Two Papers on the Cost Effectiveness of Conservation Programs

by

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Abstract

This study explores the cost effectiveness of conservation offsets and three different methods of obtaining conservation easements. Given limited conservation dollars, conservation programs should be designed a cost effective manner. A new framework for evaluating offset programs is developed and applied to seven offset programs. A detailed study of an offset pilot program in Alberta is presented in Chapter 3, including calculations of the transactions costs and stakeholder perceptions. An analysis of three methods of obtaining a conservation easement, including a novel method using land purchase and re-sale, is presented in Chapter 4. The results presented in Chapter 3 show that transactions costs can be proportionally large, but do not necessarily affect perceptions on the cost effectiveness of conservation offsets. Results from the conservation easement paper show that a new approach employing land purchase and re-sale can provide a low cost method of obtaining easements in low discount rate scenarios. Both studies yield policy implications, which are synthesized in the conclusion.

Preface

This thesis is an original work by Warren Noga. The research project, of which this thesis is a part, received ethics approval from the University of Alberta Ethics Board, Project Name "Lessons Learned and Transaction Costs of Conservation Offset Programs", ID Pro00042197, amendments approved March 19, 2014.

The research presented in chapter 2 "Background and Lessons Learned from Conservation Offset Programs" is a collaborative research paper written for Sustainable Prosperity (unpublished) by Warren Noga and W.L. Adamowicz. I was responsible for the literature review and applying the framework developed in section 2.3.3 to the case studies in section 2.4.

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Chapter 1: Introduction

When an activity disturbs an ecosystem, the services provided by that ecosystem may be degraded or lost. A conservation offset program allows for an agent to disturb habitat in their operation and offset the loss in ecosystem goods and services[1] by paying a landowner to create equivalent habitat elsewhere. Conservation offsets are growing in popularity as a policy tool to meet the targets set by government policy (e.g. maintaining the services provided by wetlands as described in the new Alberta Wetland Policy [AESRD 2013b]). The use of conservation offsets is also acknowledged in the South Saskatchewan Regional Plan (SSRP 2013), which outlines land use plans for the South Saskatchewan River area of Alberta. Internationally, standards guiding the use of offsets have been developed (BBOP 2012) and other countries have implemented offset programs (e.g. BushBroker 2013).

Conservation offsets are touted as an economically efficient method of compensating for losses in ecosystem services (ES). However, many offset programs are designed in ways that seem to ignore components of cost effectiveness and other economic criteria. If conservation offsets are to be used as a cost effective means of achieving environmental goals, it is useful to evaluate existing programs and methods. The lack of consideration of cost effectiveness for conservation offsets is empirical in nature, where the economic concept of transactions costs (TCs) is often acknowledged, but little is done to minimize TCs or even account for them. As a result the economic goal of cost effectiveness is not always being considered in the design and implementation of conservation offset programs and a policy problem may emerge where offsets do not function as desired.

Another potential problem with implementing conservation offsets is a thin market (Kinzig et al 2011). With a limited number of sellers of ES (landowners), there is the potential for the landowners to gain market power, and obtain a price higher than

[1] ES are the benefits, as realized by humans, provided from healthy, functioning ecosystems (De Groot et al 2002). ES vary from ecosystem function; the latter is the physical process provided by the ecosystem (e.g. roots from plants retain soil- function, which preserves arable cropland-service) (De Groot et al 2002). Note that often ES, function, and habitat are used interchangeably, though they are not synonyms.

what would exist in a competitive market. Therefore, a thin market is not as efficient as a competitive market. New approaches to obtaining conservation easements may reduce the potential for thin markets; a novel approach known as the revolving land purchase (RLP) program has been suggested. The RLP program involves buying land, restoring wetlands, placing a conservation easement on the land, and then reselling the land on the market. By selling the land in an open market, many buyers have the opportunity to purchase the land, limiting the potential for a thin market.

Two economic problems are addressed in this thesis: (1) TCs are quantified for a pilot conservation offset program and compared to other known examples, in order to assess the size and significance of these costs in conservation program design, and (2) a novel approach (RLP program) is examined to determine whether it can provide conservation easements more cost effectively than other methods. To explore these questions, a review and evaluation of existing programs is presented. The review of current offset programs provides a state of the knowledge to frame the discussion of new projects and methods being explored to compensate for the loss of ES from impacts. The framework is created from existing criteria from both the biological and economic disciplines (Noga and Adamowicz 2014). Conservation offsets are further explored by examining a case study of a pilot project in Southeastern Alberta, which is supported by interviews with the stakeholders involved in the pilot. The survey results reveal the opinions of various stakeholder groups on conservation offsets and their implementation. Because payments for ES (PES) and offsets are touted as being cost effective, it is important to analyze and discuss the cost of establishing such a program. To do this, interview participants were asked about how much time they have invested in the development of the program they were involved with, as well as their perceptions about time requirements. These costs, TCs, are added to the program budget to establish what percent of the program expenditure is made up by TCs.

The second part of this thesis is made up of a financial simulation of Ducks Unlimited's (DU) revolving land purchase (RLP) program at two sites, one in Forty Mile County and the other in Red Deer County. DU restores wetlands on private land through the use of conservation easements (CEs). In an attempt to reduce the cost of providing

ES through CEs, DU is exploring the RLP program. To add an analytical component, the data for two sites provided by DU are simulated based on historical agricultural land prices. This analysis will show the effect of land price increasing or decreasing over the period that DU owns the land.

Each of these chapters relate to the cost effectiveness of PES. In order for these programs to be used as a cost effective means of providing ES, it is important to understand the costs. These costs can then be minimized and the correct program type selected so the ES are provided at least cost and conservation dollars can be spent on actual ES provision. The rest of the thesis is presented as a two paper thesis. To begin, a review of conservation offset programs is provided, including common issues and a review of existing programs. Following the review of offset programs, two papers are presented. Chapter 3 covers results from interviews conducted with stakeholders involved in a conservation offset pilot. Chapter 4 explores three methods of obtaining conservation easements on private land and frames the discussion in terms of cost effectiveness for the provision of habitat. The final chapter discusses the policy implications of the two papers.

Chapter 2: Background and Lessons Learned from Conservation Offset Programs

This chapter provides a background on conservation offset programs. The focus is on Canadian programs; however select international examples are also discussed. Common problems with offset programs are reviewed, including a literature review of TCs and how these costs apply to offset programs. Following the background information, a framework for evaluating offsets is presented and used to evaluate several case studies (Noga and Adamowicz 2014).

2.1 Introduction

There is increasing recognition that humans benefit directly from services provided by nature, yet these services are not always recognized in market processes (US EPA 2009). While some changes in ES directly affect agricultural crops and timber, and are thereby reflected in market value, other ES affect outdoor recreation experiences, wildlife habitat, or scenery and are difficult to capture in market values. In the latter cases the services may be underprovided since there is no direct incentive to generate improvements in their levels of provision. As public or quasi-public goods, the market will likely fail to provide these types of ecosystem benefits in sufficient quantity, which results in the need for policy tools that affect the provision or maintenance of these goods and services. As a corollary, the true costs or scarcity value of declines in these services, from land conversion or other development, will also not be reflected in market values. These non-market benefits and costs have led to a host of policy responses including conservation offsets, in which a loss in services must be offset by an equivalent gain in that service to maintain a non-declining level of ES provision, or possibly an increase in ES provided.

2.1.1 Conservation Offset Use

Conservation offsets are typically part of a hierarchy of "avoid, mitigate, rehabilitate / restore, and offset" (BBOP 2010). In this hierarchy, agents who are

affecting ES are required to attempt to first avoid losses in these services, then mitigate them, then rehabilitate other areas to reduce losses, and finally offset the remaining losses by creating or purchasing new habitats that are equivalent to the losses in services from development. While an agent can internally offset such impacts, often they purchase such offsets from others – either directly or through an agency responsible for creating or verifying the generation of offsetting services. In this way the offset mechanism provides for the possibility of cost effective conservation – achieving conservation targets like no-net-loss at least cost. Landowners who wish to participate in the creation of offsets may provide increased services by restoring wetlands or converting cropland to grassland as examples. Such a program is a direct mechanism that provides incentives for ES provision (Ferraro and Kiss 2002) and is viewed as a ESPES approach. Many conservation offset programs use ratios (or quality adjustments) to capture the difference in services provided between "impacted" and "created" ecosystems. The use of ratios allows a program to account for heterogeneity in ecosystems, and the services they provide; by requiring a net increase in habitat area (e.g. 1 hectare of wetland loss may be offset with 3 hectares of restored wetlands elsewhere) that takes into account quality differences between the area lost and the area created.

An example of an offset scheme, where firms or individuals who disturb an ecosystem create new ecosystems somewhere else to compensate society for the loss in ecosystem function, is the Alberta Conservation Association's (ACA) Conservation Offsets Framework (Croft et al 2011). This program can be used to outline the components of conservation offsets. A typical set of requirements for offsets are that they be additional, permanent, and equivalent (Croft et al 2011). These three terms indicate that offsets must:

1. Create *new* habitat
2. Exist for at least the duration of the impact
3. Provide equivalent "value" (ecological and/or economic) to the services lost by the development activity

In addition, an offset obtained at least cost, by finding the most inexpensive provider of the services, will result in cost effectiveness. Cost effective conservation offset programs

can be found using market based instrument[2] programs in which agents who seek offsets (e.g. developers) are facing market-based costs of purchasing the offset, while agents who are selling offsets are being provided with incentives to increase the provision of habitat or ES. The existence of a constraint, such a as a no-net-loss constraint, generates the negative incentive on developers and the consequent positive incentive for suppliers of offsets. A market based mechanism if appropriately designed will facilitate the provision of cost effective offsets and construct an effective scarcity signal of the value of the ES.

2.1.2 Challenges of Implementing Conservation Offsets

Many offset programs offset habitat loss or ecosystem function, rather than the ES provided (see case study 3: Alberta's wetland offsets). While offsetting habitat loss is more easily accomplished than accounting for ES, it does not necessarily reflect the loss of ES. Ecological function and ES can overlap, however the function is the natural process and the service is what the function can provide to humans (De Groot et al 2002). An example of the difference between ecological functions and ES is soil retention from plant roots (function) and the preservation of arable land (service) (De Groot et al 2002). It is also important to note that "biodiversity" is increasingly not viewed as an ES. Biodiversity may better reflect the function, while services such as wildlife (viewing or existence values), potential pharmaceutical provision or other such items are the services.

