	18.2%	19.9%	33.9%
	Neutral	18.5%	22.2%	29.6%	29.6%
	Likely	44.4%	11.1%	11.1%	33.3%
d1_e -- Vote 'yes' in a plebiscite to permanently sell some district water to outside of the district (*District Only*). */*	Unlikely	29.1%	19.4%	21.2%	30.3%
	Neutral	16.7%	20.0%	16.7%	46.7%
	Likely	0.0%	11.1%	55.6%	33.3%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

The next round of chi-square tests analysed the significant associations between risk-averse attitudes, pro-environmental value and policy preferences. Social acceptance attitude and pro-sharing attitude did not display significant associations with policy preferences. The policy preference responses were much more normally distributed than the trading intentions (Table 5.9). The responses to the statements suggest that there is a reluctance to re-allocate water via market mechanisms. This matches Bjornlund *et al* (2007) and Nicol *et al* (2008) findings indicating a general reluctance among irrigators to use market mechanisms to re-allocate water. The findings also suggest that irrigators believe that if water is to be re-allocated, the government should not set the price, but should abide by the market rules. There is also a general belief that water saved through efficiency gains should be used to increase economic activity, not to be re-allocated to

rivers and streams. These perceptions among irrigators support the fear that some researchers have expressed that increased efficiencies may not lead to more water conservation, due to irrigators' intentions to use the water (English *et al*, 2002; Whittlesey, 2003; Bjornlund *et al*, 2009).

Table 5.9 – Policy Preference Responses

Policy Preference Statement		***Frequency***	***Percentage***
b1_a -- The government, rather than market forces, should determine who uses Alberta's water.	SD	84	27.5
	N	78	25.6
	SA	137	44.9
b1_b -- If an ID/private license holder isn't using all water allocation, the gov't should be able to take water for environmental purposes, w/o compensation.	SD	246	80.7
	N	25	8.2
	SA	32	10.5
b1_c -- Minimum flows of water should be set for all rivers and streams, and only the water above those minimum flows should be used for economic purposes.	SD	68	22.3
	N	58	19.0
	SA	175	57.4
b1_d -- Private groups and individuals should be able to hold water licenses for environmental purposes.	SD	94	30.8
	N	91	29.8
	SA	117	38.4
b1_e -- Water that is saved through improved water use efficiency should be used to increase economic activity.	SD	24	7.9
	N	50	16.4
	SA	228	74.8
b1_f -- The government should buy water from current license holders, like irrigation districts, so that more water can be left in the rivers.	SD	164	53.8
	N	73	23.9
	SA	62	20.3
b1_g -- The seniority of a water license must be honoured under all circumstances.	SD	31	10.2
	N	32	10.5
	SA	239	78.4
b1_h -- Public funds should be used to improve irrigation systems only if the water that is saved is left in rivers.	SD	106	34.8
	N	74	24.3
	SA	122	40.0
b1_i -- If water is to be traded among irrigation districts and/or municipalities, the government should set the price.	SD	196	64.3
	N	51	16.7
	SA	53	17.4

Underneath the intentions to use water, is, however, a fairly polarized level of environmental consciousness amongst the respondents. When asked if public funds should be used to improve irrigation systems only if the water saved is left in rivers, responses tended to be bi-modal with similar numbers agreeing and disagreeing. Furthermore, when

asked if private license holders should hold water for environmental purposes, the responses indicate general agreement. This reiterates recent findings in the SSRB analysing the value orientations of rural and urban populations (Bjornlund *et al*, 2013a; 2013b).

Another similar finding is that the majority also believed that minimum flows should be set for rivers and streams, and only water above that minimum flow should be used for economic purposes (Bjornlund *et al*, 2013a). The two value and attitude factors that had significant differences in policy preferences are risk-averse attitude and pro-environmental value (Table 5.10 and Table 5.11)

Table 5.10 – Risk-Averse Attitude and Policy Preferences

Policy Preference Statement		***Risk Averse Attitude***			
		1	2	3	4
b1_a -- The government, rather than market forces, should determine who uses Alberta's water. **/**	SD	38.0%	8.9%	19.0%	34.2%
	N	22.1%	26.0%	16.9%	35.1%
	SA	24.0%	16.5%	28.9%	30.6%
b1_b -- If an ID/private license holder isn't using all water allocation, the gov't should be able to take water for environmental purposes, w/o compensation.	SD	26.6%	21.0%	23.1%	29.3%
	N	36.4%	4.5%	22.7%	36.4%
	SA	27.6%	10.3%	24.1%	37.9%
b1_c -- Minimum flows of water should be set for all rivers and streams, and only the water above those minimum flows should be used for economic purposes.	SD	22.6%	19.4%	19.4%	38.7%
	N	25.5%	16.4%	21.8%	36.4%
	SA	28.6%	16.1%	24.8%	30.4%
b1_d -- Private groups and individuals should be able to hold water licenses for environmental purposes. */*	SD	27.9%	11.6%	29.1%	31.4%
	N	19.3%	22.9%	18.1%	39.8%
	SA	33.6%	15.5%	21.8%	29.1%
b1_e -- Water that is saved through improved water use efficiency should be used to increase economic activity. **/**	SD	58.3%	12.5%	8.3%	20.8%
	N	22.9%	18.8%	31.3%	27.1%
	SA	24.6%	16.9%	22.7%	35.7%
b1_f -- The government should buy water from current license holders, like irrigation districts, so that more water can be left in the rivers.	SD	31.5%	13.4%	23.5%	31.5%
	N	23.2%	21.7%	18.8%	36.2%
	SA	20.3%	18.6%	27.1%	33.9%
b1_g -- The seniority of a water license must be honoured under all circumstances.	SD	40.7%	7.4%	25.9%	25.9%
	N	30.0%	23.3%	20.0%	26.7%
	SA	25.4%	17.0%	22.8%	34.8%
b1_h -- Public funds should be used to improve irrigation systems only if the water that is saved is left in rivers.	SD	30.3%	13.1%	21.2%	35.4%
	N	33.3%	21.7%	20.3%	24.6%
	SA	21.4%	17.0%	25.9%	35.7%

b1_i -- If water is to be traded among irrigation districts and/or municipalities, the government should set the price.	SD	27.7%	19.0%	22.3%	31.0%
	N	23.9%	17.4%	19.6%	39.1%
	SA	29.2%	8.3%	27.1%	35.4%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

Table 5.11 – Pro-Environmental Value and Policy Preferences

Policy Preference Statement		***Pro-Environmental Value***			
		1	2	3	4
b1_a -- The government, rather than market forces, should determine who uses Alberta's water.	SD	32.9%	16.5%	15.2%	35.4%
	N	28.6%	14.3%	23.4%	33.8%
	SA	23.1%	22.3%	21.5%	33.1%
b1_b -- If an ID/private license holder isn't using all water allocation, the gov't should be able to take water for environmental purposes, w/o compensation.	SD	28.8%	18.8%	21.0%	31.4%
	N	22.7%	9.1%	22.7%	45.5%
	SA	24.1%	20.7%	13.8%	41.4%
b1_c -- Minimum flows of water should be set for all rivers and streams, and only the water above those minimum flows should be used for economic purposes.	SD	33.9%	21.0%	17.7%	27.4%
	N	34.5%	10.9%	27.3%	27.3%
	SA	23.0%	19.9%	19.3%	37.9%
b1_d -- Private groups and individuals should be able to hold water licenses for environmental purposes.	SD	34.9%	19.8%	15.1%	30.2%
	N	24.1%	21.7%	24.1%	30.1%
	SA	25.5%	13.6%	21.8%	39.1%
b1_e -- Water that is saved through improved water use efficiency should be used to increase economic activity.	SD	37.5%	16.7%	20.8%	25.0%
	N	22.9%	18.8%	25.0%	33.3%
	SA	28.0%	18.4%	18.8%	34.8%
b1_f -- The government should buy water from current license holders, like irrigation districts, so that more water can be left in the rivers. **/**	SD	32.9%	21.5%	18.8%	26.8%
	N	26.1%	15.9%	24.6%	33.3%
	SA	16.9%	11.9%	18.6%	52.5%
b1_g -- The seniority of a water license must be honoured under all circumstances.	SD	18.5%	14.8%	18.5%	48.1%
	N	36.7%	6.7%	20.0%	36.7%
	SA	28.1%	20.1%	20.5%	31.3%
b1_h -- Public funds should be used to improve irrigation systems only if the water that is saved is left in rivers.	SD	34.3%	21.2%	19.2%	25.3%
	N	23.2%	20.3%	24.6%	31.9%
	SA	25.0%	14.3%	18.8%	42.0%
b1_i -- If water is to be traded among irrigation districts and/or municipalities, the government should set the price. **/**	SD	32.6%	17.9%	15.2%	34.2%
	N	23.9%	23.9%	28.3%	23.9%
	SA	16.7%	12.5%	31.3%	39.6%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

Higher risk-averse attitudes tend to be associated with support for government control over allocation as opposed to market-based allocation (Table 5.10). High risk-averse attitudes also tend to coincide with neutrality or disagreement over the issue of private ownership of licenses for environmental purposes. The most marked difference in

policy preferences within the risk-averse attitude orientation is the issue of whether or not water saved through efficiency gains should be used to increase economic activity. Low risk-averse attitude is associated with negative views towards using efficiency gains solely for economic purposes, whereas high risk-averse attitude are associated with neutrality or agreement with the use of efficiency gains for economic purposes.

Higher pro-environmental value is associated with a positive views of government interference towards i) allocating water back into rivers and streams; and ii) government setting prices for permanent water sales between irrigation districts and municipalities. This is consistent with the extractive-commodity literature suggesting that pro-environmental views tend to have positive associations with more of a desire for government regulation (Tremblay and Dunlap, 1978; Beus and Dunlap, 1990; Beus and Dunlap, 1994).

5.3.1 – Summary of Value and Attitude Relationships with Intentions and Policy Preferences

Risk-averse attitude and pro-environmental value are the factors which are mostly associated with differences in trading intentions and policy preferences. High risk-averse attitude is associated with a desire to purchase more temporary water, and with more of a desire to use efficiency gains for economic purposes. Pro-environmental value orientations, on the other hand, are associated with favourable views of conserving more water and putting unused water back into rivers and streams. Pro-environmental value orientations generally support the role of the government in ensuring environmental protection and water conservation. Low social acceptance attitudes towards re-allocation is associated with more of an intention to purchase temporary water, most likely indicative of the negative views of re-allocation (Bjornlund *et al*, 2007; Nicol *et al*, 2008). These findings lead to the conclusion that **hypothesis one is partially confirmed**. Underlying

value and attitude orientations did account for some of the variation of intentions and policy preference responses, but not all value and attitude orientations. For instance, pro-sharing attitudes had no significant association with intentions or policy preferences; and social acceptance attitude was limited in its categorical differences in trading intentions and policy preferences. The next step in the research is to identify groups of irrigators based on demographics and farm characteristics.

5.4 Cluster Analysis

As discussed in the Methodology chapter, clusters of farmers were identified based on demographic and farm characteristics as set out in table 5.12:

Table 5.12 – Cluster Analysis Variables

Characteristics	***Variables***
Demographics	Age Education Income derived from Land
Farm Characteristics	Amount of allocation used Proportion of irrigated land to dry land Crops Grown Irrigation Equipment

For hierarchical cluster analysis, the best results are obtained by clustering variables of the same type (i.e.: categorical to categorical, numeric to numeric) (Anderberg, 1973). The two-step clustering method is usually recommended for data that varies in nature (Anderberg, 1973). Therefore, to yield the most robust results, numeric and string variables were re-coded into categorical variables. Crops were first recoded from string variables to categories. The percentage of land dedicated to each crop type is outlined in Table 5.14.

The crop categories used are listed in table 5.13 and are defined by using Alberta Agriculture and Rural Development crop reports (2011a; 2011b).

As discussed in the Methodology chapter, not all land uses were known as many refused to answer the question in the survey. There was one other use of irrigation, which was for mixed farming purposes accounting for 700 acres that is not represented in Table 5.14. Since most farmers in the sample irrigated more than one type of crop, four variables were created based on percentage of irrigated land in each crop type. Each variable has the following categories: 1 = 0%-33%; 2 = 34%-66%; and 3 = 67%-100%. Missing values were not used in the cluster analysis.

The final farm characteristic that needed re-coding was irrigation equipment types. Respondents were asked roughly what percentage of their irrigated land was under gravity/flood, hand move, wheel move, high pressure centre pivot, and low pressure centre pivot. This information was re-coded into three different variables, each representing different irrigation systems. Each of these four variables was re-coded into the following categories depending on the percentage of the irrigated land in each irrigation equipment type: 1 = 0%-33%; 2 = 34%-66%; and 3 = 67%-100%. All relevant variables were then included into a hierarchical agglomerative cluster analysis to group irrigators according to these farm characteristics. Descriptive statistics, as well as preliminary cluster analysis results, showed that percentage of land under certain irrigation systems was not a good variable for clustering. Problems arose because of outliers in the data, particularly for gravity/flood and hand move where more than 85% of respondents had between 0%-33% of their land covered by each irrigation system

Table 5.13 – Crop Classifications

Crop Category	***Crop Types***
Grain Crops	Barley – all types Wheat – all types Rye Buckwheat
Forage Crops	Alfalfa Hay Timothy Hay Fescues Pasture and Ranges Green Feed
Oilseed Crops	Canola Flax
Specialty Crops	Sugar Crops – Sugar Beets Potatoes Corn for Grain Fodder Corn Dry Beans Chickpeas Soybeans Canary Seed Lentils Triticale Sunflower Alfalfa Seed Mustard Seed Canola Seed

Most irrigation equipment types were heavily skewed one way or another, which has serious effects for Ward's minimum variance clustering method (Anderberg, 1973; Adams, 2003; Rienmann *et al*, 2008). For this reason, it was not practical to use irrigation systems information to internally validate the clusters. Due to this, these variables were taken out of the cluster analysis and were instead used for external validation, after the clusters have already been created with the existing demographic and farm characteristic variables.

Table 5.14 – Percentage of Land Dedicated to Crop Type 2011

Crop Type	***Hectares***	***Percentage***
Grain	27,293	35.43%
Forage	19,772	25.67%
Oilseed	18,418	23.91%
Specialty	11,542	14.98%
Total	**77,025**	**100%**

Before cluster analysis began, the relationships between the variables were observed by analysing a Pearson's correlation matrix. The Pearson's correlation matrix indicated that multi-collinearity was not strong, as the highest coefficient was 0.576, considered low by most standards (Anderger, 1973; Gujarati, 2003). Nevertheless, variables with a coefficient higher than 0.50 were subjected to linear multiple regression generating VIFs. The highest VIF obtained from multiple regression was 2.5 indicating very low multi-collinearity (Gujarati, 2003).

The final diagnostic was to check for outliers for the remainder of the variables. More than 86% of the respondents had between 0% and 33% of their land under specialty crop production. This item was broken down further to investigate the amount of respondents at quartile levels. More than 85% of respondents had between 0% and 25% of

their land under speciality crop production. The variable representing land under specialty crop production was therefore removed from the cluster analysis, and was used as an external validation variable much like irrigation equipment. The remaining items were then used for cluster analysis.