An important issue in evaluating offset programs is the mechanism used to generate the offsets. The mechanism on the demand side of the offset (requiring firms to obtain offsets) may be voluntary or mandatory; clearly a mandatory mechanism is more effective (Kollmuss et al 2008). The mechanisms on the supply side are more complex. For example, in the context of ES offsets – how are landowners encouraged to generate the offset?[3] A variety of mechanisms including voluntary programs, negotiations, cost-sharing programs, the development of offset banks, and a range of different types of

[2] A market based instrument (MBI) is any method that uses a market element to achieve an outcome (e.g. trading, transaction).

[3] In some contexts the entity that generates the environmental impact can internally generate an offset. But the cost effectiveness of this type of offset can be questioned as there may be other less costly providers of offsets. In addition the transactions costs may be significantly higher as the entity generating the offset may not have the capacity or be able to benefit from economies of scale in offset provision. Opportunities for ecological benefit from larger scale offsets may also be lost.

payments for ES programs have emerged. Many have argued that direct payments, such as payments through a reverse auction or conservation tender, are most effective (Ferraro and Kiss 2002). However, each of these programs needs to be evaluated in terms of how cost effective it is, particularly when TCs are included in the evaluation. Kinzig et al (2011) raise additional concerns about offset or PES programs including "thin markets" (especially in the context of auction like mechanisms), leakage, unintended consequences arising from payments for only one ES in a system with multiple interrelated ES, and design flaws such as attempts to achieve multiple goals with a single instrument (e.g. ES provision and farm income support or poverty alleviation).

Offset programs must deal with the inherent risk in attempting to create equivalent services. Mainly these risks are dealt with through the use of "ratios" or in some cases identification of certain habitat types that are not "offsetable". The development of ratios (e.g. three hectares restored for every hectare developed) raises significant questions from biological and economic standpoints in terms of the measurement of equivalence. However, an additional motivation for ratios greater than one has been outlined by Horowitz and Just (2013). They suggest that the trading ratio should be above one, even in cases with perfectly measured equivalence, as the ratio operates as a policy tool to reduce non-additionality from the providers of offsets[4]. Using a ratio gives policy makers another tool to achieve emissions reductions in addition to adjusting the baseline which reductions are measured against (Horowitz and Just 2013). An alternative to a trading ratio is to offer a subsidy to offset providers, along with a reduction in the baseline used to calculate offsets, as a way to reduce non-additionality. The policy maker employs two tools – the setting of the baseline and the ratio or subsidy – to achieve an optimal outcome. These findings have not been recognized in the policy literature and further consideration is necessary. The appropriate choice of either a ratio or a subsidy (and the accompanying change in the baseline) remains an issue for research. In terms of the framework for evaluation of offset policies, the Horowitz and Just paper

[4] This conclusion arises in part from the expectation that suppliers who benefit from the definition of a baseline will be more likely to participate in a market relative to those who do not benefit from the defined baseline, where the baselines are typically defined at an aggregate or regional level, while the individual supplier has private information about their conditions.

suggests careful assessment of the relationship between baselines, ratios (even in cases of complete certainty), and potential subsidies for offset provision.

An area of exploration in conservation offsets that could increase the ecosystem goods and services provided is the incorporation of stacking. The concept behind stacking is that one unit of land (grassland, wetland, etc.) can provide multiple ES. In order to account for these multiple services, it may be best to unbundle the services (and therefore credits) being provided so that the landowner can sell their credits in a way that reflects the true value of what is being provided (Fox 2008).

Allowing for stacking can potentially increase the value of conserved land to private landowners because they can sell credits for multiple services, which could increase their participation in offset programs. However, buyers may also change their behaviour and offer less per unit, resulting in an indeterminate outcome. While allowing for credit stacking can increase the potential participation and more accurately reflect the value of conserved land, there are some challenges surrounding the practice. The first issue is one of TCs. When multiple buyers and sellers are exchanging credits for different ecosystem goods and services, the TCs will increase (Weber et al 2011). So while there is the potential for better matching the needs of buyers with sellers with respect to offset type, there is also the potential for an inefficient trading system (Weber et al 2011).

The second issue with stacking is that of "double dipping." This occurs when the same offset is being sold to multiple buyers, therefore not providing any additional ES after the first payment (Fox 2008). The extent of double dipping will depend on how easily the goods and services can be unbundled, where more easily unbundled goods and services can be stacked (Fox 2008). Additionally, stacking will be more effective when one offset agency or exchange is involved for all the credits, as opposed to multiple exchange agencies (Fox 2008). An example of multiple ES crediting has been developed by the Willamette Partnership (Willamette 2013).

An alternative aspect of multiple ES in offset programs is that unintended negative consequences may arise for an ES that is not the direct target of the offset

protocol. One ES should not be protected or increased at the expense of another. Such potentially negative outcomes may be addressed by including constraints within the targeted offset protocol (e.g. monitoring for no adverse effects on related non-target ES).

Leakage, another consideration in offset design, is the concept that regulating or using a conservation tool in one area will simply transfer the harmful activity to another location. This can be split into two subcategories: primary and secondary leakage (Aukland et al 2003). Primary leakage occurs when the harmful activity is merely shifted to another location (by the same agent); while secondary leakage can take the form of market effects (Aukland et al 2003). An example of a market effect is reducing carbon emissions by halting deforestation, which increases the price of timber, thereby encouraging logging firms in other areas to increase harvest (Aukland et al 2003). If either form of leakage occurs, even on a small scale, the overall benefit of the offset program will be overstated. While tracking and quantifying secondary leakage is difficult, programs can be developed to minimize the potential for primary leakage (contracts, monitoring, establishing accurate baselines) (Aukland et al 2003).

Within the literature on market based instruments there is concern that incentives for conservation may crowd out voluntary conservation initiatives. This issue may be best illustrated with an example. On an international scale, the Reduced Emissions from Deforestation and forest Degradation (REDD) program allows developed countries to offset emissions by paying developing countries to halt deforestation (Alpizar et al 2013). The design of the REDD program leaves countries that have voluntarily reduced deforestation ineligible to benefit from payments for reductions, a factor that may have an adverse effect on conservation outcomes (Alpizar et al 2013). On a smaller scale, landowners who wish to participate, but are not selected because of cost, may change their conservation behaviour (less likely to conserve, or reducing voluntary conservation actions) (Alpizar et al 2013; Kits 2011; Kits et al 2014). Both crowding out and exclusion need to be managed appropriately in order to achieve optimal environmental outcomes when using an offset mechanism.

A method for rewarding landowners who have been voluntarily conserving is employed in the Montana sage grouse program, which pays landowners of existing

habitat to maintain it (NRCS 2013). While the Montana sage grouse program is not additional, it offers landowners an incentive to maintain existing habitat. Paying landowners who are already providing voluntary conservation can also happen in the Australian BushBroker program (BushBroker 2013). Learning from how these programs reward landowners already undertaking voluntary conservation is important, as the issue of how to account for these landowners in new programs is often discussed.

One major issue that is not often discussed in the evaluation of offset programs is the possibility of conducting a formal program evaluation arising from the program itself. Offset programs include discussions of monitoring – typically compliance monitoring to ensure that created offsets proceed as planned. But program evaluation is a broader concept that includes assessment of the entire program in a before-after, treatment-control type of framework. Many offset programs are designed as "pilot" programs to promote learning by doing and other experiential outcomes. However, the formal incorporation of opportunities for program evaluation would significantly improve the potential to learn from offset pilots. Ideally any conservation offset program should include a design that permits evaluation. Such designs include considerations of "controls" or identifiable matching cases that can be used to assess the efficacy of the program. A recent example is Zheng et al (2013) and the evaluation of a PES program for water quality and quantity improvement in China. This program is evaluated using a matching protocol and the ecological and economic outcomes from the program are assessed against the control groups.

Offset programs can be quite complex as a number of issues arise from the attempt to generate offsetting habitats or ES. Such complexities include the metrics used to assess equivalence, the extent to which offsets must be permanent or if they can be temporary and revolving, the monitoring and verification of offsets, and the use of cost effective mechanisms to secure the offsets. Other issues in offset design include considerations of multiple interdependent services; the effect that offsetting one service may have on related ES. There are also questions regarding the potential for offset programs to "crowd out" voluntary environmental behavior and the possibility that high

TCs[5] associated with offset programs will result in low participation rates or economically inefficient projects. Nevertheless there is considerable interest in the use of conservation offset schemes, by industry, government and NGOs. An illustration of government interest is the inclusion in Alberta's Land Stewardship Act (ALSA) of conservation offset programs and the provision to support pilot projects on such market based instruments. Industry may be interested in such mechanisms as a cost effective approach to achieving regulatory outcomes, such as no-net-loss, and they may appreciate increased certainty around mechanisms to deal with environmental impacts of projects.

However, there are only a few examples of conservation offset programs in Canada. By exploring the few existing offset programs, new programs can be designed to be more effective; both from an economic efficiency view and the environmental benefits realized. In addition, lessons learned from other offset programs, such as carbon offsets, will be considered. The analysis will be conducted in two ways. First, a framework for "successful" conservation offsets (a "gold standard"), will be presented. This framework is a compilation of frameworks and criteria that can be found in the current literature. The framework will provide a benchmark from which existing or new programs can be compared. The examination of emerging programs against a benchmark has been used in other contexts (Collie et al 2013) and provides a mechanism for assessment and guides future implementation. The case studies will be evaluated through a combination of: literature reviews, existing assessments of the programs, results from the program, and a survey of individuals involved in offset programs. In the case studies there will be additional emphasis on the TCs associated with the design and implementation of conservation offset programs as there are relatively few detailed quantitative assessments of TCs associated with participating in conservation offset programs.

2.2 Transactions Costs

TCs are an important component in decision making. Whenever a market transaction takes place, there exists a cost to both the buyer and the seller to complete the transaction. This concept was illustrated in considerable detail by Coase (1937), where

[5] Transactions costs are the costs of developing, implementing, and maintaining a program.

he stated that market transactions implicitly determine how production will be carried out. These market transactions will inherently be influenced by TCs; therefore TCs will impact how and what is produced. When applied to environmental programs such as offsets, the importance of understanding TCs becomes clear; higher TCs will lead to fewer ecosystem goods and services being provided with a fixed budget, or lower than efficient participation levels in conservation programs. Because more funds are used in the transaction, fewer benefits are realized, which will make the program less efficient.

While minimizing TCs is important to provide more ES at a lower cost, it is also important to explore transactions cost economics in a broader context. Fox (2007) provides an interpretation of Coase (1937, 1960) regarding how TCs will shape the institutions that allow externalities to be addressed. In a world where TCs exist, institutions will arise to minimize TCs. Individuals may choose to pay a landowner to bring about a land use change (e.g. restoring a wetland on agricultural land), however there will likely be high TCs associated with this method of addressing an externality. In this example, there is the potential for a reorganization of transactions to minimize TCs. Fox (2007) contends that when TCs are present (as is observed in reality), there is the potential for government action to change property to higher value uses where individual transactions would be inefficient because of high TCs.

The following discussion and the results reported in sections 3.1.3 and 4.3 address TCs, however it is important to note how these TCs fit in to a transactions costs economics framework. Institutions will arise to address externalities in a way that minimizes TCs (Fox 2007, Coase 1960), the results presented in chapters 3 and 4 will be used to explain how these new institutions arise.

Coggan et al (2010) list three main factors regarding the good/market that will influence TCs. These are: specificity of the good, temporal aspects, and the institutional framework that the program will exist in (Coggan et al 2010). Several examples of studies that quantify TCs can be found. McCann and Easter (2000) describe a system which can be used to measure the costs borne by the government/public agency in establishing and carrying out a soil conservation project. Given the data available for their study, the authors were constrained and could not examine private TCs. However,

they do calculate the planning and application costs of a project by utilizing the salary of a conservationist and a technician respectively and find average TCs (including both private and public agents) of $12.52/ac (McCann and Easter 2000).

Mettepenningen et al (2009) quantify private TCs for European landowners who participated in a conservation program. Using both a survey and a detailed 1-year pilot study the authors gather data on the TCs borne by landowners. An important finding of their study is that the TCs experienced by private agents, in this case, farmers, can be quite large, up to 15% of the cost of a program in their analyses (Mettepenningen et al 2009). Landowner TCs will affect program participation and efficiency. This last point may be particularly important as what landowners *perceive* TCs to be is more important in the decision making process than the realized TCs (Mettepenningen et al 2009, Buckley and Chapman 1997).

Santos et al (2014) provide a review of payment for ES scheme, including estimates of TCs. In a case study from Costa Rica, the authors find that using a simple proxy for the ES will have the lowest TCs and allow for application of the program to other areas; however detailed information on the services provided may be lost in a proxy (Santos et al 2014).

Pannell et al. (2012) also describe a framework for evaluating environmental policies and TCs. The authors suggest that TCs for government agencies can be reduced by screening projects with stakeholders before doing a detailed planning phase. Additionally, a properly designed study with selective data requirements may lower TCs for the landowner (Mettepenningen et al. 2009).

Understanding the role of TCs in decision making and accurately quantifying them is important not only to search for efficiencies in program design, but also in the assessment of choice of policy instrument. If the public TCs are too high, offset projects may not be the optimal policy choice, or they may not be as successful as hoped. Because the supply of offsets from private land is typically voluntary, it is necessary to recruit willing landowners. Assuming the landowner is a rational agent, they will expect to receive compensation for their participation in the conservation/offset program equal to

at least the cost of participation. A successful program will therefore offer compensation at least equivalent to foregone income and TCs, and minimizing the variable TCs will allow for efficiency gains. One must also note, however, that when evaluating pilot programs, like the Southeastern Alberta conservation offset pilot (SEACOP) program, the TCs as a percentage of the program may be quite high and they would benefit from economies of scale in a broader program. High start-up costs for PES programs can reflect up to 10 years of program payments (Wunder et al 2008). As a result, it is important to look at the long term TCs when evaluating a program rather than only analyzing the start-up costs. Reducing start-up costs is challenging (Wunder et al 2008), however reducing TCs can be achieved. In a review of Norway's forest policy, it was found that TCs can be reduced from 35% to 20% by limiting the government processes involved (Skjeggedal et al 2010).

While TCs vary across programs, Libecap (2014) identifies four factors that influence TCs associated with programs addressing global environmental externalities. Although they are identified for larger geographic areas than the offset and conservation programs presented in this thesis, they can be used to provide additional insight into the TCs of conservation offset programs. The following four factors increase TCs (Libecap 2014):

- Scientific uncertainty
- Varying preferences and perceptions (see section 3.1.3 for an example of varying perceptions by stakeholder group)
- Asymmetric information
- Lack of compliance

The elements influencing TCs have been identified (Libecap 2014). The following presents methods of estimating TCs. Using the breakdown of the elements of TCs laid out by McCann et al (2005), it is possible to systematically determine the TCs of a program. In addition to the actual costs of a transaction, it is also important to consider the costs of researching and establishing a payment for ES program (McCann et al. 2005), described above as learning costs. TCs can be broken down into seven

components, with some taking place at different times (see McCann et al. 2005 for a more thorough explanation). The seven components are:

- Research and Information
- Enactment or Litigation
- Design and Implementation
- Support and Administration
- Contracting
- Monitoring, Detection, and Conflict Resolution
- Prosecution and Enforcement

The Southeastern Alberta conservation offset pilot[6] is used as an example of the measurement of the TCs. Since the pilot project is in the process of being developed, there are several options given by McCann et al (2005) for gathering information on costs. These include proposed budgets, surveys, and interviews. If the analysis was *ex post* it would also be possible to utilize financial reports. Using interviews with government agencies, as well as the oil and gas producers and the landowners involved, it should be possible to determine the labour inputs into this program. Once the approximate time spent by all parties involved is established, it will be possible to estimate the expense of the program using pay scale information. The breakdown given above of TC elements will be used to guide the estimation of costs. Given that the project is still in development stages, some of the costs will not be known. However, they can be estimated using other incentive based programs as guidelines (if the information is available). Additionally, the costs of contracting should be available through estimates provided by other similar programs (e.g. the Alberta Conservation Association or ACA), who have already undertaken several native range re-seeding projects in the area).

Analysis of TCs in existing programs reveals a large amount of heterogeneity, where newer, international, and developing country programs have higher TCs than

[6] SEACOP is a voluntary pilot program where industrial developments that disturb native grasslands can be offset by paying a farmer to take land out of cultivation and return the land to native grass for a finite contract period.

established, more localized programs (Alston et al 2013). Localized programs may have an opportunity for lower TCs than national or international programs because they generally involve fewer parties (Alston et al 2013). The nature of the good and particularly how this interacts with property rights can also influence TCs, which should be considered when planning an offset program (Alston et al 2013). The conservation reserve program (CRP) in the United States has TCs estimated at 1% (calculated as TCs as a percentage of the overall program expenditure), the Countryside Stewardship Program in the UK has TCs of 18%, and a program of payments for carbon in Mexico has TCs between 30% and 50% (TCs reported here are total TCs for the program) (Alston et al 2013). Because TCs increase with program size and complexity, it is not surprising that an international program, involving multiple national governments, to pay for reduced carbon emissions has higher TCs than an established national program such as the CRP in the US, which involves only one national government.

A recent pilot in Florida that paid ranchers for water management services had a budget of $7 million for a small number of ranchers (10 projects were submitted for consideration) (Shabman and Lynch 2013). The Florida pilot, similar to other pilots, identifies high learning costs as an issue (Shabman and Lynch 2013). A large budget will help overcome these costs with enough money left over to spend on the actual projects. A small budget for creating offsets has been listed as a concern for the Southeastern Alberta Conservation Offset Pilot (SEACOP) program. TCs, including learning costs, can be very high for pilots, therefore future pilots will benefit from larger budgets and /or larger scale to provide ES and test market mechanisms.

2.3 A Framework for Assessing Conservation Offsets

Below elements of the biological and economic literature are synthesized to create a framework for evaluating conservation offsets. This framework will then be applied to seven case studies.

2.3.1 Biological Considerations

A review of the literature on frameworks for offset programs revealed documents outlining a general framework for offsets or standards for developing and implementing conservation offsets. For example, the BBOP (2012) report on biodiversity offset standards outlines 10 principles for offset design and accompanying criteria and indicators for each principle. The BBOP principles, summarized below, outline the goals of a conservation offset program in terms of achieving biological outcomes, transparency and equity. Somewhat surprisingly there is relatively little discussion of economic or financial aspects of offset design or consideration of cost effectiveness. For resources or ES that are very scarce the assessment of economic and financial aspects may not appear to be as important, as the social value is likely to be high and initial offset "providers" may be willing to supply them for a low payment. But as the application of offsets grows these conditions may not hold. Furthermore, if conservation offset programs are intended to provide signals of the value of ES as a way to integrate ES into market decision making contexts, then considerations of efficiency and cost effectiveness will be important.

Summary of BBOP (2012) Principles for Design and Implementation of Biodiversity Offsets

1. Does the program follow the mitigation hierarchy?
2. Does the program have a risk analysis for residual impacts that cannot be offset?
3. Does the program have a broad scale, landscape context?
4. Does the program adhere to the principle of no net loss and incorporate offset equivalence?
5. Are the conservation outcomes additional?
6. Is there stakeholder participation?
7. Do all stakeholders have an equitable role?
8. Does the program have a long-term plan?
9. Is the program transparent?
10. Does the program utilize proven science and traditional knowledge?

Similarly, the recent contribution by Pilgrim et al (2013) describes "offsetability" in terms of whether an asset (habitat, etc.) can be offset in biological terms using considerations of risk of impact or extinction, available offset options, and likelihood of success. Their conclusions suggest that there is a trade-off between the degree of biodiversity concern (risk) and the likelihood of success of the offset program and that offsets are most suitable for cases with low biodiversity concerns and high likelihood of offset success. However, these dimensions are largely viewed in biological terms. Likelihood of success is based on biological potential rather than whether landowners will successfully adopt and maintain lands enrolled in programs and whether such programs can be implemented cost effectively.