The number of clusters to be extracted from hierarchical cluster analysis is rather subjective (Anderberg, 1973; Punj and Stewart, 1983; Gujarati, 2003; Padgett, 2011). It is first important to analyse a dendrogram (Figure 5.2) in order to visually identify the data. After analysing the dendrogram, it was decided that a three cluster solution was optimal. The variables included in the analysis were then compared against each cluster in order to offer some form internal validation, that is, to ensure that the variables used in the cluster analysis differ significantly between the clusters (Anderberg, 1973; Padgett, 2011).

Table 5.15 – Cluster Composition

Cluster	***Frequency***	***Percentage***
1	87	33.0%
2	113	42.8%
3	64	24.2%
Total	**264**	**100%**

5.4.1 – Cluster Validation

Internal validation was conducted using Chi-square tests and Cramer's V statistic. Each variable used in the cluster analysis was compared between cluster groups in order to identify differences. Clusters that have high internal validity will have significant Chi-square and Cramer's V statistics indicating that the clusters have a significant degree of difference between the clusters.

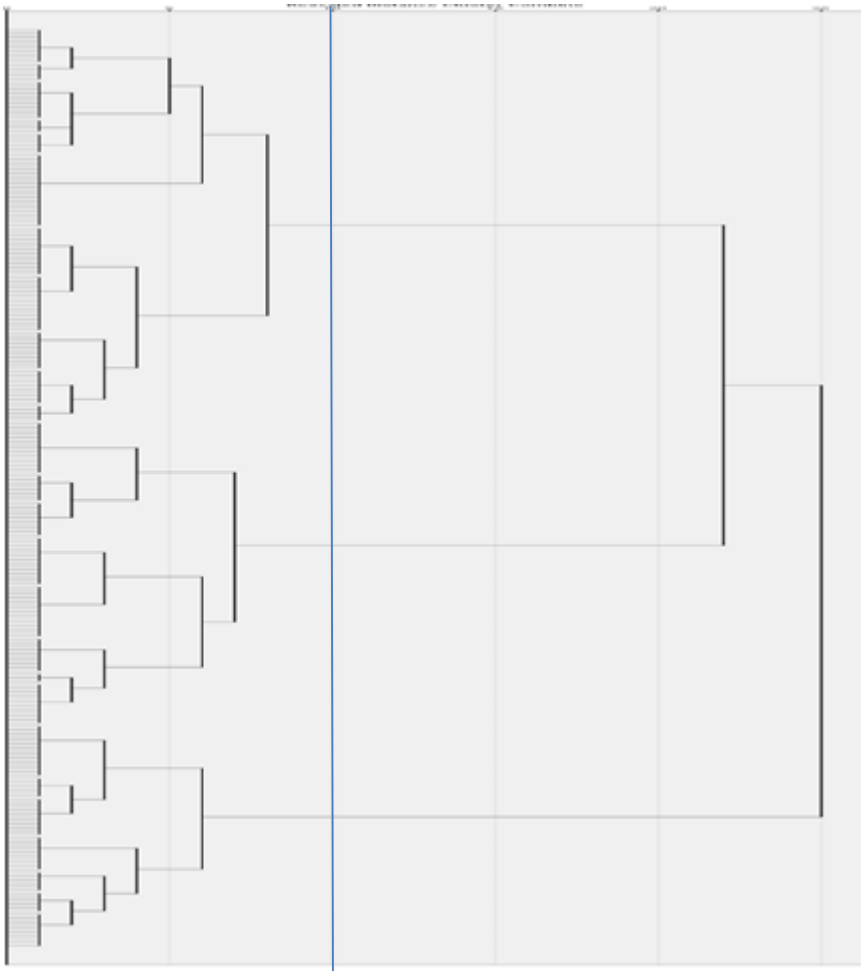

Figure 5.2 – Dendrogram

Age and education are not very different between the clusters (Table 5.16). Age is found to be significant at the 10% level and education did not show any significant differences between clusters. Cluster group 2 is the youngest with a larger proportion falling into the 36-45 year old and 46-55 year old ranges than the other two clusters. Cluster group 1 has more of its respondents in the 56-65 year old cohort than the other two clusters.

Table 5.16 – Demographic Variables

Demographic Variable		***Ward Method***			
		1	**2**	**3**	**Total**
Age */*	18-35	4.6%	8.8%	9.4%	7.6%
	36-45	6.9%	21.2%	17.2%	15.5%
	46-55	29.9%	31.0%	25.0%	29.2%
	56-65	37.9%	27.4%	26.6%	30.7%
	66 or older	20.7%	11.5%	21.9%	17.1%
Education	Completed high school or less	28.7%	28.3%	28.1%	28.4%
	Some College/University	21.8%	21.2%	17.2%	20.4%
	Completed College/University	44.8%	40.7%	48.4%	43.9%
	Some graduate school or more	4.6%	9.7%	6.3%	7.2%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

Crop type is a defining feature of the clustered groups, despite the fact that the oilseeds category violated the minimum cell count requirements, and specialty crops not being included in the cluster analysis (Table 5.17). The second cluster has more land dedicated to grain and oilseed production than the other two clusters. Furthermore, specialty crop production was heavily represented in the second cluster, whereas the first and third clusters had a comparatively small amount of land dedicated to specialty crop production. The third cluster proportionally has the most land dedicated to forage purposes, and proportionally had less land dedicated to oilseed and specialty crop production than the other two clusters. The first cluster had most of its land dedicated

towards forage and grain production, but also had a sizeable amount dedicated to oilseed production.

Table 5.17 – Crops by percentage of Irrigated Land, 2011

Crop Type	*Percentage*	*Wards Method*			
		1	**2**	**3**	**Total**
Grain ***/***	0-33%	64.4%	50.4%	79.7%	62.1%
	34%-66%	23.0%	42.5%	9.4%	28.0%
	67%-100%	12.6%	7.1%	10.9%	9.8%
Forage ***/***	0-33%	44.8%	63.7%	23.4%	47.7%
	34%-66%	13.8%	19.5%	10.9%	15.5%
	67%-100%	41.4%	16.8%	65.6%	36.7%
Oilseeds *Minimum cell count violation	0-33%	78.2%	71.7%	98.4%	80.3%
	34%-66%	14.9%	23.9%	1.6%	15.5%
	67%-100%	6.9%	4.4%	0.0%	4.2%
Specialty *Minimum cell count violation *Not Included in Cluster Analysis	0-33%	93.1%	76.8%	92.2%	85.9%
	34%-66%	5.7%	18.8%	3.1%	10.7%
	67%-100%	1.1%	4.5%	4.7%	3.4%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

The most defining features of the clusters are the percentage of income derived from land, the percentage of land irrigated, and the area of land irrigated (Table 5.18). The first cluster clearly represents mainly dryland farmers with a small proportion of irrigated land. The vast majority of farmers in this cluster depend on farming for income, yet the majority only have 0 to less than 25% of their land irrigated. Despite the low proportion of irrigated land, this cluster has an average of 612 acres under irrigation which is still quite

large in comparison to the third cluster. This indicates that this group is primarily composed of full-time, large scale farmers that primarily use irrigation to support another part of their operation, such as livestock (Table 5.19).

Table 5.18 – Income derived from Land and Percentage of Land Irrigated, 2011

		Ward Method			
		1	**2**	**3**	**Total**
Percentage of Income derived from Land. ***/***	0 to less than 25%	0.0%	2.7%	67.2%	17.4%
	25% to less than 50%	3.4%	5.3%	31.3%	11.0%
	50% to less than 75%	16.1%	20.4%	1.6%	14.4%
	75% to 100%	80.5%	71.7%	0.0%	57.2%
Percentage of Land Irrigated. ***/***	0 to less than 25%.	66.7%	0.0%	18.8%	26.5%
	25% to less than 50%	27.6%	2.7%	14.1%	13.7%
	50% to less than 75%	5.7%	15.9%	18.8%	13.2%
	75% to 100%	0.0%	81.4%	48.4%	46.6%
Mean Irrigated Land ***/***		612acres	991acres	179acres	

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

Table 5.19 – Irrigated Crops supporting Other Parts of Farming Operation by Cluster

		Ward Method			
		1	**2**	**3**	**Total**
Do your irrigated crops support another part of your operation, for example providing feed for livestock? */*	Yes	70.1%	55.4%	68.8%	63.5%
	No	29.9%	44.6%	31.3%	36.5%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

The second cluster, on the other hand, is heavily dependent on irrigation with the vast majority of farmers having between 75% and 100% of their land under irrigation. This group on average has 991 irrigated acres, by far the most of the three clusters. The majority of the farmers in this cluster depend on irrigated crop production for their income, although they are slightly less dependent on farming than the first cluster group. The third cluster most likely represents hobby or lifestyle farmers that use irrigation to support livestock operations. The vast majority of farmers in this group had a low level of dependence on farm income. Although the majority of this group had over half of their land under irrigation, they also had the smallest irrigated land area with an average of 179 acres.

Table 5.20 – Location and Irrigator Type

		Ward Method			
		1	**2**	**3**	**Total**
Location *Minimum cell count violation.	Bow River Group	37.5%	56.3%	27.3%	43.1%
	Central Group	41.1%	32.3%	31.8%	35.1%
	Southern Tributaries	21.4%	11.5%	40.9%	21.9%
Irrigator type ***/***	Private Irrigator	36.8%	15.9%	31.3%	26.5%
	District Irrigator	63.2%	84.1%	68.8%	73.5%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

Geographic distribution is different between each cluster, as well as their status as either private or district irrigators. Locational information was re-coded so that both private and district irrigators could be classified into: i) the Bow river group (including the Western Irrigation District, Bow River Irrigation District and Eastern Irrigation District); ii) Central group (Lethbridge Northern Irrigation District, St. Mary River Irrigation District and Taber Irrigation District); and iii) Southern Tributaries (Leavitt Irrigation District, Mountain View Irrigation District, United Irrigation District, Magrath Irrigation District, Raymond

Irrigation District and Aetna Irrigation District). Private irrigators were also grouped into these categories based on where their water source is from. Although the information violated the chi-square minimum cell count, it is clear that a large proportion of the third cluster farms in the Southern Tributaries (Table 5.21). The majority of the second cluster comes from the Bow River group and are predominantly composed of district irrigators, possibly indicating the large representation of the Bow River Irrigation District in the sample. A higher percentage of the first cluster is private irrigators compared to the other two, with the majority of its farmers coming from the Central group. It is interesting to note that the Central group is also the most evenly distributed in geographic location.

Table 5.21 Irrigation Systems as percentage of Land Coverage

Irrigation System	***Percentage***	***Wards Method***			***Total***
		1	**2**	**3**	
Gravity/Flood	0-33%	81.6%	89.4%	70.3%	82.2%
	34%-66%	2.3%	4.4%	4.7%	3.8%
*Minimum cell count violation	67%-100%	16.1%	6.2%	25.0%	14.0%
Hand Move	0-33%	93.1%	99.1%	87.5%	94.3%
	34%-66%	1.1%	0.0%	3.1%	1.1%
*Minimum cell count violation	67%-100%	5.7%	0.9%	9.4%	4.5%
Wheel Move	0-33%	80.5%	85.0%	67.2%	79.2%
	34%-66%	3.4%	5.3%	0.0%	3.4%
*Minimum cell count violation	67%-100%	16.1%	9.7%	32.8%	17.4%
High Pressure Centre Pivot	0-33%	83.9%	83.2%	90.6%	85.2%
	34%-66%	1.1%	3.5%	1.6%	2.2%
*Minimum cell count violation	67%-100%	14.9%	13.3%	7.8%	12.5%
Low Pressure Centre Pivot ***/***	0-33%	56.3%	34.2%	84.4%	53.7%
	34%-66%	3.4%	10.8%	1.6%	6.1%
	67%-100%	40.2%	55.0%	14.1%	40.2%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

An analysis of irrigation systems, in addition to information concerning crop types and the role of irrigation on the farm, confirms studies in the region indicating that most efficiency gains are possible among private irrigators who use irrigation to support another part of their operation (Bjornlund *et al,* 2007; Bjornlund *et al,* 2009; Nicol *et al,* 2010). Irrigators that grow more specialty crops and oilseeds, and who tend to be within irrigation

districts, have the most efficient irrigation systems (Table 5.21). The third cluster has the most room for efficiency gains.

Table 5.22 – Percentage of Water Allocation Used During Average Year

		Ward Method			**Total**
		1	**2**	**3**	
To the best of your knowledge, how much of your water allocation do you typically use during an average year? ***/***	Less than 60%	17.2%	17.7%	51.6%	25.8%
	60% - less than 70%	13.8%	17.7%	25.0%	18.2%
	70% - less than 80%	32.2%	35.4%	14.1%	29.2%
	80% - less than 90%	17.2%	19.5%	7.8%	15.9%
	90% - 100%	19.5%	9.7%	1.6%	11.0%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

Finally, the percentage of water allocation used during the average year differs between clusters. This is particularly the case when comparing the third cluster with the first and second clusters (Table 5.22). Whereas the majority of the first two clusters use more than 70% of their allocations in the average year, the third cluster typically uses less than 60%. The first cluster tends to use the most of their allocations. Nearly one-fifth of the first cluster uses between 90%-100% of their allocations, over double that of the second cluster.

5.4.2 – Naming the Clusters

The first step of cluster validation, comparing and contrasting clusters on variables used in the cluster analysis, has yielded sufficient evidence to suggest that three distinct groups of irrigators exist within the sample (Table 5.23). Based on this information, **hypothesis two is confirmed**. Furthermore, variables included for external validation (location, irrigation status and irrigation systems information), have shown that each distinct group has differences in characteristics that go beyond what was included in the

cluster analysis. This is indicative of good cluster formations (Anderberg, 1973; Punj and Stewart, 1983; Gujarati, 2003; Reinmann *et al,* 2008).

Table 5.23 – Cluster Characteristics

Characteristic	***Cluster 1***	***Cluster 2***	***Cluster 3***
Age	Tend to be older, over 56 years old.	Tend to be between 36-65 years old.	Tend to have a normally distributed age range.
Crops Grown	Focus on grain and forage crops for livestock operations.	Focus on oilseeds and specialty crops, but also involved in livestock.	Focus on forage for livestock operations.
Location	Spread out throughout southern Alberta.	Majority located in Bow River Group.	Majority located in Central Group and Southern Tributaries.
Dependence on Irrigation	Tends to have lower dependence on irrigation with low proportion of irrigated land to dry land.	Tends to be heavily dependent on irrigation with large proportion of irrigated land to dry land.	Tends to have high proportion of irrigated land to dry land, but also tends to have less irrigated land than the other two clusters.
On-farm vs. Off-farm income	Heavily dependent on use of land for income.	Tends to have high dependence on use of land for income.	Least amount of dependence on land for income.
Irrigation Systems	Room for efficiency gains, comparatively high percentage of land under wheel move and gravity/flood.	Efficient systems with less room for efficiency gains.	Tend to have less efficient systems with more room for efficiency gains.
Water allocation used during average year	Usually between 70% and 100% used.	Usually between 70% and 90% used.	Usually less than 70% used.