2.3.2 Economic Considerations

The BBOP (2012) and Pilgrim et al (2013) studies do provide very good summary guidance for issues like additionality, equivalence, and other very important components of an offset program. However, as a framework for assessment they are missing more detailed economic components. Economic considerations can be found in other literature. The Pannell Public-Private Benefits Framework (PPBF) (Pannell 2008) describes instrument choice (e.g. extension, positive incentives, negative incentives, or the choice to not implement any policy instrument) in the context of the size of net public and private benefits arising from an action. This relatively simple framework generates several interesting insights, particularly in the case of conservation offsets, and thus is explained in some detail here.

Figure 1 illustrates the Pannell framework. If a development project, such as an energy sector development or a residential sub-division (assumed to produce positive private net benefits) also produces significant negative public net benefits, where the net public benefits include environmental costs and economic benefits, through the loss of habitat – a negative incentive is the optimal policy response (the lower half of the south-east quadrant in Figure 1). Note that the loss in net public benefits must be greater than the gain in net private benefits for this policy response to be warranted. In the case of a

conservation offset this negative incentive is the requirement to offset the impact. Thus the development agent must pay for another landowner to construct an offsetting project. This occurs in north-west quadrant of the diagram. A landowner would experience a negative private net benefit from undertaking the offset project (e.g. converting cropland to native grassland, restoring a wetland). Assuming that the gain in net public benefits offsets the loss associated with the development project one can identify the location of the net private / public benefits point and assess whether a policy instrument such as a positive incentive (e.g. payment for ES) is best.

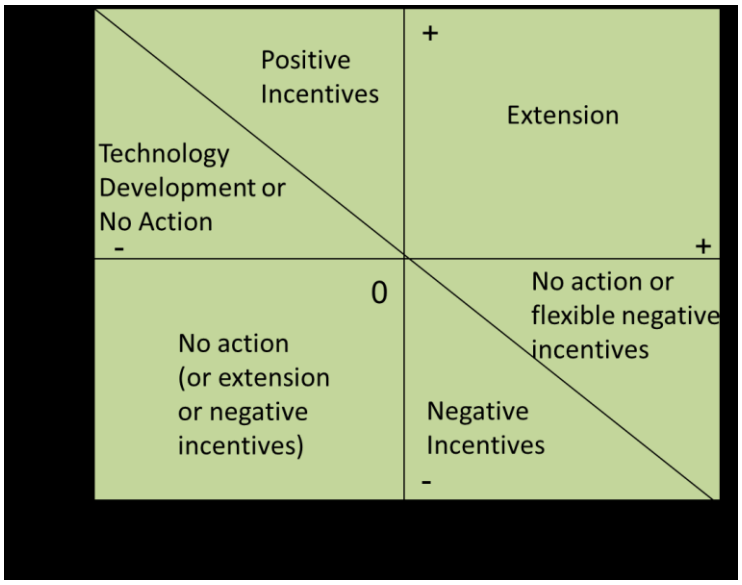

Figure 1: Pannell Public Private Benefit Framework (Pannell 2008, page 228)

The PPBF has been modified to include TCs. Figure 2 illustrates this situation for the offset program. If TCs are significant it is more likely that "no action" or "flexible" incentives are used rather than direct positive or negative incentives. Another potential extension of the framework is the fact that the negative incentive on the developer (requirement to offset) constitutes a "willingness to pay" for a type of input into the development project. For the landowner the payment for ES is effectively a "willingness to accept" context. Large willingness to accept amounts may reduce the possibility that a positive incentive is optimal (opting instead for a less direct mechanism or no action outcome). These insights from the PPBF illustrate the importance of TCs and mechanism

design on the choice of instrument and approach. Offsets evaluated purely in ecological terms may not generate sufficient net benefits to warrant a policy instrument; as a result "no action" may be the correct decision if economic components are not considered. In contrast to the analysis presented by Pilgrim et al (2013), it is more likely that high value ES (e.g. scarce habitat resources), if they can be established, will generate sufficient public net benefits to justify an offset scheme. In cases with low value ES, TCs in particular may be significant enough to render offset programs as an economically inefficient solution.

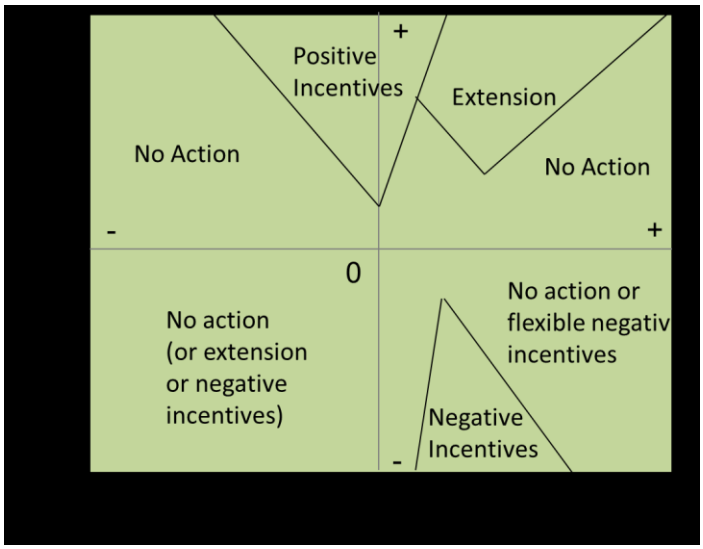

Figure 2: Pannell Public Private Benefit Framework with Transactions Costs (Pannell 2008, Page 228)

In a series of papers Pannell and colleagues have outlined a process for evaluation of environmental projects that is aligned with the PPBF. The INFFER (Investment Framework for Environmental Resources) employs a benefit-cost approach to assess which "projects" to include in a conservation initiative (INFFER 2014). This can be viewed as determining which projects to include given a budget for offsetting activities (noting that this budget is endogenous / negotiable). A key relation in the INFFER framework is that projects should be compared on the basis of their benefit cost ratio (BCR)

$$BCR = \left(\frac{V * W * A * P}{C}\right) * \left[\frac{1}{(1+r)^L}\right]$$

Where V is value, W is the proportional improvement arising from the project, A is the adoption rate, P is the probability of success, C represents costs, r is the discount rate and L is the time lag before benefits occur. The main insights from this framework are that the evaluation of an offset program should include consideration of the adoption rates (by landowners) and the probability of success, as well as accounting for the time lags and appropriately discounting flows of resources. The latter is a factor that is often not discussed in offset analyses, yet is a key component in habitat equivalency analysis as employed in natural resource damage assessments (e.g. Chapman 2004). The inclusion of success probability and adoption rates is somewhat analogous to the likelihood of success criteria in Pilgrim et al (2013), but this INFFER framework includes social, behavioral, and economic aspects as well as ecological elements.

2.3.3 Proposed Framework for Assessing Conservation Offsets

The discussion above leads us to construct a new framework for the evaluation of offset programs. This framework includes criteria identified in more ecologically focused sources such as BBOP (2012) but also integrates the economic literature on program design and evaluation. The key elements of the framework are listed below with the source of the criterion identified in brackets following the item.

Criteria for Evaluation of Offset Programs:

1. Mitigation hierarchy approach employed. (BBOP)
2. Incorporates or assesses risk of inability to offset impacts, probability of failure and low adoption (BBOP, Pilgrim et al, Pannell, Horowitz and Just).
3. Landscape scale (BBOP, Pilgrim et al)
4. Adheres to the principle of no net loss, or other well defined target, and identifies equivalence (BBOP, Pilgrim et al, Kinzig et al)
5. Additionality occurs (BBOP, Pilgrim et al, Kinzig et al)
6. Incorporates stakeholders in design (BBOP)

7. Includes equity considerations in design (BBOP, Kinzig et al – alternate / dissenting view)
8. Focuses on long term conservation (BBOP, Pilgrim et al, Kinzig et al)
9. Transparency (BBOP, Kinzig et al).
10. Employs the best available science and/or traditional knowledge (BBOP, Pilgrim et al, Kinzig et al)
11. Is cost effective or efficient, and includes consideration of TCs, leakage, discounting of temporal service flows and crowding out (Kinzig et al, Pannell)
12. Addresses multiple ES, or accounts for potential unintended consequences on non-target ES (Kinzig et al)
13. Integrates effective monitoring and enforcement into the program (Pannell, Kinzig et al).
14. Incorporates methods for program evaluation (Zheng et al, Pannell)

2.4 Case Studies

The following are examples of Canadian[7] programs, as well as an exploration of the lessons learned from Australia's experience with market based instruments and offset programs. Three Canadian programs examined in terms of the extent to which they appear to be consistent with the elements of the framework developed above include: the offsets created under the Harmful Alteration, Destruction of Disruption of Fish Habitat (HADD) provision of the *Fisheries Act*, Alberta's wetland offsets, and Alberta's carbon offset protocols. Three other case studies are examples of market based instruments in practice and not technically offset programs, and therefore will not be examined using the evaluation framework but will be included in this discussion as they provide interesting insights into conservation offset programs. While the focus is on offsets that generate ecosystem goods and services (ES) or habitat, examples of other programs will be discussed as their design and implementation can aide in the discussion of designing new offset programs that learn from past experiences.

[7] A case study not covered here is the Beaver Hills Initiative (BHI 2010), which uses transferable development credits.

		Program				
		HADD	Alberta's Carbon Offsets	Alberta's Wetland Offsets	SEACOP	BushBroker
Criteria	1. Mitigation hierarchy employed	+	N/A	+		+
	2. Incorporates risk of program failure	-	+	+	+	+
	3. Landscape scale	-	N/A	+	+	
	4. No net loss or explicit target	+	+	+	+	+
	5. Additionality	+	+	+	+	+
	6. Stakeholders aid in design		+	+	+	+
	7. Equity considerations in desgin			+	+	
	8. Long term focus	+	+	+	-	
	9. Transparency	-	+	+		+
	10. Employs best available science/traditional knowledge	+	+	+	+	+
	11. Economic efficiency/cost effectiveness	-	0	-	+	+
	12. Addresses multiple ecosystem services	-		+	+	+
	13. Effective monitoring and enforcement	+	+	+	+	+
	14. Incorporates program evaluation		N/A	0		+

+ yes - no 0, balanced N/A, not applicable blank, unknown

Figure 3: A Summary of Selected Case Studies Evaluated with the Developed Framework

In Figure 3 HADD refers to offsets for the harmful alteration, destructions or disruption of fish habitat and SEACOP refers to the Southeastern Alberta Conservation Offset Pilot.

Figure 3 provides a summary of the analysis of the case studies, indicating whether the program appears to address the criterion (+) or if it does not appear to meet the criterion (-)[8]. N/A means the criterion is not applicable to that program, 0 means the criterion is partly fulfilled (or is balanced between fulfilling and not fulfilling the criterion), and blank spaces mean it is unknown if the criterion is satisfied or not as that information is not available to us. The information used to evaluate if a program satisfies is collected from existing literature, program websites, and policy documents. Following Figure 3 is a description and analysis of each program.

[8] For a detailed explanation of how the framework was applied to each program, see appendix A.

Generally, the programs follow a mitigation hierarchy, use the best available science, and generally satisfy the other "biological" criteria. However, two criteria (supported by the survey results discussed below) are more likely to have room for improvement. These are criteria 11 (cost effectiveness, leakage, etc.) and 14 (program evaluation). Perhaps it is not surprising that cost effectiveness concerns are not paramount in pilot programs and initial investigations. The main concerns seem to focus on the equivalence of the outcomes or the maintenance of environmental quality. In addition, striving for cost effectiveness may increase TCs. However, ignoring cost effectiveness and the associated economic aspects of offset programs means that resources will be inefficiently used and effective scarcity signals will not be generated. Furthermore, the resulting high costs of offsets may result in reduced interest in the use of offset mechanisms and other market based instruments without providing a "fair" test of their efficacy. In almost all cases there appears to be a need for formal program evaluation. While the programs are evaluated to a degree using available information, it will be difficult to know with certainty if any of the criteria are met without a more formal program evaluation. More importantly, it will not be known if a program has been successful at achieving its stated goals without a program evaluation, which underscores the need to build a system for ongoing evaluation into the offset program.

Several important findings or lessons emerge from our examination of the individual programs using the evaluation criteria. A full description of each program is included in Appendix A but the highlights from these assessments are described below.

2.4.1 Case 1: Harmful Alteration, Destruction or Disruption of Fish Habitat

The Harmful Alteration, Destruction of Disruption of Fish Habitat (HADD) program is an offset program in that it requires that impacts on fish habitat be offset by equivalent construction of additional habitat or other approved methods (artificial propagation, like for unlike habitat) (Harper and Quigley 2005). Recently, changes to the *Fisheries Act* have changed the nature of the HADD provision to protect species of commercial and recreational importance (DFO 2012). However, the lessons learned from the operation of the HADD offsets can still be analysed. In Canada, under the *Fisheries*

Act section 35(2), there is the opportunity for damage (harmful alteration, destruction or disruption; HADD) to fish habitat to be compensated by an offset and therefore gain approval for the project (Harper and Quigley 2005). Beginning in 1986, the stated goal of the Department of Fisheries and Oceans (DFO) was to have no net loss (NNL) when it came to fish habitat (DFO 1986).

The HADD program as a whole has led to an overall increase in fish habitat (in this time frame, Harper and Quigley 2005). Based on the evaluation with the framework (Appendix A), the program could be improved by following a mitigation hierarchy, considering multiple ES (rather than "habitat"), and considering impacts on a landscape level. While the program was not designed to provide a cost effective way to address habitat alteration, it could be made more economically efficient by incorporating mechanisms to generate cost effective habitat provision.

2.4.2 Case 2: Alberta's Carbon Offset Programs

Greenhouse gasses (GHG), most notably carbon dioxide, are widely accepted to be the cause of climate change. These GHG emissions therefore create an externality which an offset program as a type of market based instrument (MBI) may help correct in a cost effective fashion. In contrast to wetland and other biodiversity offsets, which are difficult to measure and are local in scale, carbon offsets are more easily defined (e.g. tonnes of carbon dioxide emissions) and do not have the spatial focus that habitat and biodiversity do. The difference between carbon and conservation offsets means that not all of the features of a carbon offset can be applied to conservation offsets. However the carbon offset scheme's protocols and its use of a market based instrument (MBI) may still provide helpful insights into the development of cost-effective conservation offset programs. Because there are limited examples of MBIs and protocols surrounding trading environmental goods in Canada, it is important to review carbon trading. While carbon trading is done in several markets around the world, this case study will focus on the Alberta program.

The policy used in Alberta to regulate carbon dioxide emissions is targeted towards large emitters; those who contribute over 100 000 tonnes per year of carbon dioxide (AESRD 2013a). The program is based on intensity targets,[9] where the goal is to decrease carbon dioxide emissions per unit of output (AESRD 2013a). If these large emitters do not meet their targets (12% by intensity from July 1, 2007), they can either purchase offsets within Alberta, or pay a $15/tonne tax (AESRD 2013a). The offsets can be purchased from an aggregator who works with landowners to use low carbon technologies, such as zero till seeding. This reduction in carbon emissions in one sector can now be sold to regulated large emitters as an offset. Other activities can also be undertaken by large emitters to receive credit for reduction such as enhanced oil recovery or using biofuels (a complete list of activities that will give credit for emission reductions along with their protocols can be found at AESRD 2013a). The detailed protocols developed for activities that can receive credit for emissions reductions provide a valuable lesson in credit accounting and insuring additionality. While these other emission reducing activities exist, the discussion will focus on offsets provided by agricultural practices as agriculture is in a unique position to provide carbon sequestration (AARD 2005).

The Alberta carbon offset/tax program works as a negative incentive for large emitters and a positive incentive program for landowners. There is a provincially regulated target, and while options for industry to meet this target are flexible, there are clear negative incentives that exist for emitting firms (contribute to a fund, buy an offset, reduce emissions, or use performance enhancement credits) (AESRD 2013c).

2.4.3 Case 3: Wetland Offsets in Alberta

Water in Alberta, including wetlands, is regulated by the provincial government under the *Water Act*, specifically section 36. In addition to the Act, wetlands are also managed by the newly released Alberta Wetland Policy (AESRD 2013b). The wetland

[9] Intensity targets are calculated using the amount of GHGs emitted to produce a certain level of output. In effect, the efficiency of production (in terms of GHG emissions) is increasing, however overall GHG emissions are still rising.

policy does not describe the use of a market based instrument (MBI) directly; however NGOs such as Ducks Unlimited have used MBIs to find willing landowners (see the Assiniboine Wetland Reverse Auction case study for an example, as well as other Ducks Unlimited projects, such as their revolving land purchase program (DUC 2013)). While Alberta's wetland policy is not an offset program *per se*, offsets may be used to satisfy the goal of no net loss.

Alberta's wetland policy meets many of the criteria outlined above, but it does not appear to meet the criteria of cost effectiveness (see the discussion in Appendix A). An important lesson to be drawn from Alberta's wetland offset programs is the usefulness of the resource equivalency analysis principle of service-to-service offsets (Roach and Wade 2006). The policy does allow for varying offset ratios based on the distance between the disturbed site and the offset, which is a promising component. However, the program could likely benefit from a more systematic approach to offset ratios that includes the value of the services provided by the wetland. A varying ratio based on distance from the impacted and restored sites is used, but this doesn't necessarily capture the service loss to service gain associated with offsetting a wetland (AESRD 2007). The use of a dynamic offset ratio scheme would allow for a more efficient mechanism that offsets the true value of the service. In the recent policy release, a new offset matrix was developed that accounts for different quality of wetlands (however it is based on "function", not the services provided), and establishes the offset ratios between different types (AESRD 2013b). The new ratios are intended to capture the variation in wetland quality; a step towards approaching a service-to-service offset suggested by Roach and Wade (2006).

Recently, likely because of the costs associated with securing permanent easements on parts of farming operations, and / or the costs associated with repeated temporary easements, Ducks Unlimited has been experimenting with a revolving land purchase program (RLP) as a mechanism for restoring and retaining wetlands. In the RLP program land is purchased, wetlands are restored, a permanent easement is placed on the wetlands, and the land is resold using an online auction (DUC 2013). This new method of obtaining a CE may be evidence of reorganization to limit TCs, a process explained in the transactions costs economics discussion in Chapter 2. This program is hoped to

improve upon current methods used to achieve permanent conservation easements, and challenges with recurring temporary easements. Chapter 4 provides a financial analysis of the RLP program compared to temporary easements. A preliminary analysis reveals that the RLP is more cost effective than renewable easements when a low discount rate is used. However, under other conditions there appears to be a premium being offered for the security of the permanent easement, and the ability to avoid future TCs from re-negotiating the easement.

2.4.4 Case 4: Australian Case Studies

Australia has more experience than Canada with conservation offsets and using MBIs to provide ES. Recently, a series of studies (Blackmore et al 2013, Blackmore and Doole 2013, Doole et al 2013) were completed evaluating these programs, and as a result there is an opportunity to learn from existing Australian programs. The two different types of Australian programs, conservation tenders and biodiversity[10] offsets, represent different conservation methods. Conservation tenders allow landowners to receive payment for preserving or restoring an ecosystem, while biodiversity offsets allow for the creation of new ecosystems in exchange for impacting existing ones through a market mechanism (Blackmore et al 2013). All of the case studies reviewed in section 2.4 (except for ACA's Landowner Habitat Program, discussed below) fall into the category of creating additional habitat (or carbon), potentially through restoring a degraded ES, rather than programs that focus on retention or protection. As such they are more in line with offset schemes that will require creation of habitat or offsetting ES features.