The first cluster tends to exhibit some of the trends outlined by previous research in the SSRB concerning irrigators who use irrigation as a supplement for pre-dominantly dry land farming operations (Bjornlund *et al,* 2009; Nicol, 2010). Since the first cluster is comparatively less dependent on irrigation than the other two, but even more dependent on farming for income, they are henceforth termed as ***drylanders***. The second cluster is most dependent on irrigation. Respondents from the second cluster tend to produce higher valued crops than the other two clusters, and have comparatively efficient irrigation

systems compared to the other two clusters. To highlight their comparative dependence on irrigation for income, and the amount of irrigated land they have, this group is henceforth termed as the ***dependent*** group. Finally, the third cluster has a lower dependence on irrigated agriculture for income, and has a relatively small amount of irrigated land in comparison to the other two clusters. As such, this group is henceforth termed the ***hobby*** group.

5.5 Cluster Results

The remainder of the results are dedicated to analysing differences between the drylander, dependent, and hobby groups with respect to values and attitudes; intentions; past actions; and policy preferences.

5.5.1 – Values and Attitudes

The third hypothesis is that irrigators will have different value and attitude orientations. **This hypothesis is confirmed** (Table 5.24). Different groups of irrigators had different risk-averse attitude, social acceptance attitude and pro-environmental value.

The only factor that does not have a significant difference between groups is pro-sharing attitude. The dependent group displayed the most risk-averse attitudes, identifying input costs, weather patterns and farm uncertainties as particularly important when making water trading decisions. Conversely, the hobby group seems less risk-averse. The drylander group put less emphasis on risk-averse attitude than the dependent group, but more so than the hobby group. These attitudes most likely reflect the different levels of dependence on irrigation, as also identified by others (Bjornlund, 2002; Gomez-Limon and Riesgo, 2004; Maybery *et al,* 2005).

Table 5.24 – Value and Attitudes by Cluster

		Ward Method			Total
		Drylander	**Dependent**	**Hobby**	
Risk-Averse Attitude ***/***	1	28.0%	20.0%	31.1%	25.3%
	2	18.3%	12.4%	24.6%	17.3%
	3	24.4%	20.0%	27.9%	23.4%
	4	29.3%	47.6%	16.4%	34.0%
Social Acceptance Attitude ***/***	1	32.9%	48.6%	16.4%	35.6%
	2	12.2%	7.6%	34.4%	15.6%
	3	11.0%	18.1%	16.4%	15.3%
	4	43.9%	25.7%	32.8%	33.4%
Pro-Sharing Attitude	1	24.4%	26.7%	24.6%	25.4%
	2	17.1%	18.1%	26.2%	19.7%
	3	25.6%	22.9%	23.0%	23.8%
	4	32.9%	32.4%	26.2%	31.1%
Pro-Environmental Value **/**	1	36.6%	29.5%	14.8%	28.3%
	2	22.0%	19.0%	11.5%	18.2%
	3	14.6%	22.9%	24.6%	20.6%
	4	26.8%	28.6%	49.2%	33.0%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

Social acceptance attitude differs between groups with drylanders expressing the strongest belief that their neighbours, family and friends think re-allocation is a good idea. This group also has the largest proportion of private irrigators. Dependents experienced a very low social acceptance attitude highlighting their comparative dependence on irrigation water. The hobby group was split somewhere down the middle.

The analysis of pro-environmental value orientations among the clusters confirms other findings in the literature suggesting that those less dependent on farming for income express more pro-environmental values (Tremlay and Dunlap, 1978; Beus and Dunlap, 1990; Berenguer *et al*, 2005). The majority of the hobby group displayed high pro-environmental value while the drylander group displayed the lowest pro-environmental value. The dependents had a rather normally distributed response towards pro-

environmental value. This finding is interesting considering that the extractive-commodity literature suggests the existence of a negative association between dependence on land for economic purposes, and conservation values and attitudes (Tremblay and Dunlap, 1978; Beus and Dunlap, 1990; Beus and Dunlap, 1994; Berenguer *et al*, 2005).

5.5.2 – Future Intentions and Past Behaviours

Water trading intentions remained largely the same across each group, with the exception of the intention to permanently buy water (Table 5.5.2). The hobby group has low intentions to buy water if it becomes available over the next five years. The drylanders and dependents have more of a bimodal distribution with roughly equal amounts being unlikely and likely to buy water if it becomes available.

This intention to buy water coincides with intentions to buy land over the next five years. A roughly equal amount of drylanders do and do not intend to buy more land over the next five years. Dependents express similar intentions, with a slightly larger margin not having intentions to buy more land. The hobby group has an overwhelming intention not to buy land, which coincides with this groups low level of dependence on farming, and generally not having a successor lined up for the farm. A larger proportion of drylanders have a successor lined up for the farm than dependents.

The groups also had different past actions regarding water rights acquisitions over the last five years (Table 5.25). The dependents had a large proportion who acquired water rights over the last five years, with drylanders having the second large proportion. This contrasts with the hobby group whose overwhelming majority did not engage in any market activity. All other past trading activity did not show significant differences between the groups.

Table 5.25 –Trading, Transfer and Expansion Intentions by Cluster

Trading Intention		*Ward Method*			
		Drylander	**Dependent**	**Hobby**	**Total**
d1_a -- Purchase a lease of water.	Unlikely	48.3%	45.1%	53.1%	48.1%
	Neutral	9.2%	20.4%	15.6%	15.5%
	Likely	42.5%	34.5%	31.3%	36.4%
d1_b -- Permanently buy water. **/**	Unlikely	42.5%	41.1%	57.8%	45.6%
	Neutral	9.2%	19.6%	10.9%	14.1%
	Likely	48.3%	39.3%	31.3%	40.3%
d1_c -- Selling a lease of water.	Unlikely	79.3%	80.5%	78.1%	79.5%
	Neutral	11.5%	8.8%	6.3%	9.1%
	Likely	9.2%	10.6%	15.6%	11.4%
d1_d -- Permanently sell some of your water allocation.	Unlikely	82.8%	85.8%	77.8%	82.9%
	Neutral	9.2%	8.0%	14.3%	9.9%
	Likely	8.0%	6.2%	7.9%	7.2%
d1_e -- Vote 'yes' in a plebiscite to permanently sell some district water to outside of the district. *Minimum cell count violation	Unlikely	80.4%	82.3%	77.3%	80.5%
	Neutral	16.1%	12.5%	18.2%	15.1%
	Likely	3.6%	5.2%	4.5%	4.5%
Intention to buy land over next five years. ***/***	Yes	42.5%	38.9%	14.1%	34.1%
	No	40.2%	44.2%	75.0%	50.3%
	Uncertain	17.2%	16.8%	10.9%	15.5%
Do you have a successor lined up for your farm? ***/***	Yes	60.5%	38.2%	33.3%	44.4%
	No	29.1%	48.2%	58.7%	44.5%
	Uncertain	10.5%	13.6%	7.9%	11.2%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

Table 5.26 – Cluster differences in Permanently Buying Water over last Five Years

		Ward Method			
		Drylander	**Dependent**	**Hobby**	**Total**
Permanently bought water?	Yes	25.3%	37.8%	10.9%	27.2%
****/****	No	74.7%	72.6%	89.1%	77.3%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

As discussed, there is relatively little room for efficiency gains among the drylanders and dependents in comparison to the hobby group. Nevertheless, these findings suggest that it is these two groups with more of an intention to upgrade irrigation systems than the hobby group. Most of the drylanders and dependents already have relatively

efficient irrigation systems, a finding similar to Bjornlund *et al* (2009) suggesting limited room for further efficiency improvements. As a result, the only intention that differs between groups regarding equipment changes is the intention to convert from high pressure to low pressure centre pivots. The drylanders and dependents are significantly more likely than the hobby group to have intentions to upgrade by using AIMM or IMCIN; purchase computer panels for their pivots; or starting to use private consulting to assist with irrigation decision making. This suggests that the drylanders have the strongest intentions to expand and the dependents have the most intentions to improve efficiency. The hobby group has little intention to do either.

Table 5.27 – Intentions to Upgrade Irrigation Systems

Irrigation System Upgrade		***Ward Method***			
		Dryalnder	**Dependent**	**Hobby**	**Total**
Convert from flood/gravity to wheel move.	Yes	7.0%	3.5%	9.8%	6.2%
	No	93.0%	96.5%	90.2%	93.8%
Convert from wheel move to pivot irrigation.	Yes	16.5%	24.3%	17.5%	20.1%
	No	83.5%	75.7%	82.5%	79.9%
Convert from flood/gravity to pivot irrigation.	Yes	8.1%	12.6%	8.1%	10.0%
	No	91.9%	87.4%	91.9%	90.0%
Convert from high pressure pivot system to low pressure pivot system. */*	Yes	18.3%	21.3%	8.1%	17.1%
	No	81.7%	78.7%	91.9%	82.9%
Purchase a computer panel for your pivot system. ***/***	Yes	21.7%	35.9%	11.9%	25.4%
	No	78.3%	64.1%	88.1%	74.6%
Start to use AIMM or IMCIN to schedule irrigation. **/**	Yes	25.9%	23.7%	7.3%	20.4%
	No	74.1%	76.3%	92.7%	79.6%
Start to use private consultants to support irrigation decision making. **/**	Yes	19.8%	26.0%	8.1%	19.6%
	No	80.2%	74.0%	91.9%	80.4%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

When analysing past irrigation systems upgrades, it becomes clear why there are low intentions amongst drylanders and dependents to change systems (Table 5.28). These findings suggest that room for efficiency gains are running out, as many irrigators already have upgraded in the past. Large proportions of each group have upgraded from relatively inefficient to more efficient systems over the last five years. Again, the hobby group has

been the most dormant group, with the vast majority not upgrading over the last five years. The long-term intentions of farmers seem to differ depending on their dependence on farming and intensity of irrigation. These findings **confirm hypothesis four** that different groups of irrigators have different long-term goals and intentions for their farms.

Table 5.28 – Past Irrigation System Upgrades

Past Upgrade		***Ward Method***			
		Drylander	**Dependent**	**Hobby**	**Total**
Converted from flood/gravity to wheel move.	Yes	3.5%	4.5%	10.9%	5.7%
	No	96.5%	95.5%	89.1%	94.3%
Converted from wheel move to pivot irrigation. ***/***	Yes	28.7%	38.7%	15.6%	29.8%
	No	71.3%	61.3%	84.4%	70.2%
Converted from flood/gravity to pivot irrigation. ***/***	Yes	9.2%	21.6%	3.1%	13.0%
	No	90.8%	78.4%	96.9%	87.0%
Converted from high pressure pivot system to low pressure pivot system. ***/***	Yes	29.9%	42.0%	9.4%	30.1%
	No	70.1%	58.0%	90.6%	69.9%
Purchased a computer panel for your pivot system. ***/***	Yes	26.7%	41.1%	10.9%	29.0%
	No	73.3%	58.9%	89.1%	71.0%
Start to used AIMM or IMCIN to schedule irrigation. **/**	Yes	17.2%	15.5%	3.3%	13.1%
	No	82.8%	84.5%	96.7%	86.9%
Started to use private consultants to support irrigation decision making. ***/***	Yes	14.9%	27.7%	4.8%	17.9%
	No	85.1%	72.3%	95.2%	82.1%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

These findings confirm some fears in the literature over the intentions to save and re-allocate efficiency gains (English *et al*, 2002; Whittlesey, 2003; Bjornlund *et al*, 2009). The fear that improved irrigation systems will actually result in an increase in net use of water, rather than less was clearly expressed by Whittlesey (2003). Whittlesey (2003) argued that more improved irrigation systems that maximize efficiency enables irrigators to put to use water that traditionally flowed back into the water cycle as run-off. Therefore, because of irrigators' intentions to maximise the productive use of water, as opposed to intentions to conserve, water use actually goes up and conservation aims become threatened (Whittlesey, 2003). These findings do, indeed, suggest that those who have upgraded the most, and with intentions to upgrade systems further, have stronger intentions to maximize

the productive use water saved through efficiency gains. A review of their policy preferences identifies their views on this issue in more detail.

5.5.3 – Policy Preferences

The findings for policy preferences closely resemble findings concerning value and attitude differences between the clusters (Table 5.29). An interesting finding is that only three of the nine policy statements were significantly different between the clusters, and all three of them were associated with securing water for the environment. The hobby group generally supports minimum flow requirements for rivers as well as buy back of water from irrigators for in-stream or environmental purposes. This reflects the findings of differences in environmental values.

The dependents and drylanders tend to be split on whether or not private individuals should hold licenses for environmental purposes, whereas the hobby group tends to find this a preferable policy. This finding has interesting implications concerning the Minister's Advisory Groups 2009 recommendation to "assess the potential role of water trusts as a vehicle for acquiring licenses through the transfer process for WCO purposes on an arms' length basis." The hobby group, who tends to have more of a proportion of private licenses than the other two groups, seems to be most receptive to this policy idea.

The final difference in policy preferences concerns the possibility of the government actively buying back licenses for environmental purposes, similar to what has been done in the Murray Darling Basin of Australia (Maybery *et al,* 2005; Kuehne *et al,* 2008). The drylanders expressed a strong dislike of this policy preference with over 65% disagreeing. This is in contrast with the hobby group who tends to have a more normally distributed response range for this statement.

Table 5.29 – Policy Preferences by Cluster

Policy Preference		*Ward Method*			
		Drylander	**Dependent**	**Hobby**	**Total**
b1_a -- The government, rather than market forces, should determine who uses Alberta's water.	SD	26.7%	28.6%	23.8%	26.8%
	N	22.1%	25.9%	31.7%	26.1%
	SA	51.2%	45.5%	44.4%	47.1%
b1_b -- If an ID/private license holder isn't using all water allocation, the gov't should be able to take water for environmental purposes, without any compensation.	SD	81.6%	83.0%	79.7%	81.7%
	N	9.2%	5.4%	9.4%	7.6%
	SA	9.2%	11.6%	10.9%	10.6%
b1_c -- Minimum flows of water should be set for all rivers and streams, and only the water above those minimum flows should be used for economic purposes.	SD	25.3%	25.9%	14.1%	22.8%
	N	26.4%	16.1%	10.9%	18.2%
	SA	48.3%	58.0%	75.0%	58.9%
b1_d -- Private groups and individuals should be able to hold water licenses for environmental purposes. **/**	SD	36.0%	30.4%	23.4%	30.5%
	N	32.6%	34.8%	21.9%	30.9%
	SA	31.4%	34.8%	54.7%	38.5%
b1_e -- Water that is saved through improved water use efficiency should be used to increase economic activity.	SD	5.8%	8.0%	7.8%	7.2%
	N	16.3%	15.0%	15.6%	15.6%
	SA	77.9%	77.0%	76.6%	77.2%
b1_f -- The government should buy water from current license holders, like irrigation districts, so that more water can be left in the rivers. ***/***	SD	65.5%	59.5%	39.7%	56.7%
	N	19.5%	25.2%	27.0%	23.8%
	SA	14.9%	15.3%	33.3%	19.5%
b1_g -- The seniority of a water license must be honoured under all circumstances.	SD	9.2%	8.0%	15.6%	10.2%
	N	6.9%	10.6%	12.5%	9.8%
	SA	83.9%	81.4%	71.9%	79.9%
b1_h -- Public funds should be used to improve irrigation systems only if the water that is saved is left in rivers.	SD	34.5%	39.3%	31.7%	35.9%
	N	26.4%	23.2%	22.2%	24.0%
	SA	39.1%	37.5%	46.0%	40.1%
b1_i -- If water is to be traded among irrigation districts and/or municipalities, the government should set the price.	SD	66.7%	65.5%	66.7%	66.2%
	N	18.4%	18.2%	15.9%	17.7%
	SA	14.9%	16.4%	17.5%	16.2%

*p<0.1 **p<0.05 ***p<0.01 Chi-square/ *p<0.1 **p<0.05 ***p<0.01 Cramer's V

This coincides with a stronger agreement for the role of WCOs and holding back water for environmental purposes. Simply put, the hobby group is not as economically dependent on irrigation, and have more of an attachment than the other two clusters to what they perceive as the environmental and lifestyle values of the land and water. Therefore, they have less incentive to conserve water for economic purposes. The fact that the majority of this group live in the Central group and Southern Tributaries, regions with the

highest risks of water scarcity, has interesting implications concerning the possibility of private license holders holding water for environmental purposes.