In the Australian review of programs, surveys were administered to landowners and non-landowners who were associated with either conservation tenders or biodiversity offsets (Blackmore and Doole 2013, Doole et al 2013). Particular importance was placed on evaluating the cost effectiveness of these programs, which can aid in minimizing TCs (Blackmore et al 2013). The results of the Blackmore et al (2013) study focus on conservation tenders, however the factors perceived to be the most important may be

[10] Note that here "biodiversity offset" is used rather than "conservation offset" because the Australian programs refer to their offsets as "biodiversity offsets" (Blackmore et al 2013, Blackmore and Doole 2013, Doole et al 2013).

applicable to designing cost effective (low TCs) biodiversity offsets. For the non-landholder participants, the most important factors for successful offset programs determined by Blackmore et al (2013) were:

- Taking advantage of the efficiency of large programs, which may benefit from experience with past programs, or "learning by doing"
- Allowing flexibility in the design, implementation, and location of tenders
- Have the landowner self-monitor to keep costs low, and through this develop a relationship of trust between the landowner and the regulating agency

Blackmore et al (2013) determined that for landowners, the following conclusions could be drawn with respect to conservation tenders,

- Allow governments to buy tenders to spur more conservation activities and reveal cost data
- Give landowners easy access to the agency information, including direct staff contacts
- Reduce the amount of administrative work for landowners
- Establish joint monitoring by landowner and agency
- Establish appropriate contract length is important to achieve environmental goals (~10 years) and landowners must be able to break the contract (with conditions in the agreement)

Next, for biodiversity offsets; Blackmore et al (2013) claim the following was important:

- Establish an efficient trading process, with as little government involvement as possible
- Reduce time lag between injury and restoration
- Have contracts last for the length of the impact that is being offset
- Ensure that the offsets are additional
- Give landowners education on these programs

As can be seen in the lessons learned above, there is a common theme of reducing administrative inefficiencies, designing a trading system that works without much

intervention, using well-designed contracts, and offering education programs to landowners. The desire for administrative clarity may be particularly important in Canadian cases because offsets can involve multiple ministries at a provincial level, and sometimes additional federal jurisdiction can be involved. Thus there is need for a streamlined system that lowers costs. The second lesson of relevance to Canada is landowner education. This could take the form of online extension tools that introduce landowners to the terminology, implementation, and potential effectiveness of conservation offsets. Such web-based programs could be bolstered by in-person workshops or other extension activities.

There are multiple offset-like programs in Australia. To reduce complexity we apply the evaluation framework described above to BushBroker – which is a representative Australian program (see Appendix A). As seen in Figure 3, BushBroker does better in terms of economic efficiency and formal program evaluation than the Canadian programs largely because of the use of auctions and trading platforms to improve cost effectiveness.

The following four case studies are examples of small scale offset programs. Because these programs are technically not offsets at a program or resource scale (e.g. carbon), and may not employ market based instruments, they are not evaluated using the framework developed above.

2.4.5 Case 5: Alberta Conservation Association Conservation Offset Programs

The ACA have implemented various voluntary conservation programs. In a published framework for conservation offsets, they suggest guidelines for successful offset programs in Alberta. These can be used to add to the discussion of what lessons can be learned from past programs, as the report is based on their experiences (Croft et al 2011). The major points stressed in the development of an offset framework are ensuring additionality, making the offset permanent if it is on private land, and using an ecological scale to deal with equivalency (Croft et al 2011). In the case of like-for-like offsets, a 1:1 offset ratio is advocated (Croft et al 2011). Aside from the 1:1 offset ratio used, the ACA

programs do not deviate from the literature or what has been described above in terms of the biological criteria.

The ACA also operates landowner conservation program where landowners can be compensated for preserving ecosystems. This is known as the Landowner Habitat Program (LHP). In the LHP a price and contract length is negotiated. In an evaluation of the program the number of acres enrolled in the LHP is declining over time (from 2008 to 2013), thought to be because of the low per acre rate paid (ACA 2013). Because of declining number of acres enrolled, the effectiveness of this tool for long term conservation goals may be low. Increasing the flat rate paid per acre of enrolled land or implementing joint monitoring may increase participation and therefore the effectiveness of providing long term conservation.

2.4.6 Case 6: Assiniboine Wetland Reverse Auction

The Assiniboine wetland auction demonstrates the use of a market based instrument in the provision of wetlands. This region of Saskatchewan has had a marked increase in improved farmland since 1956 and consequently high rates of wetland drainage (Hill et al 2011). In 2008-2009, a pilot project testing a reverse auction[11] mechanism was conducted in the Assiniboine river watershed. Landowners submitted bids for restoring wetlands, and the parcels of land were then evaluated using an environmental benefits index (EBI)[12] (Hill et al 2011). By ordering the bids by lowest cost per unit of EBI, it was possible to spend the fixed budget to maximize the benefit per dollar. Note that the reverse auction is based on an EBI and not just an area basis of wetland habitat.

An important objective of this pilot was demonstrating that a reverse auction can work in Canada (Hill et al 2011). From a TCs perspective, the authors estimate that they

[11] A reverse auction is a method used to pay for ecosystem services (ES). It works by having landowners submit an amount they would like to be paid to provide an ES. These bids are usually then ranked in terms of lowest cost per unit of ES. The projects are then selected according to the program budget. In the Assiniboine auction, bids were received to provide wetland restoration, rather than an ES.

[12] An EBI is different from ratios and quality adjusted area measures in that an EBI uses multiple environmental elements to value the land, including soil capability, wildlife habitat/migration, hydrologic function, etc. These benefits can be combined to make a single index for the area to be offset.

spent $39 000 on "administration" ("staff time, plotting maps, supervising ditch plug construction, and advertising" Hill et al (2011) p. 256) costs (Hill et al 2011), which includes items that can be attributed to TCs as defined by McCann et al (2005). This represents a value of approximately 16% of the $240 000 allocated to the program for purchasing wetlands (Hill et al 2011). Another feature of this auction that could be applied to future programs is using a fair market value to select bids. Initially, if a bid was more than what it would cost to buy the land at market value; the bid was rejected (Hill et al 2011). The rejection criterion was later extended to include any bid that was more than 50% of the market value of the land (Hill et al 2011). Using this method will help provide restored wetlands in an efficient manner, because when the bids approach market values, a program like DUs RLP program may be more efficient. Additionally, the pilot gives a clear framework for implementing a reverse auction (advertising, developing an EBI, ground truthing the size and location of wetlands, etc.). While not necessarily the case here, through a well-designed EBI, a reverse auction can yield low cost positive environmental outcomes, and therefore increase the ES provided by the restored habitat.

2.4.7 Case 7: South Nation Conservation Offsets

South Nation Conservation (SNC) is an example of a water quality offset program from Ontario. Under SNC's program, point source phosphorus polluters can offset their emissions by paying landowners to abate non-point source pollution through a variety of approved practices where each type of approved practice is credited for a different amount of phosphorus abated based on the effectiveness of the project (O'Grady 2011). While the SNC program uses offsets, it is not a market based system[13]; instead the SNC program is identified as a cap and tax program (Shortle and Horan 2013). A cap and tax program places a limit on emissions from point source polluters, and emissions in excess of this limit are "taxed", in the SNC case through point source polluters paying non-point source polluters to undertake a management practice that will reduce the phosphorus in the water (O'Grady 2011, Shortle and Horan 2013). From 2000 to 2009, SNC has abated

[13] SNC is not an MBI because the offset price is set by the trading authority and farmers do not directly participate in trading (Shortle and Horan 2013).

11 843 kg/year of phosphorus emissions (O'Grady 2011). An additional component of program evaluation is that over 80% of landowners said participating in the program has increased their land value (O'Grady 2011).

2.4.8 Summary of Case Studies

Three Canadian examples of offset programs and the Australian BushBroker program are evaluated above. Additionally, four other MBIs and small scale offsets are also explored. While there are only a few formal offset programs in Canada, the principle is being considered by other agencies. The National Energy Board (NEB) now encourages the use of "habitat offsets" as a mitigation strategy in the application of new energy projects (NEB 2013). There is little discussion in the guidelines of how these offset will be deployed, and what metrics will be used to establish impact-offset equivalence, and how security or permanence will be achieved, however the inclusion of offsets as a recognized practice demonstrates that new offset schemes are being considered.

Another federal government program in Canada that allows for the use of conservation offsets is Environment Canada's (EC) "conservation allowances" framework (EC 2012). Under the conservation allowance framework, any activity undertaken on federal land (or other land that falls under the jurisdiction of Environment Canada) that may negatively impact the environment can be offset with a conservation allowance (EC 2012). The framework states that the conservation allowances should only be used if the impact cannot be avoided or minimized; following the mitigation hierarchy (EC 2012). The framework does not explicitly discuss the use of a market to generate allowances; instead the document focuses on the biological considerations associated with conservation offsets (EC 2012). As a result, EC's conservation allowance framework is not evaluated as a case study; however it does provide another example of the use of offsets, and therefore reinforces the importance of evaluating existing programs.

Both the National Energy Board and Environment Canada's approach to conservation offsets appear to be at a "project" level rather than at a natural resource or environmental service level. That is, offset projects such as wetland offsets in the U.S. have aimed at sector wide no-net-loss while the NEB and EC approach appear to be relevant to project approvals. Because the NEB and EC offsets are onetime programs, it is not clear what the implications of such project level schemes are in terms of ecological or economic outcomes.

This chapter has provided a background on the state of conservation offset programs in Canada. As discussed, TCs and cost effectiveness are not explicitly addressed in some programs. The following chapter builds on this discussion by providing an estimate of the TCs associated with designing and implementing a new offset program.

Chapter 3: Transactions Costs and Pilot Programs

The following chapter focuses on TCs, providing an analysis building on the background presented in the previous chapter. Two case studies are provided to expand the discussion of TCs on landowner participation rates, as well as other stakeholder groups. The main objective of this chapter is to build on the review of current literature by exploring the effect TCs have on perceptions of offset programs. The main goal is to determine how much it costs to design and implement a conservation offset program. The following chapter also provides other information on offset/conservation auction programs obtained through stakeholder interviews regarding stakeholder's perceptions of these programs.

The chapter contains two case studies of market based instruments being used for conservation programs. The first is a conservation offset pilot and the second is a reverse auction. Each program is explored using interviews with stakeholders. Additionally, estimates of TCs are provided.

3.1 Southeastern Alberta Conservation Offset Pilot

The South East Alberta Conservation Offset Pilot (SEACOP) program is currently under development; the following discussion reflects the program as of fall 2013. This pilot program, which is described in the following case study (and is formally referenced in the South Saskatchewan Regional Plan; SSRP 2013) provided the opportunity to monitor the development of an offset pilot from its initial stages. As such, it provides a unique opportunity to examine the challenges associated with designing a conservation offset program. In addition, the opportunity to examine the program from its beginnings allows for a more detailed analysis of the TCs associated with program design. Therefore, this case study will centre largely on TCs, which are the costs associated with developing and maintaining the program.