5.6 Intentions' Association with Attitudes and values

The survey findings suggest that intentions to trade water via purchasing a lease, and intentions to permanently buy water, display a bimodal distribution in the sample. This indicates that, dependents and drylanders in particular, are expressing an interest to expand their operations within the next five years. Generally speaking, 'market' activity has been slow, as previous research has identified in the SSRB (Nicol *et al,* 2006b; Bjornlund *et al,* 2007).

Pro-environmental value has the strongest association with intentions to vote yes in a plebiscite. The hobby group has the strongest pro-environmental value, with more of their group supporting environmental claw-backs. This re-affirms extractive commodity literature indicating that those with less of a financial attachment to land tend to have different views towards the environment than those with a strong financial attachment to land (Van Liere and Dunlap, 1980; Samdahl and Robertson, 1989; Beus and Dunlap, 1990; Morris and McBeth, 2003). Strong pro-environmental values are associated with a positive disposition towards government control over the transfer system, and towards the government taking an active approach towards buying portions of licenses to put towards WCOs. This conclusion is also reiterated through risk-averse attitude's association with policy preferences. In particular, the hobby group who had the lowest risk-averse attitude tend to have a negative disposition towards the notion of only using efficiency gains towards enhancing economic activity.

Another finding re-affirming transactional theory literature, is that different groups of irrigators based on their farm characteristics and demographics, tend to have different values and attitudes (Willock *et al,* 1999a; Willock *et al,* 1999b; Austin *et al,* 2001;

Bjornlund, 2002; Jackson-Smith and Buttel, 2003; Maybery *et al,* 2005; Darnhofer *et al,* 2005; Kuehne *et al,* 2008). This research also suggests, however, that using the types of attitude and value constructs that were used in the survey are not very strongly associated with trading or transfer intentions.

Social acceptance attitude and risk-averse attitude do have associations with intentions to purchase a lease of water over the next five years. This affirms TRA and TPB literature suggesting that social influences, as well as perceived behavioural controls, influence farming intentions and goals (Ajzen and Fisbhein, 1970; Ajzen, 1985; Sheppard *et al,* 1988; Madden *et al,* 1992; Beedell and Rehman, 2000; Armitage and Conner, 2001; Rehman *et al,* 2007). An interesting finding is that attitudes and values associate with intentions to trade or transfer differently. Risk-averse attitude, social acceptance attitude and pro-environmental value have associations with intentions to purchase a lease of water. Different clusters of irrigators display different risk-averse attitude, social acceptance attitude and pro-environmental value. These groups, however, do not have significant differences with their intentions to purchase a lease over the next five years. This suggests that values and attitudes associate differently with intentions than demographics and farm characteristics do.

On the other hand, risk-averse attitude has associations with policy preferences pertaining to role of market forces in water distribution and whether private groups should own licenses for environmental purposes. Pro-environmental value has associations with minimum flows and government control over the pricing of transfers. This corresponds with hobby farmers who are less dependent on irrigation who have less risk-averse attitude and more pro-environmental value than drylanders or dependents. Furthermore, it is also associated with very low intentions of hobby farmers to expand, and to invest more in their operations.

All groups display a lack of intention to sell, or to lease. The main differences exist with intentions to expand, intentions to upgrade, and policy preferences towards environmental legislation. Dependents have the strongest intentions to expand their farms and to purchase a lease of water. The dependents have the strongest intentions to upgrade, despite investing the most in upgrades over the past five years. These groups express a desire to use water saved through efficiency gains for economic purposes. This raises a concern that is expressed regarding increased water use due to increased efficiency (English *et al*, 2002; Whittlesey, 2003; Bjornlund *et al*, 2009).

The most pronounced difference in policy preferences amongst all groups views towards environmental claw-backs of water, and government involvement in the transfer process. This brings up two questions that were discussed with the key informants: i) what is the root of skepticism towards WCOs and ii) what is the root of skepticism towards using the transfer system? The next sections express viewpoints towards the skepticism towards the transfer process. They include transaction costs, use it or lose it concerns, property rights concerns, and the role of WCOs.

5.7 Summary of Survey Results

The differences in policy preferences **partially confirms hypothesis five**, that different groups of irrigators will have different policy preferences regarding water re-allocation for environmental purposes. With the partial confirmation of this hypothesis, the survey has achieved the second and third research objectives, which sought to investigate factors influencing irrigators' unwillingness to engage in transfers; and to investigate irrigators' approval of policies towards re-distributing water for environmental purposes and the government's role in water transfers. The key finding from this research is that dependence on irrigation seems to have a strong association with different long termed goals and plans. Furthermore, they tend to indicate different risk-averse attitudes, social

acceptance attitudes and pro-environmental values. The findings confirm previous research indicating little room for efficiency gains, but it also indicates that most irrigators in the sample intend to maximise the productive and economic value of efficiency gains.

On the other hand, most in the sample did support minimum in-stream flows and the policy of only allowing water above this minimum to be allocated to economic purposes, such as irrigation. Furthermore, there was no significant difference between the groups regarding involvement with environmental organizations such as WPACs. So, even though the hobby group displayed the highest support for WCOs and re-allocating water from irrigation to environmental purposes, there is a general environmental consciousness.

These findings seem to support extractive commodity literature stressing that the dependence on the land for income is a fundamental driver of values and attitudes towards that environment (Tremblay and Dunlap, 1978; Van Liere and Dunlap, 1980; Beus and Dunlap, 1994). High dependence on irrigated land use for income seemed to correlate with higher risk-averse attitudes and lower pro-environmental value. Those with more irrigated farm investments had intentions to expand, and to maximise the value of irrigation water, a similar finding to Bjornlund and Rossini's (2005) study.

This chapter has identified how the survey results match up against the literature by testing the five research hypotheses. The next chapter will focus on discussions with the five key informants that were interviewed after the survey was analysed. These discussions often lead to topics that were not identified in the survey, but may play a vital role in the unwillingness of irrigators to use the transfer system to re-allocate water to non-agricultural uses. Chapter seven discusses the implications of the two results chapters, and conclusions as to the implications of these findings.

CHAPTER SIX

INTERVIEW RESULTS

6.0 Introduction

The objective of this chapter is to identify factors, identified in the previous chapter, causing the skepticism towards, or unwillingness to use, the transfer system as a tool for re-allocation in the SSRB. This was done by analysing in-depth interviews with key informants. The results of this chapter contributed to the research objectives in a different way than the survey findings. The survey findings re-affirmed trends in the literature, particularly showing that different types of irrigators based on personal and farm characteristics, tend to have different values and attitudes towards transfers. There were many similarities, however, between all groups including a general unwillingness to use the transfer system. This formed the basis for interviews with five key informants between May and August of 2012. Common themes began to emerge among the five key informants when asked about the general unwillingness of irrigators to participate in the transfer system in order to re-allocate water to meet new demand. i) Transaction costs associated with transfers; ii) the ability to make assignment agreements or licensed amendments to meet new demand; iii) fear of government claw-backs; and iv) dissatisfaction with WCOs and environmental holdbacks associated with transfers.

6.1 Transaction Costs

Barriers to transfers found in the chapter conclusions of the Policy Context include a lack of information and a lengthy approval process that impedes incentives to temporary or permanently transfer water from one user to another (Thobani, 1997; Bjornlund, 2003b; Horbulyk, 2005; Nicol *et al*, 2008). Interviews with key informants reiterated these concerns about transaction costs, particularly towards temporary transfers of low volumes of water. This concern was reiterated by the Minister's Advisory Group (2009) with their

recommendation: "a number of operational barriers established in the Water Act should be removed to allow the transfer system to operate more effectively" (Alberta Environment, 2009: 7). As the Minister's Advisory Group points out, the process imposes significant costs on the applicant, and may take many months from the time of initial application to the time of final approval. This operational barrier was reiterated by one AARD representative:

> If we had a system in place right now that if I put a 'for sale' tag in the Lethbridge Herald that said I have 100 acre feet of water for sale on the St. Mary's river, and there was a way that very quickly that Alberta Environment could give me the ok to sell it wherever I want…I think people would be just fine with it. Right now, as a seller, there are so many hoops you have to go through. I think there's so much confusion that people think there must be something behind it. If it takes that much paper work and that much time... My guess is that if I went to Albertan Environment today and said I had 100 acre feet on the St. Mary's, and I have potential buyers here and here, could I sell it? My guess is that it would take months before I would get that decision (Key Informant 7).

The main concerns over the lengthy process and operational barriers to transfers have come about largely because temporary and permanent transfers undergo the same application and approval procedures (Water Act Section 81). While for permanent transfers that involve a change of ownership, and change in point of extraction, it has been argued that a thorough and rigorous analysis of the third party effects and environmental effects has been cited as necessary in the literature ((Thobani, 1997; Solanes and Gonzalez-Villarreal, 1999; Easter *et al*, 1999; Horbulyk, 2005; Chong and Sunding, 2006; Levine *et al*, 2007; Bjornlund, 2010). Applying the same system for temporary transfers of water, with smaller volumes of water, may present transaction costs that are too great, and an

approval process that is too long and drawn out to make it feasible. As one representative from Alberta Environment notes:

> The rules are the same for everyone. If someone wants to move 2 acre feet half a mile upstream and split it in half, putting some towards some acres and others for some cows, it's a ridiculous system because they see all the things they have to do for a little bit of water. But, it's the same rules if you're moving 10,000 acre feet 100 miles upstream and changing the timing from summer to winter. It's the same rules. So yes for a small land owner who isn't familiar with a lot of other jurisdictions, and wants to do something small and local, it would seem like ridiculous (Key Informant 8).

The same representative from Alberta Environment also notes that the process appears long and convoluted because of Alberta Environment's willingness to approach problems with applications as opposed to rejecting them. By doing this, few applications are denied, but applicants are approached to fix certain problems associated with their applications. This is described by the Alberta Environment representative below:

> If we want to make the Auditor General happy when they do audits, we should refuse every one of those [applications]. So that way, when they come in the door they're complete and everything is perfect. Instead we work with them [applicants] and see what they can do to fix the issue as opposed to making them re-apply. This makes the process look long and convoluted (Key Informant 8).

Furthermore, the same Albertan Environment executive went on to acknowledge that although the administrative process of transferring water in Alberta may appear time consuming, it is much cheaper and more efficient than other systems. In particular he made a comparison between the administrative control process regarding water transfers in Alberta against the appropriative, court based transfer system prevalent in many western states of the USA.

> There are two ways of doing a transfer system: i) we can do it as a government administrative process; or ii) you can do it as a court based system. The Americans in

> the western states, they do it as court based. You apply to the water court. The judge will decide. Ours is administratively based. So to do that, we end up with a whole bunch of stuff in the legislation about the 'how's'. In a court based system all you have to say is 'don't hurt anybody' and the judge will make sure, and away you go. The appeal system is already laid out in a court system so you don't have to identify an appeals system. Because we do it administratively, it's a hell of a lot cheaper. In a court based system you have to do all the technical work anyways, plus the lawyers. Here, no lawyers and you have to do the technical work…we do half the technical work (Key Informant 8).

This matches the findings by Nicol *et al* (2008) that Alberta's transfer system actually has fewer transaction costs than other systems around the world, including those in the western USA. Nevertheless, the high transaction costs, particularly for temporary transfers of small volumes of water, is identified and acknowledged as a barrier to the transfer system. As mentioned earlier in this thesis, there is a suggestion in the literature to revise lengthy approval processes, and to make it easier to transfer water (Rosegrant and Binswanger, 1994; Dinar *et al*, 1997; Thobani, 1997; Bjornlund *et al*, 2003b). The current legislative regime is cumbersome in that the approval process for temporary changes in diversion from one point to another are treated very similarly to permanent transfers. There is a common disposition in the survey findings, however, that suggest that most irrigators approve of government control and regulation over the transfer system. Although the survey findings suggest that support for government regulation over the system is strong, key informants acknowledge that the system can be revised to make it operate in a more efficient and flexible manner.

6.2 Property Rights

In Alberta, water is attached to irrigated land in a different way to countries like Australia, Chile or the United States, with long established and more active water markets. The Water Act and Irrigation Districts Act attach irrigation water to land according to its

use and purpose. While the Water Act does allow for water to be detached from land, studies have shown that there is rarely the financial incentive to do so given the increased land values associated with water entitlements (Easter *et al,* 1999; Bjornlund, 2001). One key informant from the EID reiterated this concern:

> All our land [in EID] is now worth $800,000 a quarter, it would go back to being worth $5,000 a quarter plus whatever oil wells you have [if the water is sold]. So it's [the water] worth huge amounts of money and we see that increasing. So obviously people are going to be reluctant to trade some of it (Key Informant 9).

Furthermore, many key informants expressed skepticism towards separating water from land as many farmers have borrowed money based on land values including water rights. This fear was most appropriately expressed by a representative from the SMRID:

> If a farmer has irrigation rights and wants to sell it somebody, he can sell it. He can control that market. But again, we have to leave it tied to the land because if you take it off the land we are going to have some problems…The scary thing about Australia is that they didn't tie that to the land. So once it's tied off from the land it is chaos. Plus all the banking system, all the finance... all this land is borrowed by water rights because water rights add value to the land. So the banks are just going to be upset [if they separate this from the land] (Key Informant 10).

Beyond the disapproval of detaching water from land, there is also a major issue concerning the allocations that license holders are able to put to use, or to transfer. The current legislation does give Alberta Environment control over the allocation process, and allows Alberta Environment to limit diversions. The current legislation is, however, not clear about the volumes of water that license holders can transfer. This concern has been addressed by the Minister's Advisory Group (2009) with their recommendation that "the minister must clarify the amount of water the licensee is entitled to transfer. The Water Act does not deal clearly with this and it must ultimately be resolved for the transfer system to

achieve its full potential" (Alberta Environment, 2009: 4). This brings into question the amount license holders ought to be able to transfer, given the potential changes in water use, return flows, and how they will effect environmental and third party users. This is a particularly complex issue regarding water that has been saved through efficiency gains.