In order to conserve net habitat in Southeastern Alberta, an offset program has been proposed. Under this program, oil and gas producers as well as other industrial

entities that disturb native grasslands can offset their impact by creating new grasslands elsewhere in the region. These are the buyers in the system. The sellers are landowners, who voluntarily submit parcels of currently cropped land to be converted to grasslands, along with a bid price. By submitting this bid, they are offering to take that land out of production and re-seed it with native grasses, and not cultivate it again for the duration of the contract (likely 10 years). Through the exchange of money, the industry agent offsets their activity via the landowner's creation of new grassland.

The process of offsetting a disturbance may warrant an offset ratio greater than one; that is, one acre of disturbed grassland must be offset by more than one acre of new grassland. The pilot program has adopted a system of varying offset ratios based on the sensitivity of the disturbed site. Therefore, sites that are more environmentally significant or sensitive (as defined by the metrics developed by government staff and consultants) will require greater offset ratios (for example, instead of 3:1, sensitive areas may require 5:1). These offset ratios are currently determined based on consensus from industry stakeholders and government employees.

While the pilot program is currently voluntary, some stakeholders believe that offset programs like this one will become regulatory as part of Alberta's Regional Plans, in this case the South Saskatchewan Regional Plan (SSRP 2013). Because it may become mandatory for industry to offset impacts, there is incentive for industry stakeholders to begin participating voluntarily to earn credit towards future programs and to learn by doing. A further complicating factor in the region is that there are multiple species at risk, which require special planning and operations procedures (under the *Species at Risk Act [SARA]*). When critical habitat for species listed under SARA is involved, the offset program must be designed in a way that satisfies SARA, a factor that may increase TCs. The potential for high TCs arises from multiple agencies, laws, and policies are involved at different levels of government. Unlike the other programs evaluated so far, SEACOP has consideration for cost effectiveness built in (Figure 3). A complete description of the application of the framework is available in Appendix A.

During the design phase, the government staff and consultants working on SEACOP decided that in order to best achieve the goal of increasing the area of native

grasslands, it would be better to use the funds[14] provided by the Land Use Secretariat (under the *Alberta Land Stewardship Act* [ALSA]) to begin establishing an offset bank, potentially using a reverse auction[15], rather than proceeding directly to an offset scheme. The rationale for not proceeding with an offset mechanism is that with only a small budget, only a few landowners would be paid, which may lead to a loss of voluntary conservation actions by landowners whose bids were rejected. This means that the pilot will provide information on the development of concepts of equivalence, program implementation and other ecological elements, but there will be little information on price discovery or cost effectiveness.

From the SEACOP program so far, a few lessons can be demonstrated. The first is the importance of developing consistent and meaningful offset ratios that can be understood by landowners and industry stakeholders. This will make the offset process more transparent and encourage participation, while at the same time ensure that additional, equivalent offsets are created. The second lesson is the importance of legislative support and jurisdictional cooperation. Where multiple agencies and levels of government and NGOs have a claim in the project it is important to have effective communication strategies.

3.1.1 Survey Methodology

To explore the lessons learned from existing and developing offset programs and other applications of MBIs, an in-person questionnaire was developed and completed by multiple stakeholders. The questionnaire includes questions regarding time and effort invested in a program (including expected time and effort), perceptions on the cost effectiveness of offset programs, and open ended questions about the participants' experiences, leading into what lessons can be learned (see Appendix D for interview questions). Each of the stakeholder groups (except for the landowners) was asked a series of five Likert scale questions related to the efficiency and participation rates of

[14] SEACOP is funded from a variety of government departments as part of ALSA, to test offset tools.
[15] A reverse auction would used to build a bank of restored native grassland first, rather than allowing offsets to be generated right away.

conservation offset programs. Several questions included in the questionnaire paralleled questions used in the Australian review of offset programs (Blackmore and Doole 2013, Doole et al 2013) to allow for comparisons across the countries. Stakeholders include members of conservation groups, landowners, government ministries, and industry. Five different versions of the structured interview were created to reflect the different information available from the various stakeholder groups. The survey included several individuals involved in the SEACOP program (either directly or indirectly) as well as individuals involved in other pilots or programs in Alberta and other provinces.

3.1.2 Sampling Procedure and Response Rate

Participants were recruited for the interviews in a variety of ways. Government staff and non-government staff who are working on the SEACOP program were identified based on project meetings. Landowners were invited to participate at a town hall meeting in Medicine Hat. After a presentation on the purpose/goal of the study reported here, a contact information sheet was filled out by those landowners wishing to participate.

All participants were initially contacted by phone or email, and upon receiving consent were sent an information letter, including research ethics informed consent forms, and a copy of the questions before the interview. The questions were sent in advance so respondents had an opportunity to prepare comments and answers. Before each interview began the purpose of the study and confidentiality considerations were discussed and oral consent was obtained. The interviews lasted on average 30 minutes, although some were closer to an hour. Handwritten notes are augmented by a typed version of the participant's responses. A number of interesting and important insights into offset programs in the Canadian context were observed.

Participants were recruited as described above. 32 people were contacted and 16 participated in the interview process for a participation rate of 50%. Of the 16 participants, 13 were individuals who are involved with the SEACOP program and 3 worked on other offset or reverse auction programs. The number of participants from

each stakeholder group who were interviewed can be seen in Table 1 below. The majority of the participants interviewed are members of either the government or environmental group stakeholders.

Table 1: Number of Participants by Stakeholder Group and Conservation Project

Project	Stakeholder Group				
	Government	Industry	Consultant	Conservation Group	Landowner
SEACOP	4	2	2	2	3
Other	1			2	

3.1.3 Results

The results section will present the results of the time required to participate. Second, information on stakeholder views is presented including both quantitative and qualitative analysis. Third, the results for the TCs associated with SEACOP are presented.

As discussed in the TCs section, not only do realized TCs influence the decision to participate in a program, but perceived TCs are important as well (Mettepenningen et al 2009, Buckley and Chapman 1997). In order to explore how those working on SEACOP and other offset programs perceived the time requirements for designing an offset program, participants were asked how they felt about the time and effort required compared to their expectation. As seen in the figure below, no participants felt that designing an offset program took less time and effort than they expected.

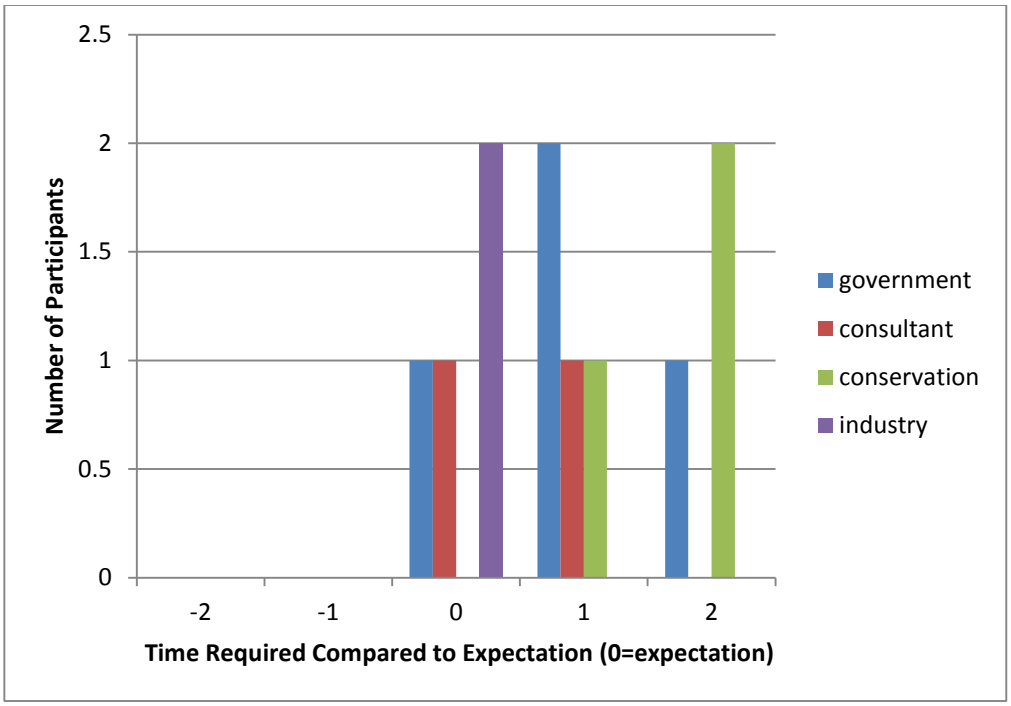

Figure 4: Comparing Time Required to the Expected Time Required to Participate in a Conservation Offset by Stakeholder Group[a]

[a]The time required compared to expectation scale is: -2=much less than I expected, -1=less than I expected, 0=about what I expected, 1=more than I expected, 2=much more than I expected. Landowners are not included in Figure 4 as they were asked a different question about their time requirements. Only those who participated in SEACOP are included in Figure 4.

As can be seen in the Figure 4 above, stakeholders generally felt that the process of developing an offset program took more time than they expected. Conservation stakeholders more than other groups thought the process took more time than they expected. Industry and consultant stakeholders generally thought the process took as much time as they expected. On average, government stakeholders thought the process took more time than expected. Three of the respondents included in the figure above worked on a different offset than SEACOP, and two said it took about what they expected and only one said it was more than expected.

On average, participants agree that conservation offsets encourage industry participation and disagree that time is a deterrent to industry participation; this is a logical result. The results reported in parentheses range from strongly disagree (a value of one) to strongly agree (a value of 5). On average, participants:

- Agree conservation offsets are cost effective (3.92)
- Agree conservations offsets encourage landowner participation (3.8)
- Agree conservation offsets encourage industry participation (4.33)
- Disagree that time is a deterrent to landowner participation (2.44)
- Disagree that time is a deterrent to industry participation (1.91)

To explore the variation in perceptions on conservation offsets, Figure 5 below separates the responses to these statements by stakeholder group.