Water that is saved through efficiency gains is either kept in storage, or is not used. This usually results in more water not being diverted. The fear associated with district expansions, and transfers, is that these mechanisms will allow license holders to divert more water from the rivers. While increased water use does not necessarily equate with increased diversions, there is a fear expressed by some that expansions and transfers will result in less water in the rivers and streams (Bankes and Kwasniak, 2005; Christensen and Droitsch, 2008).

Another point that was brought up by key informants during the interviews was that other options available, such as assignments and license amendments, are more preferable than transfers. In particular, amendments were highlighted as most preferable, since assignments cannot satisfy new demand, but are rather used as an alternative to the priority system. This is a finding consistent with the literature (Bankes and Kwasniak, 2005; Bjornlund *et al*, 2007; Christensen and Droitsch, 2008; Bjornlund *et al*, 2009).

6.2.1 Amendments and Assignments

There has been a fear that amending district licenses will effectively allow districts to become water brokers, selling water to the highest bidder (Christensen and Droitsch, 2008). As discussed, there is also a fear that amendments and transfers may result in more water being diverted, which is contrary to the goals of the WFL strategy (Bankes and Kwasniak, 2005; Christensen and Droitsch, 2008; Alberta Environment, 2009). The Water Act does have safeguards for third party users and the environment stipulated in the amendment process (Section 54). It does not, however, make stipulations or guarantees

over return flows. This is very different to actual transfers of licensed allocations where the director must be satisfied that the transfer will not have third party impacts. A concern raised by some is that assignments circumnavigate the approval process and thereby avoid environmental safeguards (Bankes and Kwasniak, 2005; Christensen and Droitsch, 2008). This issue was touched upon by a representative from the AIPA:

> Say we're going to save 15% more water over a 10 year period. About 10% of that saved is going to be reducing return flows. So that will be used now, and not going back to the river. So they are actually increasing use. So we save 15% let's be generous and say half of that is reduced return flow and half of that is water saved. So there's the complaint of the environmental groups. That's why in our conservation and efficiency plans we did not say we will use less water. We will divert the same [amount] or less. So even though the districts are expanding we may be leaving more water in the rivers. I think there's a very distinct possibility that we are (Key Informant 6).

The Water Act does require an application for an amendment to contain detailed plans explaining how the amended license will affect riverine eco-systems (Section 54). The act also enables the director to amend the license lowering the diversion if he/she feels it negatively affects third parties or the environment (Section 54). Nevertheless, concerns do remain over the increased water use. As discussed in the Policy Context and Literature Review chapters, often times the increased efficiency leads to more use, which puts more of a strain on the resource because of less return flow (English *et al,* 2002; Whittlesey, 2003). Amendments leading to more use of water naturally lead to fears about reduced return flows and the long-term vitality of riverine eco-systems and water available for downstream users.

On the other hand, amendments allow users to maximize the benefit of being able to use or transfer water that is saved through efficiency gains, which is the foundation of the goals of the WFL strategy. Irrigation districts in particular, see amendments as an optimal

alternative to transfers because they are able to retain control over the licensed allocations in the future. This sentiment was expressed by a representative from AIPA:

> The districts don't like the ideas of transfers. I will give you the EID's view because I think it's quite rational. They think that, if we supply to a community we would like to do it via transfer because we know that community is going to be there. Water for the district we would like to do that via amendment because in essence it's a lease. That's because, we don't know if the business is going to be there in the next five years. In the case of the community that water licenses is pretty secure. In the case of a business, if it goes under, then that water is lost (Key Informant 6).

Furthermore, there was a sentiment expressed by the key informants that amendments are complementary towards the goals of the WFL in the sense that they "expand" the resource by taking advantage of efficiency gains. Section 6(1) of the Irrigation Districts Act clearly defines that the purpose of each district is to "maintain and promote the economic viability of each district". Many of the key informants see this as promoting food based industry in the districts, including food processors. This was expressed clearly from a representative of Alberta Environment:

> When an irrigation district wants to attract a food producer and move a bit of their water from water savings by upgrading from flood/gravity to a bunch of pivots; and divert that water to a processor so the processor can process the goods coming off of the fields so that they can grow more high valued crops because they could not afford to transport bulky crops that are perishable 800 miles to a processor...that's within the purpose of the irrigation district to facilitate this, so why not? That subject went to appeal and everyone went crazy. We got appeals and all kind of things over something as simple as that. Something a municipality does all the time (Key Informant 8).

Irrigation districts often run the conveyance and delivery systems for municipalities and industries. Several users are, therefore, inter-connected through irrigation works. Sharing agreements, often times involving licensed amendments, have been used in the past

as an effective way to meet the demands of non-agricultural users within a district. Due to this, many key informants see amendments as cooperation between several users, while providing security for districts over long-term control over the licensed allocations. The representative from the AIPA identified these sentiments by responding to the opposition encountered over the EID amendments accounting for 940,000 ML:

> The big scare came when the EID tried to amend their license. Certain groups thought the sky was falling, and that the EID was going to send water down to the states and that they would start charging more for their water. But it was really the EID trying to supply the town of Brooks. It's sensationalized in order to try to create negative thoughts in my opinion. So the EID finally got their amendment a while ago. It was enough to help the town of Brooks and other industries (Key Informant 6).

Another option that license holders have is to share their water through assignments. The researcher was fortunate enough to discuss assignments with the individual that assisted in their creation as an administrative tool in Alberta, leading to the ability to use assignments being entrenched in the Water Act (Section 33). This individual from Alberta Environment explains the popularity of sharing water via assignments over the permanent or temporary transfer of licensed water allocations:

> I never thought it would work past the bus route the kids take from school. But we made it work in 2001 with no money or no lawyers. There were assignments done between individuals but there was money trading hands. But in the big assignment, the 'social engineering' assignment, there wasn't any money changing hands. To the point where the districts have now formalized their intentions in a statement saying 'we're not going to use our priority if it conflicts with human uses' (Key Informant 8).

Assignments cannot exceed the licensed volume that was originally stipulated on the license (Water Act Section 33). Therefore, assignments cannot satisfy new demand. In many ways, an assignment is an administrative mechanism that can be used to circumvent

the FITFIR system by allowing license holders to make agreements to share risk. Nevertheless, they have traditionally been much more popular than temporary transfers of licensed water allocations because assignments do not have the transaction costs associated with the transfer process (Nicol *et al,* 2008).

As mentioned, one of the key factors that lead to the unwillingness of districts to transfer water, is the loss of control they have over the long-term allocation. This is why they typically prefer supply agreements made under amended licenses for long term transfers, and assignments for short term allocations, as under both scenarios districts are still guaranteed control over their licensed allocations. It is no surprise, given this sentiment, that there is a fear prevalent pertaining to the use it or lose it legislation in the Water Act (Section 55).

6.3 Use it, or lose it

One finding from the survey indicates that a large percentage of drylanders and dependents have intentions to buy water and land over the next five years; and they also have bought irrigated land over the last five years. There have been several district expansions since 2006, largely because the irrigation districts have saved significant amounts of water from increased efficiency gains over the last 15 years (Bjornlund *et al,* 2007; Nicol *et al,* 2010). Many of these efficiency gains are derived from on-farm efficiency improvements (Bjornlund *et al,* 2007; Nicol *et al,* 2010). This research confirms that a large proportion of drylanders, and especially dependents, have upgraded their irrigation equipment over the last five years.

When discussing this finding with the key informants, it became clear that there are serious concerns over the recommendation made by the approved water management plan with respect to how Alberta Environment is able to claw back part of a license when traded. There are two main concerns: i) it will be to the detriment of irrigators and food processors

because it will increase risk of shortage during drought years; and ii) it actually encourages irrigation district expansion to occur, thereby resulting in more water use thereby increasing the volume of water diverted.

The second point is interesting, in that the fear of losing some of a license has led to irrigation district expansion. As one representative from the AIPA explains:

> So if they [irrigation districts] feel threatened that they are going to take portions of licenses they are not using then what are you going to do? You are going to expand. So why are the districts expanding? It is out of fear. I know the districts have presented it to their farmers that if you don't use it, you're going to lose it (Key Informant 6).

This view was further reiterated by an executive from Alberta Environment, and an irrigation district board member from the EID. The Alberta Environment representative specifically referred to the potential reaction of irrigation communities towards more strict government guidelines, taking away water that has not been traditionally used:

> Do we really want that knee jerk reaction? That if the government tries to say 'well we're going to take it away and give it to them if they grow'? Then the one party will just try to stop the growth. They'll use all their rural friends to try to block any expropriation of land to any municipality that's trying to grow while expropriating their water at the same time (Key Informant 8).

A representative from the EID reiterated fears over government claw backs by explaining how district expansions have taken place out of fear, and that this has ultimately resulted in more water being used:

> As far as I can see they've [environmental groups] really hurt themselves. They wanted this but they didn't really like what might occur. A lot of districts have expanded. For example the SMRID has another 10% expansion going on, BRID has just expanded another 30,000 acres and I heard most of that is already spoken for... So all of a sudden there's a whole bunch less water. That is in part caused by this, people are afraid there will be nothing available (Key Informant 9).

Many within irrigation communities also fear the risk associated with cutting back allocations. These risks go beyond the farm, as there is a fear that food processors and other industries, supported by district water, may scale back their operations if claw backs were to occur. One member from AARD expressed this concern with regards to the recommendation in the approved water management plan:

> Claw-backs put the whole industry at risk. They increase the risk as an irrigation producer and as an irrigator crop processor. The only reason we have McCain's potatoes processor here is because of the high quality of the product. The only reason why the canola seed industry is here, is because the guaranteed high quality of the product. Will they remain and stay here if somebody stipulates that in 10% of the years there may not be sufficient allocation to meet the needs of these crops? I'm going to suggest there are a number of processors that think that's a risk they are no longer willing to take (Key Informant 7).

These findings suggest that fears exist towards the use it or lose it policy in Alberta. These fears have encouraged irrigation districts to expand in order to use their allocations as opposed to the possibility of having some of that license being taken away. The survey findings suggest that most irrigators in the sample support using this water for economic expansion, and many dependents and drylanders have taken this opportunity to expand their irrigated acres. This brings up an issue pertaining to government policies towards WCOs that intend to increase the naturalized flow of many of the rivers and streams in the SSRB. While license holders are not necessarily increasing their diversions, they are increasing their net water use which may affect stream flow. The main argument made by the key informants is that, through threatening to claw back some of the licensed volumes, efficiency gains that would have otherwise resulted in less water use and reduced diversions have resulted in more water use. This has a tangible effect on government

strategies to allocate more water for environmental purposes. There is also the fear of activating previously unused water allocations in order to keep them, which means that water previously left in rivers or reservoirs will be used. It has been a goal of the government to protect water by creating WCOs that serve as licensed environmental holdbacks. WCOs are, however, viewed upon negatively by many in the survey findings and most key informants.

6.4 Environmental Holdbacks

As discussed in the survey findings, the hobby group tends to have more of a positive disposition towards WCOs and the notion that the government should claw back water to put back in the rivers. Dependents and drylanders tend to have more negative dispositions towards WCOs as they intend to expand and use that water in the future. This finding was interesting in the sense that most irrigators from all groups in the sample tended to view minimum flows positively, and acknowledged the role of the government towards setting environmental flow objectives; while having significantly different views towards WCOs.

This finding was discussed with the key informants. These interviews uncovered that there exists much skepticism towards WCOs among those in the irrigation community because of their perceived lack of effectiveness. Furthermore, the key informants expressed a certain mistrust of government holdbacks; and also cite WCOs not taking into account riverine eco-system resiliency. First, the issue of eco-system resiliency is explained by an executive of the AIPA:

> So the WCO was set in the South Saskatchewan basin at 45% of natural flow. There were a number of things that went into that. Number one, the basin already had lots of allocation in it. So, are you going to dry society and the economy here? No. So you have to allow diversions out of the river. One scientific study says you need 85% of the natural flow of the river or else you're doing

> damage. That's what being talked about for setting WCOs on rivers that have low allocations. One thing that does not take into account is what's called resiliency. Let us say at 85% of the flow on June 4th that would be 2500 c/f/s. Next year we have a dry year and nature sends us 500 c/f/s. So why didn't nature meet the WCO? So if nature doesn't meet the WCO the year earlier, then is the river damaged? So, rivers are dynamic, they have resiliency, and we need to stay in the bounds of natural resiliency of the system. So yes, if we are stressing an eco-system, then sometimes that stress needs to be relieved so it doesn't do damage. That's the hard number to get at. It's not that a specific flow is the right number. It's hard to get that [number] for functional flow. That is the flow that has specific purpose for riparian areas (Key Informant 6).

Furthermore, most key informants expressed an opinion that WCOs were not as useful as they should be because of the miniscule volumes that have thus far been allocated towards them via a 10% holdback of a traded volume. The following key informants from the AIPA and AARD discuss this in more detail:

> If you're taking 10% out of the rivers, that is a token. That is a small volume. The modelling that was done on the Bow River they could say 'well if the districts can take this much water at this stage, say in late August and we can negotiate with other users like Trans Alta, that would make a big difference'. So I don't know what the transfers have contributed, what they've accumulated but let's say there's... I'll use a number so it's easy math...let's say there has been 14,600 acre feet of water transferred. So 10% of that would be say 1400 acre feet of water. So if you were to see how much, if you were let all that water out into a river for six months, how many cubic feet per second is that? …That's around what 4 cubic feet per second. Can you measure the difference for that? That's in your margin of error. So what are we really accomplishing there? We don't say that too loudly because people think that they are important and if that's what makes them feel good so be it. But, managing the river for specific times and stuff like that is, in my books, what we need to do more of (Key Informant 6).

> Yeah the 10% holdback is an interesting concept. Somebody thought it was a win so they put it in. But, if you add up all the transfers that have happened in the

> last five years and take 10% of it from the Oldman River, I would question whether that amount is even accurate enough to know whether it's there or not. Your margin of error is actually bigger than what you're getting back. So let's say we quadruple that amount, it still is so insignificant. Is it really going to make an impact? It's a good news story for the environmental part of the rivers. Is it measurable and is there really an impact? I doubt it (Key Informant 7).

These are very similar concerns to those raised by the minister's advisory group in 2009 stating that WCOs "…[do] not reflect the level of protection that would have been defined if the basin had not been so heavily allocated at the time that the Management Plan was completed." (Alberta Environment, 2009: 1). This is why the minister's advisory group recommended future studies of the possibility of a fee or financial charge as opposed to the 10% holdback. Furthermore, cutting back the licensed volume by 10% is seen as an impediment to transfers because of a mistrust of the government. This is expressed by one SMRID board member:

> Well there hasn't been many transfers because the government steps in and can take 10%. They [the government] screwed up and now they're trying to rectify it. But it's at the backs of people that can help. The way I look at it, we are all businessmen. So you look at it like 'wow a 10% loss'. Well what are you going to do with the 10%? That's going to correct your mistake. Well I'm sorry you made a mistake but I don't think I want to correct your mistake. So there are some issues I have with that (Key Informant 10).

The hobby group was the only group in the survey where the majority were either neutral or agreed with the ability of the government to cancel some under-utilized licenses. The other two groups, more dependent on agriculture with more invested in irrigation, tended to heavily disagree with that. An executive from the AARD explains that this may be because of mistrust over the government's intentions to do this:

> The other problem with that is, ok so we cancel it. So then you have to ask yourself, do you trust the government enough now that they have this extra allocation of water that is allocated to them again. What

> do they do with it? Are they just going to hold it? Or re-allocate it to someone who will use it? (Key Informant 7).

This executive is referring more specifically to a crown reservation. A crown reservation is water that is currently not allocated, that the government has the ability to store and lease out according to the discretion of the director (Water Act Section 35). A crown reservation is, in essence, a risk management tactic used by the government to ensure that demand may be met. It can also, however, become an 'annuals' market for users willing to lease from the government. As an executive from Alberta Environment explains,

> We could change that. We could say 'there is this much water you're not going to need, so in five years from now we are going to take that entire block of water back. We are going to put it in a water bank and distribute water from the water bank on an annual basis only to those who meet a certain conservation standard in their new growth'. We could create an annual use category by setting water aside for that specific purpose. We don't see the need for it. As long as the growth is within municipal use, and the municipal use within the current market can by far outbid the agricultural use where lots of water is available the market doesn't seem to be broken (Key Informant 8).

Interestingly, while irrigators in the survey showed predominantly negative views towards the notion of the government cancelling licenses, or clawing back portions of licenses as opposed to the entire allocation; they tended to stay neutral or even support the notion of private individuals holding water for environmental purposes. This brings up an interesting possibility that is not available under the current legislation. Under the Water Act Alberta Environment is the only entity that can hold water for in-stream flows. This means that private individuals or NGOs cannot purchase licensed water allocations with the purpose of leaving the water in the river in support of WCOs.

This is a topic that is explored by those in the literature (King, 2004; Neuman, 2004; Garrick *et al,* 2009; Garrick *et al,* 2011; Lane Miller *et al,* 2013). Since this is currently not possible under the current legislation in Alberta, the possibility of allowing private individuals or groups to hold licensed allocations to contribute towards WCOs may be a useful administrative tool to protect water for conservation purposes.

Interestingly, most key informants did not approve of this notion. As representatives from the AIPA and SMRID explained:

> I think the government needs to be responsible for managing rivers. I don't think the districts should be responsible because the districts are very well intentioned but they need to deliver water. So I think it is right that government controls the flows in the rivers. I don't think most of the districts would disagree with that (Key Informant 6).

> I don't know if private license holders [for environmental purposes] can do as well [as the government]. Private is there to make money. I mean I am still concerned about us selling our natural resources to foreign countries. It concerns me because I think in the future water is going to be a very valuable asset. I think we need to maintain control over it. I'm not saying farmers do everything right, but at least it's a grassroots approach. We are going to become the bread basket of the world here pretty quickly so water is important (Key Informant 10).

Nevertheless the disposition of most irrigators in the survey was either neutral or supportive of allowing private individuals to obtain licenses for environmental purposes. Irrigation community support is typically essential in achieving conservation objective goals by allowing private groups or individuals to obtain licenses for environmental purposes (King, 2004; Neuman, 2004; Garrick *et al,* 2009; Garrick *et al,* 2011; Lane Miller *et al,* 2013). As Lane Miller *et al* (2013) point out, however, in order to achieve conservation objectives by allowing private license holders to acquire water for environmental purposes, there must be four fundamental conditions: i) legal and

institutional settings which clearly define water rights and lower administrative and other barriers to water transfers; ii) non-governmental organizations and community groups which play a complementary role to government; and iii) creation of a system that will fairly distribute future risk of water availability and provide choices for a variety of ways of obtaining it; and iv) efforts that minimize negative community impacts, thus helping to maximize irrigator participation. This topic is explained in more detail in the next chapter.

6.5 Prior Allocation

The final topic emerging from the discussion with key informants was the FITFIR system in Alberta. As discussed in the Policy Context chapter, water users in Alberta have options for managing the priority system. This chapter has explained the viability of supply agreements via license amendments and assignments. It is an interesting fact to point out that, as of 2014, no license holder has ever "called priority" for all of their license. During water shortages, such as during 2001 and 2002 in southern Alberta, assignment agreements and water rationing were used in order to help junior license to access water by effectively applying a proportional sharing system. The key informants expressed various sentiments towards the notion of changing Alberta's priority system that included moral objections towards changing the system and other objections towards the practicality of such a move.

A moral objection is expressed in the following statement by a representative from Alberta Environment:

> The other thing about the first in time anxiety... people say that's old and dead and we should not do that. They should work with people in a drought. It's a life changing experience to work with people in a drought. I've done it for a long time. To anyone that thinks we shouldn't have a priority system of some kind...try walking into the bank 4:30 on Friday before a long weekend having only put a nickel in the parking meter. See the long line up, you go to the front of the line because you're worried about your circumstance because you only put one nickel in the parking meter so

> you just have to go first... people are going to say 'that's your problem, get the hell to the back of the line' (Key Informant 8).

From a practical point of view there is also a fear that eliminating the FITFIR system will alter land values, and result in mass dissent in the irrigation community. As one SMRID board member points out:

> If it [FITFIR] ever gets thrown out the window it will be chaos around here. Even land titles and everything like that will be thrown out. I don't think they've given it much thought (Key Informant 10).

Irrigators in the sample, and key informants, express both a moral objection to altering the FITFIR system, and a fear of depreciating land values and increasing risk of not receiving allocation during times of low flow. Furthermore, many claim that following FITFIR is not the only option, and that the current arrangements allow license holders to make do with what they have without threating the supply of others, such as with assignments, and amending licenses to allow supply agreements. License holders also have the ability to deal with risk associated with the FITFIR system by conducting a reverse transfer or an assignment of priority. A reverse transfer of a higher risk license in exchange for a low risk license allows license holders to manage risk by being able to purchase another license holders priority.

6.6 Summary

This chapter has identified factors associated with the unwillingness of irrigators to conduct water transfers as a means to re-allocate water. Many of the concerns of the key informants match concerns discussed in the Chapter Two regarding barriers to transfers, including property rights, ability to bypass the transfer system by conducting assignments or entering into supply agreements, and skepticism over environmental holdbacks from traded volumes. These findings suggest that the source of the unwillingness to use transfers as a primary tool of re-allocation among irrigation district board members and other

members of the irrigation community, is institutional in nature. The next chapter discusses the implications of these findings, shortcomings of the research, and suggested avenues of future research.

CHAPTER SEVEN

DISCUSSION AND CONCLUSIONS

The intention of this research was two-fold: i) identify the intentions of irrigators to trade or transfer water and the factors that influence those intentions; and ii) identify irrigators' acceptance of policies to re-allocate or share water. By addressing irrigators' unwillingness to use the transfer system to re-allocate water it is possible to identify gaps in the water policies in southern Alberta that may prohibit the use of the transfer system. Identifying irrigators' acceptance of policies to share water offers information about how irrigators' dispositions towards certain policies may affect the re-allocation of water between users in southern Alberta.

In order to achieve these research goals a telephone survey was used in conjunction with interviews with leading members of the water management and irrigation communities in southern Alberta. This provided information that offers useful additions to attitude-behaviour literature, extractive-commodity literature, and literature investigating the factors that may impede a transfer system in the South Saskatchewan River Basin.

7.1 Key Findings and Contributions

In order to achieve the goals of this research, the following question guided the research process: '*what are the factors associated with irrigators' unwillingness towards using water transfers as a way to re-allocate water to other users'*. Through applying concepts found in attitude-behaviour literature and extractive-commodity literature, several key findings identified the factors associated with unwillingness to use transfers as a way to re-allocate water.

7.1.1 Association between Intentions, Values and Attitudes

This research took the unique approach of combining concepts derived from the TRA, TPB, transactional theory and extractive-commodity theory to analyse the

impediments to water transfers, and the use of trading in order to facilitate water transfers. As such, the conceptual framework from which the telephone survey was created is heavily based on attitude-behaviour connection research. In this manner, the telephone survey focused much more on the non-financial influences that the literature has shown to be influential in farmers' decision making (Gasson, 1973; Potter and Gasson, 1988; Austin *et al*, 1996; Willock *et al*, 1999a; Willock *et al*, 1999b; Tisdell *et al*, 2001; Maybery *et al*, 2005).

The literature has identified several attitudes that may influence farmers' willingness to participate in water transfers. They include: i) attitudes towards social acceptability, and the power of social influences towards transfers (Potter and Gasson, 1988; Samdahl and Robertson, 1989; Beedell and Rehman, 2000; Tisdell *et al*, 2001; Jackson-Smith and Buttell, 2003; Burton, 2004; Kuehne *et al*, 2008); ii) attitudes towards risk and economic factors (Dinar *et al*, 1995; Petzrelka, 1996; Gomez-Limon and Riesgo, 2004; Darnhofer *et al*, 2005; Bjornlund, 2006; Brooks and Harris, 2008); and attitudes towards the long-termed impacts of re-allocation strategies (Bjornlund, 2002; Tisdell and Ward, 2003; Burton, 2004; Bjornlund and Rossini, 2005). Furthermore, the literature focusing on psychological motives behind farming suggests that values towards family, farming as an occupation, and values towards the environment also play an important role in farmers' decisions (Gasson, 1973; Beus and Dunlap, 1990; Austin *et al*, 1996; Salamon *et al*, 1997; Corner *et al*, 1999; Maybery *et al*, 2005; Kuehne *et al*, 2008). These concepts were included in a telephone survey that loosely embraced the affective attitude and value statements that Ajzen and Fishbein championed for TRA and TPB.

The responses gathered from the telephone survey indicate that there are four dominant dimensions that account for 57.43% of the variance in irrigators' values and attitudes towards economic, social, and environmental affairs towards water transfers.

These factors are risk-averse attitude, social acceptance attitude, pro-sharing attitude and pro-environmental value. Generally speaking, however, these factors did not associate statistically with various stated intentions, in contrast to what is articulated in the literature. However, the pro-environmental value factor did display some significant relationships with different trading or transfer intentions, and it was the only factor that displayed statistically significant associations with intentions to vote yes in a plebiscite to transfer water.

This finding shows that the attitude and values had a weaker association with intentions to trade or transfer than expected. This is most likely because most irrigators had little intentions of selling or re-allocating water via a plebiscite. Many irrigators had the intention to buy water, or purchase a lease of water, over the next five years; while very few had intentions to sell. Those who did have intentions to sell tended to have more pro-environmental values than other irrigators. This, however, can also be explained by this group's lack of dependence on irrigated agriculture for income.

7.1.2 Association between Demographics, Farm Characteristics and Intentions

This research embraced the concept that farmers are heterogeneous, and most likely have a diversity of characteristics contextualizing their behavioural intentions. This follows the literature that has categorized farmers based on their personal demographics and farm characteristics (Tremblay and Dunlap, 1978; Fairweather and Keating, 1994; Petzrelka *et al*, 1996; Salamon *et al*, 1997; Corner *et al*, 1999; Schoon and Grotenhuis, 2000; Darnhofer *et al*, 2005; Maybery *et al*, 2005). These findings re-affirmed the literature suggesting that farmers can be specifically grouped based on their characteristics, and that these groups will display different intentions, values and attitudes towards water transfers.

The core finding from the cluster analysis indicates that three main groups of irrigators were found in the sample: i) drylanders who are actively seeking to expand their

irrigated acres, who are usually dependent on livestock operations, and who have the majority of their income derived from the farm; ii) dependents who are more crop dependent growing more specialty crops, and having a large percentage of their farming operations dedicated to irrigated agriculture; and iii) hobby farmers who are not dependent on the land for income, and who have small farms usually dedicated to livestock production. The findings suggest that these groups all have varying attitudes, values and intentions.

The hobby farmers are distinctly different from the drylanders and dependents regarding their values and attitudes. They hold less risk-averse attitudes towards inputs and costs, and they display a notably higher pro-environmental value than the drylanders or dependents. The drylanders have the highest intentions to expand over the next five years, with plans to buy land and water. This group is also most certain of a successor for the farm, thereby drawing some parallel between intentions to expand and certainty of farm succession. The dependents were similar to the drylanders in their dispositions, but had more intentions to upgrade irrigation systems to maximise the water-use efficiency of their farms. The dryalnders and dependents both had few plans to sell water, and displayed a strong unwillingness to re-allocate water via plebiscite, or to permanently sell their water to other users. Universally, irrigators in the sample expressed more of a demand for water, and an unwillingness towards transfers that has been previously noted in the literature (Bjornlund *et al*, 2007; Nicol *et al*, 2008). This, combined with an analysis of the barriers to trade, and dispositions in the sample towards various policy preferences, has some implications for water policies aiming at the use of market based water transfers to re-allocate water in the SSRB.

7.2 Policy Implications

The third research objective was to investigate irrigators' policy preferences towards re-distributing water and the government's role in transfers. This was done in order to identify policy gaps, or areas of further investigation. Identifying attitudes towards policies can provide information on the root of the unwillingness and skepticism towards transfers. A review of the literature identified four institutional barriers to water trading in Alberta: i) property rights barriers; ii) lack of information; iii) environmental holdbacks; and iv) high transaction costs. Data were gathered by using policy preference statements in the telephone survey, and by conducting interviews with leading members of the irrigation community.

Interviews with leading members of the irrigation community confirmed the presence of property rights barriers, environmental holdback barriers and high transaction costs in the SSRB's transfer system. Transaction costs are seen as high to many, particularly for temporary transfers for low volumes between users. Most key informants expressed a similar sentiment as was expressed by the Minister's Advisory Group in 2009, that "a number of operational barriers established in the Water Act should be removed to allow the transfer system to operate more effectively" (Alberta Environment, 2009: 7). Clearly defined property rights were also identified as an issue, as the amount that a licensee is able to transfer is not clearly defined. Survey respondents expressed the desire to either trade water they are not using, or to use water saved through efficiency gains towards economic purposes such as expanding irrigation on the farm.

In addition to this, irrigation districts are seeking to amend licenses in order to satisfy other users. There is a fear expressed that this may lead to more water use through diversions, and less water for rivers and streams (Christensen and Droitsch, 2008). This is compounded by the intention of most drylander and dependent irrigators to expand their

farms and buy more water rights. Irrigators in the sample have shown that they are much more interested in expanding their existing operations, and using more water, than they are by transferring any efficiency gains. The common view is to identify water being transferred as 'being lost' as Key Informant 6 points out, to the district, whereas amendments and assignments can ensure that the water stays with the license holder.

These findings indicate that, because of irrigators' intentions to use water saved through efficiency gains, more water use can be expected in the next five years. This brings up a concern that increased water use efficiency will actually lead to more use and less water being left to other users or the environment (English *et al,* 2002; Whittlesey, 2003). This concern is justified from the survey results given the intentions of irrigation districts and private irrigators in the sample, and through interviews with key informants. The survey findings suggest that some efficiency gains are expected through irrigation system upgrades, particularly among the dependent irrigator group, but that irrigators have a desire to put these efficiency gains to use on their farms.

WCOs are viewed critically by most irrigators in the sample, and by several key informants. This skepticism is most likely due to how WCOs are structured, and particularly that the 10% holdback is associated with WCOs. Many see WCOs as not useful because of the trivial amounts of water that have been allocated to them from transfers. Most key informants viewed WCOs as ineffective and an impediment to transfer water.

7.3 Lessons Learned from the Research

There were some shortcomings of the research, and some mistakes that were made concerning methodology. The most apparent shortcoming was associated with the survey instrument. In particular, the value statements embodied in the telephone survey were heavily skewed. Roughly half of the value and attitudes statements were removed from the

factor analysis because of low correlations, low communalities and extreme skew-ness. This reiterates a fundamental lesson that was over-looked with the creation of the survey: to keep the statements as direct and simple as possible. Furthermore, more testing should have been conducted with the survey, as it had what could be perceived of as confusing wording. An approach to solve this error would be to create the survey instrument to test a much more specific outcome, or behaviour, as stressed by Ajzen and Fisbhein's work on TRA and TPB literature. At the same time, it is also evident that the TPB and TRA may be directly applicable in studying irrigator's decision making behaviour.

The second shortcoming of the research was the wording of the intentions to transfer or trade water in the telephone survey. The primary objective of the survey was to identify the intentions of irrigators to transfer water, and what the factors influencing those intentions are. The survey should have been reduced to one overall outcome or behaviour, as opposed to including a scenario in an attempt to gage their attitudes and values towards various factors that may influence their decisions to transfer. The scenario was considered to be confusing by some respondents.

Another shortcoming of the research was the absence of questions regarding assignments and amendments in the survey. Assignments and amendments are seen as more preferable to key informants. Questions crafted around the use of assignments and amendments to achieve the goals of the WFL may have yielded interesting results, and could have contributed to a greater understanding of the unwillingness of irrigators to use the transfer system to re-allocate water.

The final shortcoming of the research was the inclusion of private and district irrigators in the sample. The survey was crafted to be administered to both separately, and to combine the results to provide an overall explanation of their intentions, attitude and value dispositions, and characteristics. It would have been more effective to focus more on

district irrigators, as irrigation districts hold the largest and most senior licenses in the SSRB, and to analyse private irrigators in a separate survey. This is warranted due to the institutional differences between irrigators within a district, and irrigators using their own private licenses.

7.4 Suggested Avenues for Future Research

Despite the shortcomings of the research, there were several findings that warrant future investigation. The first is to investigate the viability or potential for allowing private individuals to hold licenses that can contribute towards WCOs. This is not permitted under the current legislation. The survey findings suggest, however, that most irrigators in the sample were at least somewhat receptive to the idea. Lane Miller *et al* (2013) point out that in order to achieve conservation objectives by allowing private license holders to acquire water for environmental purposes, there must be four fundamental conditions: i) legal and institutional settings which clearly define water rights and lower administrative and other barriers to water transfers; ii) non-governmental organizations and community groups which play a complementary role to government; and iii) creation of a system that will fairly distribute future risk of water availability and provide choices for a variety of ways of obtaining and; and iv) efforts that minimize negative community impacts, thus helping to maximize irrigator participation. Each of these topics deserves more investigation in the SSRB in order to not only identify the viability of allowing private individuals to hold environmental licenses, but to maximise flexibility and effectiveness of the allocation system in general.

In order to address the shortcomings of this research, it is also recommended to address value relationships with intentions more thoroughly. More concrete measures of values, in particular, may be useful in statistical models used to predict outcomes based on the parameters set by value and attitude constructs, such as with structural equation

modelling (Austin *et al*, 1998a; Austin *et al*, 1998b). This research has suggested some core attitude and value constructs through factor analysis. These constructs may be used in a more precise manner in such predictive models in order to enhance or identify their explanatory power.

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APPENDIX A

Pre-Survey Interview Questions

1. How important is irrigation water to your farming operation?

2. Is farming the only way you and your family make a living?

3. What type of irrigation system do you have?

4. As you may know, irrigators in Southern Alberta are allocated about three-quarters of the freshwater resources. Do you think this is the best use for that water, or do you think this is too much/too little?

5. Do you feel as though there is a water scarcity issue in Southern Alberta?

6. One of the goals of the Water for Life Strategy is to increase water use efficiency and productivity by 30% in 2015 over 2005 levels. Do you think is attainable?

    a. Why or why not?
    b. Do you think irrigators are as efficient as they can be with the water resources they have?
    c. Have you upgraded your irrigation system to increase water efficiency since 2003?
    d. Do you intend to increase your water efficiency?

7. How do you feel about water markets in Southern Alberta?

8. One of the goals of the Water for Life Strategy is the protection and restoration of aquatic ecosystems. How do you feel about that and how do you feel about providing water for ecosystems?

    a. How do you feel about Water Conservation Objectives?
    b. What are your views on the environment, and do you think aquatic ecosystems have as much value as agriculture?

9. What are your long termed goals for your farming operation?
    a. Are your children interested in farming?
    b. Have you ever considered selling your land to people who will use it for non-farming purposes?

10. Do you describe yourself as a religious person?
    a. Does this tend to shape your values?

11. Where do you get most of your information from regarding water and environmental issues?

12. Are you a member of any clubs or organizations (ie: Ducks Unlimited, 4-H, any political parties or organizations, etc?)

13. If you feel comfortable answering, may I ask what political affiliation you tend to 'swing' to? Conservative? Liberal? Anything Else?

14. What would you identify as the biggest problem for your farming operation?

15. What generation of farming do you belong to, and how much do you associate yourself with the farming lifestyle?

16. This may sound like a 'loaded' question but if you had to choose one of the following, what would it be?

    a. Increase profits.
    b. Protect the environment.
    c. Continue the farming lifestyle.

APPENDIX B – ETHICS FORM FOR INTERVIEWS

4401 University Drive
Lethbridge, Alberta
T1K 3M4
TEL: (403) 329-2225
FAX: (403) 329-2016

Department of Geography

Dear Participant:

You are invited to participate in a research project I am conducting for a Master's thesis at the University of Lethbridge. By agreeing to be interviewed you will have the opportunity to influence the questions asked in a survey for research that concerns the sustainability of Alberta's water supplies.

My research is investigating the values, attitudes and motivations of Alberta's irrigators towards water use and water transfers. By better understanding irrigators' values and attitudes towards water I hope to better understand what factors influence irrigators' management decisions, and to address how irrigators view optimal water usage.

By interviewing irrigators of different farming backgrounds in the South Saskatchewan River Basin I hope to identify all relevant value orientations of the irrigation sector in the region towards water use and the water market. I also hope to identify the terms under which Alberta's irrigators feel water transfers should take place. By sharing with me your personal views on this issue, you will aid me in ensuring that all aspects of concern regarding water use and water transfers are captured by the survey. This will provide valuable insight that may shape future policy and research.

Several steps will be taken to protect your anonymity and identity. While the interviews will be tape recorded, the voice files will be destroyed once they have been transcribed. The typed interviews will not contain any mention of your name, and any identifying information from the interview will be removed. The typed interviews will be kept in a locked filing cabinet at the University of Lethbridge and electronic versions of the interviews will be kept on a password protected computer. Only the two main researchers, and a research assistant, all under professional obligation to keep all information confidential, will have access to the interviews. All information will be destroyed in five years. You will be sent a copy of the transcript of the interview for your comments.

There are no known risks or discomforts associated with participating in this research, and your participation in the interview is completely voluntary. If you chose, you may withdraw from the study at any time. If you do this, all information you have provided will be destroyed.

The benefits of participating in the survey development process include ensuring that your values are considered in the development of the final survey instrument, which may influence future research and policy on the way water transfers are conducted in Alberta.

A short report summarizing the results of the survey will be published on the internet at http://www.waterresearch.net in advance of the final results being published as part of a Master's Thesis as well as in professional and academic journals and in conference presentations and

proceedings papers to academics and policymakers. At no time, however, will your name be used or any identifying information be revealed.

If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me by phone at 403-329-2535 or email at Mathew.hall@uleth.ca). You can also contact my faculty supervisors Dr. Henning Bjornlund in the Department of Economics (phone: 403-317-2884; email: henning.bjornlund@uleth.ca) or Dr. Wei Xu in the Department of Geography (phone: 403-332-4561; email: wei.xu@uleth.ca).

Questions regarding your rights as a participant in this research may be addressed to the Office of Research Services, University of Lethbridge (phone: 403-329-2747 or email: research.services@uleth.ca).

Thank you in advance for your interest in this project.

Mathew Hall
Student Investigator

I have been offered a copy of this consent form that I may keep for my own reference.

I consent to this interview being tape recorded acknowledging that all procedures concerning my privacy and anonymity will be followed.

I have read the above form and, with the understanding that I can withdraw at any time and for whatever reason, I consent to participate in today's interview.

_____ _____
Participant's signature Date

_____
Researcher's signature

I agree to be part of the focus group to evaluate the questionnaire.

I agree to be part of the final pilot test of the questionnaire which will be conducted by phone.

If you agree to be part of the final pilot test and/or the focus group please provide:

Name:

Email:

Contact Phone Number:

Participant's signature

Appendix C – SURVEY QUESTIONNAIRE

Part 1 - Introduction

Int1

Hello, my name is _____. Today we're conducting a study with local irrigators on behalf of the University of Lethbridge and Alberta Innovates about water management decisions. Your input will be very instrumental for a U of L Master's student research project and will help inform policy makers on irrigators' opinions and attitudes related to water management. By accepting to participate in this survey you will also be eligible for a one-time $500 prize draw that will be conducted upon research completion sometime early in the new year. This is not a sales call.

Are you a rural landowner with irrigated land either in an irrigation district or with your own water license, and over 18 years of age?

([If the person answering the phone is not a landowner over 18: ask if there is someone else in the household who is and ask to speak to that person])

- ❍1 Yes
- ❍2 No
- ❍3 Call back later
- ❍4 Not interested

T1 *Show if not an irrigator or over 18*

Thank you for your time. Good bye.

CB3 *Show if call back*

Go to call back page

T0 *Show if refused (No or Not Interested)*

Thank you for your time. Good bye.

Int2

Would you consider yourself a long-term decision maker for your land, if not can I speak to someone in your home who is?

([IF DECISION MAKER IS NOT HOME: Ask: Would there be a convenient time to call back to reach him/her?

Long-term decision maker: A household member who makes land management decisions that may affect their land in the long run. People who recently moved onto a property qualify, but people who only rent land should not qualify.])

- ❍1 Yes
- ❍2 Yes, getting person
- ❍3 No, call back later
- ❍4 No, refusal

T2 *Show If refused*

Thank you for your time. Good bye.

CB1 *Show If call back*

Go to call back page

Int3

<<int3_intro>>

Your number was randomly chosen from a phone list gathered by matching numbers to your corresponding postal code. This survey is voluntary and your responses will be kept strictly confidential and anonymous. Although some personal information will be collected in this survey, in order to get demographic information, it will be protected. Only the researcher and research assistants will have access to this information, and your name and identity will not be recorded, published or used in any work deriving from this survey. We are interested in your responses, not your identity. The information gathered from the survey will be used in publications and will be part of a Master's thesis. The survey will take about **20 to 30 minutes** depending on your answers, and there are no known risks or anticipated discomforts expected from participating; however, you may withdraw at any time. Would you be interested in participating in this research project by answering some questions?

([If NO: Ask: Would there be a more convenient time for me to call back?])

- ❍1 Yes
- ❍2 No, call back later
- ❍3 No, refuse

T3 *Show if refused*

Thank you for your time. Good bye.

CB2 *Show if call back*

Go to call back page

Int4

Great, before we get started I'll just let you know that if you have questions about the research, I can supply you with the contact information of Mathew Hall, a Master's student at the University of Lethbridge. He will be able to provide you information and will answer general questions you may have about the study. Also, if you have questions regarding your rights as a participant, then I can give you the phone number to the Office of Research Services at the University of Lethbridge.

I'd also like to inform you that this call may be monitored for quality assurance purposes.

([IF ASKED:
Mathew Hall: Phone: 403-329-2535 or Email: Mathew.hall@uleth.ca
Office of Research Services: Phone: 403-329-2747 or Email: research.services@uleth.ca])

Part 2 – Screening Questions

Scr1

Before we get started, does an irrigation district supply you with water or do you have your own private water license?

❍1 District Irrigator
❍2 Private Irrigator
❍3 Both

(If District Irrigator, ask **Scr2.**

If Private Irrigator, ask **Scr3** *and* **Scr4**

If Both, ask **Scr2., Scr3., Scr4 and Scr5**)

Scr2

Which irrigation district supplies you with water? *(Manually Write In Response; for Spelling look in* **Appendix A***)*

_____

❍14 Refuse to Answer

Scr3

What river(s) or stream(s) do you get your water from for irrigation purposes as specified on your license?

❍1 [*Input names of river(s) and stream(s) manually here*].

❍2 Not Sure

❍4 Refuse to Answer

Scr4

The priority date of a water license is the date on the license that specifies when it was issued. I am interested in the year the license was issued. What is the year that your water license was issued?

❍1 [*Input priority date(s) here*]

❍2 Not Sure

❍3 Refuse to Answer

Scr5

Do you get most of your irrigation water from a district or from your private license?

❍1 District

❍2 Private License

❍3 Not Sure/Refuse to Answer

Part 3 – Value Orientations

A1.

The next part of the survey entails questions about you, your farming operation, and the benefits you derive from your farming operation. Please indicate your level of agreement with the following statements using a 1 to 7 scale with 1 being "strongly disagree", 7 being "strongly agree", and 4 in the middle being "neither agree nor disagree".

		Strongly disagree			Neither agree nor disagree			Strongly agree
a.	A maximum annual financial return from your farm is your most important goal.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
b.	Managing environmental problems on your land is a high priority.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
c.	The lifestyle that comes with living in a rural area is very important to you.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
d.	Increasing the asset value or net worth of your farming operation is very important to you.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
e.	For you, a rural environment is a better place to live than an urban environment.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
f.	Your right to do what you want with your water allocation has to be balanced against wider environmental concerns.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
g.	You view your farming operation as first and foremost a business investment.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
h.	Rural communities are a great place to live and raise a family.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
i.	Having enough water in rivers and streams to support healthy ecosystems is important to you.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
j.	You make farm decisions	❍1	❍2	❍3	❍4	❍5	❍6	❍7

	based on how they will affect future generations farming on your land.							
k.	Having land to pass down to future generations is more important than selling it for profit.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
l.	When faced with decisions that affect the way you manage your farm, financial concerns tend to outweigh lifestyle considerations.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
m.	When faced with decisions that affect the way you manage your farm, financial concerns tend to outweigh environmental concerns.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
n.	When faced with decisions that affect the way you manage your farm, environmental concerns tend to outweigh lifestyle considerations.	❍1	❍2	❍3	❍4	❍5	❍6	❍7

Part 4 – Policy Statements and Water Use Attitudes

B1.

With the same 1 to 7 scale, please indicate your level of agreement with the following policy statements.

	Strongly disagree			Neither agree nor disagree			Strongly agree
a. The government, rather than market forces, should get to decide who uses Alberta's water.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
b. If an irrigation district or private license holder is not using all of their water allocation, the government should be able to take that water for environmental purposes, without any compensation.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
c. Minimum flows of water should be set for all rivers and streams, and only the water above those minimum flows should be used for economic purposes such as irrigation.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
d. Private groups and individuals should be able to hold water licenses for environmental purposes.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
e. Water that is saved through improved water use efficiency should be used to increase economic activity.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
f. The government should buy water from current license holders, like irrigation districts, so that more water can be left in the rivers.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
g. The seniority of a water license must be honoured under all circumstances.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
h. Public funds should be used to improve irrigation systems only if the water that is saved	❍1	❍2	❍3	❍4	❍5	❍6	❍7

is left in rivers.

i. If water is to be traded among irrigation districts and/or municipalities, the government should set the price. ❍1 ❍2 ❍3 ❍4 ❍5 ❍6 ❍7

B2.

Next I will provide you with a context from which to answer some related questions.

Alberta's Water for Life Strategy encourages the use of **economic instruments** in an attempt to fairly distribute Alberta's water supply to new and existing users. The term economic instrument partially refers to enabling water license holders to **transfer** all or a part of their water licenses to a willing buyer. These transfers may be **temporary leases** of water to another license holder, or **permanent transfers**.

All transfers between license holders are subject to approval by Alberta Environment and must adhere to provisions in your river basin's Water Management Plan. Transfers must also not impair or have adverse effects on the rights of a household user, traditional agricultural user, or the aquatic environment, and may result in a **10% holdback** which the government can use to meet their **water conservation objectives**. Transfers within irrigation districts may occur upon the approval of the irrigation district, and district fees associated with these transfers may be assessed. Transfers that occur within an irrigation district are not subject to a 10% holdback.

Now, with the same scale of 1 to 7 please indicate your level of agreement with the following statements:

	Strongly disagree			Neither agree nor disagree			Strongly agree
a. Rivers and streams of Southern Alberta are environmentally degraded due to low flows.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
b. You are aware of your abilities to buy or sell water with other farmers.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
c. There is an increasing demand for water from municipalities and industries in Southern Alberta.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
d. Irrigation water should not be transferred to non-agricultural users.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
e. Irrigation water should only be permanently sold to non-agricultural users if the money made from the sale goes towards increasing agricultural water use efficiency (for example, fixing canals or installing pipelines resulting in a net savings of water).	❍1	❍2	❍3	❍4	❍5	❍6	❍7

f.	Temporary leases of water are ok, but permanent sales of water are not.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
g.	More water should be set aside for irrigation.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
h.	Municipalities and other non-agricultural users should be more efficient with their water.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
i.	Re-allocating water from irrigation to municipalities and non-agricultural users is beneficial to society.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
j.	Re-allocating water from irrigation to water conservation objectives is beneficial to society.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
k.	Permanent water transfers between farmers are ok but trading water out of agriculture is not.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
l.	You would feel more comfortable transferring your unused allocation rather than water you are actually using.	❍1	❍2	❍3	❍4	❍5	❍6	❍7

B3.

To the best of your knowledge, in percentage, how much of your water allocation do you typically use during an average year?

- ❍1 Less than 50%
- ❍2 50% – less than 60%
- ❍3 60% - less than 70%
- ❍4 70% - less than 80%
- ❍5 80% - less than 90%
- ❍6 90% - less than 100%
- ❍7 100%
- ❍8 Don't know.
- ❍9 Refuse to Answer

Part 5 – Attitudes

[For District Irrigators AND Both if Scr5 answer is District**]**

In the following scenario, a non-agricultural user has approached your irrigation district with a proposition to permanently purchase water. The irrigation district is going to hold a plebiscite to approve the sale of water to the non-agricultural user. The irrigation district plans to spend the money made from the sale to upgrading its infrastructure to result in increased water use efficiency.

[For Private Irrigators AND Both if Scr5 answer is Private License**]**

In the following scenario, a non-agricultural user has approached you to buy some of your water allocation.

C1.

Using a scale of 1 to 7 with 1 being "extremely negative", 7 being "extremely positive" and 4 being "neutral" please indicate what you think about the potential outcomes of a permanent sale of water:

	Extremely Negative			Neutral			Extremely Positive
a. Move water away from agriculture.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
b. Satisfy the water demands of a municipality.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
c. Satisfy the water demands of an industry.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
d. Increase water use efficiency.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
e. A 10% holdback of the traded volume to meet water conservation objectives.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
f. Less water for irrigation.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
g. [**District Irrigators AND Both if Scr5 answer is District]. Irrigation infrastructure improvements.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
h. [**Private Irrigators AND Both if Scr5 answer is Private License]. Money made from the sale.	❍1	❍2	❍3	❍4	❍5	❍6	❍7

Part 6 – Subjective Norms

C2.

O.K. now using a 1 to 7 scale, with 1 being "strongly disagree", 7 being "strongly agree" and 4 being "neither agree nor disagree" state your level of agreement with the following statements about what other people would think about a permanent sale of water.

	Strongly disagree			Neither agree nor disagree			Strongly agree
a. Members of your family would think it's a good idea	❍1	❍2	❍3	❍4	❍5	❍6	❍7
b. Members of your community would think it's a good idea.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
c. The government would think it's a good idea.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
d. Your neighbours and friends would think it's a good idea.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
e. Members of agricultural communities and organizations would think it's a good idea.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
f. Recreational users of rivers and streams would think it's a good idea.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
g. Professionals, scientists and members of environmental groups would think it's a good idea.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
h. Other irrigators around where you live would think it's a good idea.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
i. [****For District Irrigators AND Both****] Your irrigation district would think it's a good idea.	❍1	❍2	❍3	❍4	❍5	❍6	❍7

Part 7 – Control and Social Acceptance Statements

C3.

For the next statements, with a scale of 1 to 7 with 1 being "not at all", and 7 being "very much" please indicate how much each of these factors would influence your decision to approve of a permanent transfer of water.

	Not at all						Very Much
a. Uncertainty about the costs and benefits associated with the sale.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
b. Plans to expand your farming operation.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
c. Annual precipitation patterns.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
d. Rising or declining commodity prices.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
e. Rising or declining operations costs.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
f. Having a successor lined up for your farm.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
g. Growing water demand from industry.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
h. Uncertainty about the future of your farm.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
i. Growing water demand from communities.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
j. Environmental water demands.	❍1	❍2	❍3	❍4	❍5	❍6	❍7

Part 8 – Past Behaviour and Behavioural Intentions

D1.

Now, on a scale of 1-7 with 1 being "highly unlikely", 7 being "highly likely" and 4 being "uncertain" please state the probability that you will do the following actions over the next five years assuming that the opportunity for each action arises, and in particular, assuming that the scenario mentioned before occurs.

		Highly Unlikely			Uncertain			Highly Likely
a.	Purchase a lease of water.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
b.	Permanently buy water.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
c.	Sell a lease of water.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
d.	Permanently sell some of your water allocation.	❍1	❍2	❍3	❍4	❍5	❍6	❍7
e.	[****For District Irrigators and Both]** Vote 'yes' in a plebiscite to permanently sell some district water to outside of the district.	❍1	❍2	❍3	❍4	❍5	❍6	❍7

D2.

Now, related to the previous questions, have you done any of the following actions over the last five years?

a. Leased out water?
   - ❍1 Yes.
   - ❍2 No.
   - ❍3 Refuse to Answer.

b. Permanently sold water?
   - ❍1 Yes.
   - ❍2 No.
   - ❍3 Refuse to Answer.

c. Purchased a lease of water?
   - ❍1 Yes.
   - ❍2 No.
   - ❍3 Refuse to Answer.

d. Permanently bought water?
   - ❍1 Yes.
   - ❍2 No.
   - ❍3 Refuse to Answer.

[For District Irrigators and Both**]**

e. Has your irrigation district held a plebiscite in the last five years regarding a sale of water, and if so, what did you vote in that plebiscite?
   - ❍1 Yes; I voted yes.
   - ❍2 Yes; I voted no.
   - ❍3 No my irrigation district did not have a plebiscite in the last five years.
   - ❍4 Yes; I did not vote in the plebiscite
   - ❍5 Uncertain
   - ❍6 Refuse to Answer

Part 9 – Demographics and Farm Specifics

Thank you very much we are just about finished the survey. Now I will just ask you some very brief questions about yourself and your farm that will take another couple minutes.

E1.

DO NOT READ – Record Gender

(Please select one)

- ❍1 Male
- ❍2 Female

E2.

In what year were you born?

_____

- □-8 Refused

E3.

What is your marital status?

(Please select one)

- ❍1 Single and never married
- ❍2 Legally married
- ❍3 Common-law
- ❍4 Separated
- ❍5 Divorced
- ❍6 Widowed
- □-8 Refused

E4.

How many children do you have?

_____

- □-8 Refused

E5.

Do you have a successor lined up for your farm?

(Please select one)

- ❍1 Yes
- ❍2 No
- ❍3 Uncertain
- ❍4 Refused to Answer

E6

What type of certificate, diploma or degree did you receive?

(Please select one)

❍1 Secondary (high school) diploma or equivalency certificate
❍2 College or other non-university certificate diploma (including apprenticeship or trade)
❍3 University Bachelor's Degree
❍54 University Master's or Doctorate degree
❍5 None of the above

☐-8 Refused

E7

What was your approximate net annual household income as of 2011?

❍1 Less than $40,000
❍2 $40,000 – less than $80,000
❍3 $80,000 – less than $120,000
❍4 $120,000 – less than $160,000
❍5 $160,000 – less than $200,000
❍6 $200,000 or more
☐-8 Refused

E8

How much of your net income is derived from the use of your land,in percentage?

(Please select one)

❍1 0 to less than 25%
❍2 25% to less than 50%
❍3 50% to less than 75%
❍4 75% to less than 100%

☐-8 Refused

E9

Were you raised in a rural setting?

(Please select one)

❍1 Yes
❍2 No

☐-8 Refused

E10

Up to and including yourself, how many generations has your land been in your family?

_____

☐-8 Refused

E11

How many acres of land do you farm?

_____acres

☐-8 Refused

E12

How many irrigated acres of land do you farm?

_____acres

☐-8 Refused

E13

What are the primary uses of your irrigated land (such as crops grown) and how many irrigated acres do you have of each during the 2011 growing season?

(*Check those that apply)*

☐1 Forage crops, _____ acres.
☐2 Pastureland, _____ acres
☐3 Potatoes, _____ acres
☐4 Sugar Beets, _____ acres
☐5 Oilseeds, _____ acres
☐6 Other Specialty Crops (*Specify*), _____ acres
☐7 Cereal Crops (not for forage), _____ acres
☐8 Others not mentioned (*Specify*), _____ acres
☐9 Refused

E14

Do your irrigated crops support another part of your operation, for example providing feed for livestock?

❍1 Yes
❍2 No
❍3 Uncertain
❍4 Refused to Answer

[*If Yes, ask* **E15]**

Which part of your operation does your irrigated crop support? (*Check those that apply)*

- ❍1 Cow-calf
- ❍2 Feedlot
- ❍3 Other (*Specify)* _____
- ❍4 Refused to Answer

E16

Can you estimate the percentage of irrigated acres irrigated by the following equipment categories

- ❍1 Gravity/Flood _____ %
- ❍2 Wheel move _____ %
- ❍3 Low pressure pivot (under 30 psi) _____ %
- ❍4 High pressure pivot (30 psi or more) _____ %

E17

Below is a list of activities that can possibly improve water use efficiency. Please indicate whether you have done any of these over the past five years, or intend to do so over the next five years (*Check those that apply)*.

Action	Last Five Years		Next Five Years	Next Five Years	
a. Convert from flood/gravity to wheel move.	❍Yes	❍No	❍Unsure	❍Yes	❍No
b. Convert from wheel move to pivot irrigation.	❍Yes	❍No	❍Unsure	❍Yes	❍No
c. Convert from flood/gravity to pivot irrigation.	❍Yes	❍No	❍Unsure	❍Yes	❍No
d. Convert from high pressure pivot system to low pressure pivot system.	❍Yes	❍No	❍Unsure	❍Yes	❍No
e. Purchase a computer panel for your pivot system.	❍Yes	❍No	❍Unsure	❍Yes	❍No
f. Start to use **AIMM** or **IMCIN** to schedule irrigation. *(If asked what these acronyms mean, definitions are provided in* Appendix A.)	❍Yes	❍No	❍Unsure	❍Yes	❍No
g. Start to use private consultants to support irrigation decision making.	❍Yes	❍No	❍Unsure	❍Yes	❍No

E18

Do you intend to buy more land over the next five years?

❍1 Yes
❍2 No
❍3 Uncertain
❍4 Refused to Answer

[*If 'Yes' ask* **E19**],

Do you intend to buy dryland or irrigated land?

- ❍1 Dryland
- ❍2 Irrigated land
- ❍3 Both dryland and irrigated land
- ❍4 Uncertain
- ❍5 Refused to answer

E20

Are you a member of WPAC or a Watershed Stewardship Group?

- ❍1 Yes
- ❍2 No
- □-8 Refused

E21

Are you a member of an environmental or conservation group such as Ducks Unlimited, Trout Unlimited, Alberta Eco-Trust Foundation, etc?)

- ❍1 Yes
- ❍2 No
- □-8 Refused

E22

Are you a member of a recreational or social organization such as minor hockey, 4-H, the rotary club, etc?

- ❍1 Yes
- ❍2 No
- □-8 Refused

[*If "Yes" to* **E21** *or* **E22** *ask* **E23:]**

How many hours do you spend in an average month participating in the recreational, social or environmental organizations that you belong to?

_____ hours.

Part 8 – End

Alright, thank you for your time. That concludes the questionnaire. Your participation is much appreciated, and a short report summarizing the results of the survey will be published on the internet at www.waterresearch.net in advance of the final results being published as part of a Master's Thesis as well as in professional and academic journals. But again, your responses will be kept strictly confidential and you will remain anonymous. As for the prize draw, if you are the winner we will notify you via phone call sometime early in the New Year.

[****For District Irrigators Only****]

Our group at the University of Lethbridge is conducting another study involving district irrigators. We would therefore like to ask if you are willing to be contacted again for further research involvement. Since you have already responded to this survey, the next one would be shorter because you have already responded to some of the same questions.

Would you like to be contacted again to participate in the other study?

> Yes – ([if Yes: Say: your participation is much appreciated. When would be a good time to call back?])
> No – ([If No: Say: thanks anyway, your participation is much appreciated])

Appendix A – List of Irrigation Districts and Definitions

1. Western Irrigation District (WID)
2. Eastern Irrigation District (EID)
3. Bow River Irrigation District (BRID)

4. Saint Mary Irrigation District (SMRID)
5. United Irrigation District (UID)
6. Lethbridge Northern Irrigation District (LNID)
7. Ross Creek Irrigation District (RCID)
8. Taber Irrigation District (TID)
9. Magrath Irrigation District (MID)
10. Raymond Irrigation District (RID)
11. Leavitt Irrigation District (LID)
12. Aetna Irrigation District (AID)
13. Mountain View Irrigation District (MVID)

Water conservation objective (WCO) - A volume and quality of water to remain in rivers for the protection of a natural water body and its aquatic environment. WCO's are set by water management plans for various rivers in Alberta.

AIMM – Alberta Irrigation Management model. It is a decision support tool software package that assists irrigation producers with their irrigation scheduling decisions.

IMCIN – Irrigation Management Climate Information Network. A network intended to provide the irrigation industry in Alberta with up-to-date information on Irrigated Crop Water Use and Decision Support Tools to help irrigators make on farm water management decisions.