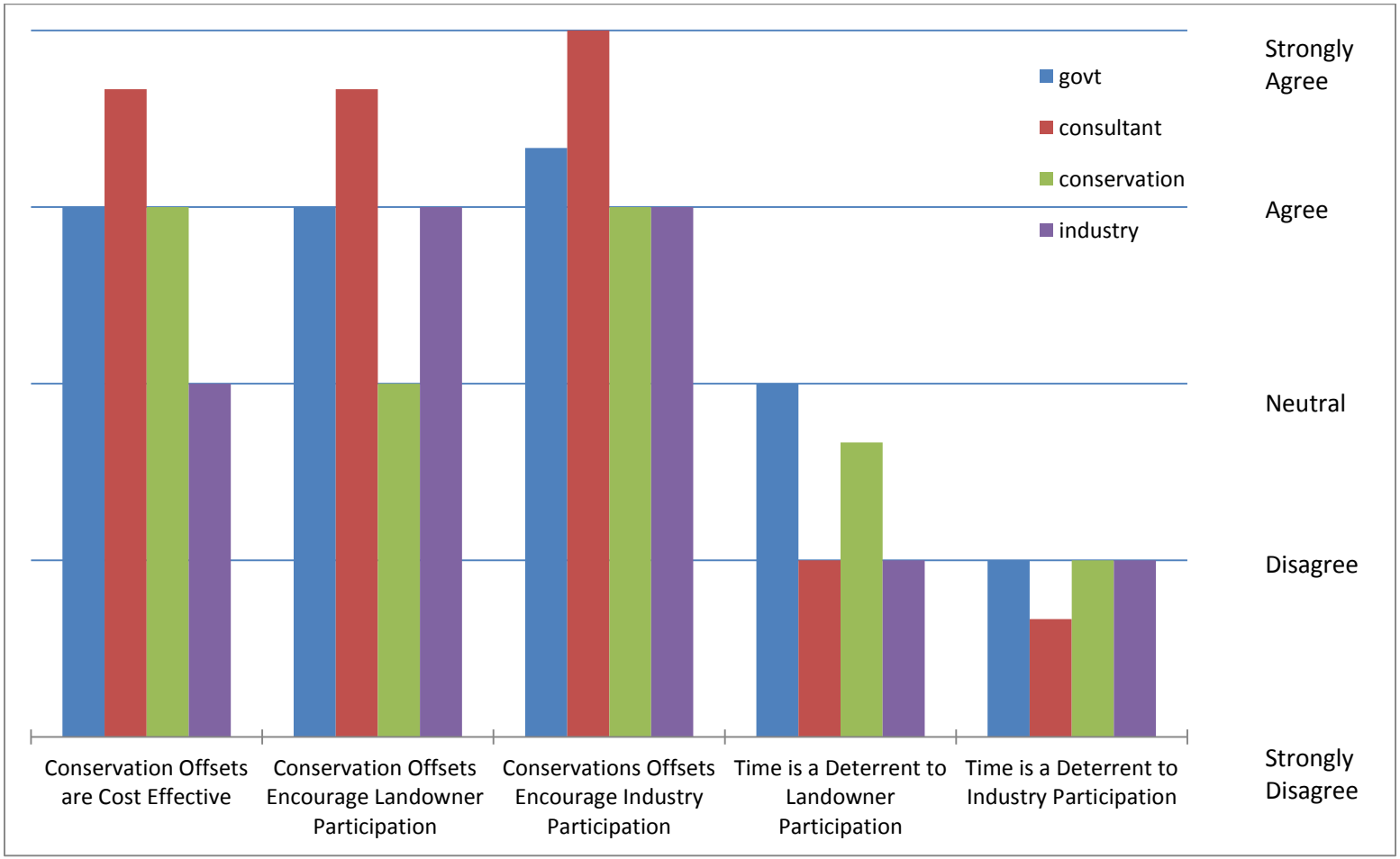

Figure 5: Perceptions on Conservation Offsets Sorted by Stakeholder Group

Figure 5 above shows the results of a set of Likert scale questions on participant's views of the cost effectiveness, and time required to participate in, of conservation offset programs, sorted by stakeholder group and averaged. The x axis shows the statement, and the y axis shows the responses. Industry stakeholders were neutral to the statement that conservation offsets are cost effective. However, the remaining stakeholder groups agreed with the same statement. Conservation groups were neutral about offsets encouraging landowner participation more effectively than voluntary initiatives, but on average the other stakeholders agreed with the statement. All stakeholders agree, with consultants strongly agreeing, that offsets encourage industry participation more effectively than voluntary initiatives. Government stakeholders were neutral to the statement that the time required to participate in an offset program is a deterrent to landowner participation, with the other stakeholder groups disagreeing (see Simpson et al). All stakeholder groups disagree that the time required to participate in an offset program is a deterrent to industry participation.

Spearman's rank correlation coefficient is calculated to explore how participant perception for time required versus time expected is related to their response to the statement "conservation offset programs are a cost effective way of achieving environmental goals". As identified, the perception of time required to participate is important (Mettepenningen et al 2009, Buckley and Chapman 1997); if participant thought participating took more time than they expected, it is of interest to note how this relates to their perception on the cost effectiveness of conservation offset programs. The Spearman correlation coefficient is 0.1134, and we fail to reject the null hypothesis that time expectation versus requirement and the response to conservation offset programs are cost effective is independent (P=0.7399). Therefore, the responses to these two questions are not related; even though many respondents felt the time and effort invested in the program was more than they expected (see Figure 4), this is not influencing their opinion on the cost effectiveness of conservation offset programs.

The five Likert scale questions introduced above are now examined for the correlations of responses between the questions. Correlations will reveal if opinions on statements are related. If perceptions on statements are related, a program change that

affects a participant's response to one statement may also affect that participant's response to other statements; understanding this correlation is important when considering changes to an existing program or building a new one. In Table 2, Spearman ranked pairwise correlations are reported with statistical significance. Pairwise correlations are used as they allow for more data to be used in this small sample size. This approach does not exclude observations with missing values in variables that are not in the pair being considered. Table 2 below contains data from all stakeholders, except landowners who weren't asked these questions, and for both those working on SEACOP and other offset programs.

Table 2: Spearman Pairwise Correlation of Perceptions on Conservation Offsets from Participants

	Conservation Offsets are Cost Effective	Conservation Offsets Encourage Landowner Participation	Conservations Offsets Encourage Industry Participation	Time is a Deterrent to Landowner Participation	Time is a Deterrent to Industry Participation
Conservation Offsets are Cost Effective	1				
Conservation Offsets Encourage Landowner Participation	0.4104	1			
Conservations Offsets Encourage Industry Participation	0.7771***	0.5506*	1		
Time is a Deterrent to Landowner Participation	0.4426	-0.3539	0.5669	1	
Time is a Deterrent to Industry Participation	-0.4282	-0.5276	-0.3317	n/a	1

P<0.01=***, P<0.05=**, P<0.1*

The results of a pairwise correlation reported above are generally what would be expected. Some notable results from the correlations are:

- There is a positive, statistically significant, correlation between participants thinking conservation offsets are cost effective and that conservation offsets encourage industry participation at the 1% level.
- The correlation between the perceptions that conservation offsets encourage landowner and industry participation is also positive and statistically significant at the 10% level.

When interpreting the sign on the "time is a deterrent" variables it is important to remember that a low number, or "disagree", should be opposite to the analogous "encourages participation" response. An example is that conservation offsets encourage landowner participation has a negative correlation with time being a deterrent to landowner participation. If conservation offsets encourage landowner participation, it should logically follow that the time required to participate is not a deterrent to landowner participation.

Landowners were asked questions from the Canadian Census of Agriculture to establish the size of their farming operation. Upon reviewing the responses to qualitative questions, the size of the farm does not appear to influence landowner opinions on conservation offsets. The homogenous response is that conservation offsets are not necessary because landowners have been good managers of the land. There is also a shared concern of the impacts of a conservation offset program on land values in the area. Because crop prices have been high recently, landowners will require a larger financial incentive to seed native grasses instead of crops. As a result, companies looking to offset may choose to purchase land to offset their impacts rather than pay a landowner to create an offset. The landowner's concern here is dependent on the cost of generating offsets. If the costs of obtaining an offset are acceptable to industry, the impact of the offset program on land prices may not become a factor; the concern that offsets may drive the buyers of offsets into the land market will depend on the cost of obtaining the offset from a landowner. This concern of landowners is discussed in more detail later in the chapter.

During the process of conducting the interviews, several key issues emerged for which different stakeholder groups have varying opinions. Generally, stakeholders within a group have homogenous opinions on these issues, while across groups the opinions on key design issues vary. These key issues are:

- Should the offsets be permanent or temporary?
- Should the offset program be regulated (administered under a law)?
- Is an offset program necessary?

The first two points relate to how an offset program should be designed and implemented. The final point, is an offset program necessary, relates to whether or not an offset program is the appropriate tool to achieve conservation goals. A summary of the opinions of the stakeholders on these issues can be seen in Table 3 below.

Table 3: Summary of Stakeholder Views on the Structure of Conservation Offsets

	Stakeholder				
	Landowners	Conservation	Government	Consultant	Industry
Does the stakeholder group favour regulated offsets	No	Yes	Yes	Yes	No, but believe it is coming
Permanence	Prefer temporary, ability to adjust to changing market	Prefer permanent offsets	Designed program to be temporary for a temporary disturbance	N/A	Prefer temporary because the disturbance is temporary, but because the site is reclaimed, some question why offset at all.
Does the stakeholder group support conservation offsets?	No	Yes, if it preserves habitat	Yes	Yes	Yes, because of belief it will become mandatory

As shown in Table 3, most stakeholder groups do support an offset program. However landowners do not view the program as necessary and further state that high cropland prices will make the offsets too costly for industry. Industry stakeholders have expressed the opinion that because the disturbance of their well site is temporary and must be reclaimed after, the use of offsets is unnecessary. However, the opinion that offsets will become mandatory in the future has induced industry participation.

Government and their consultants and environmental groups all prefer the offset program to be regulated, rather than having a voluntary program. Not surprisingly, industry and landowner stakeholders do not want a regulated offset program. However, industry representatives believe a regulated system will come in the future. An interesting observation is that the buyers and sellers, industry and landowners respectively, share common opinions on the implementation of conservation offsets with industry stakeholders participating with the belief it will become mandatory. With both groups of agents required for a successful offset program somewhat disinterested in participating, there is a need for work to be done to ensure a functioning offset market (i.e. not a "thin market").

In order to determine how much it cost to establish a conservation offset program, stakeholders in the SEACOP program were interviewed and asked about how much time their coworkers and themselves have invested in the program. These data are aggregated, and a sensitivity analysis is completed on the average salary to explore the TCs associated with the program.

Table 4: Sensitivity Analysis of the Estimated Costs of Labour for the Southeastern Alberta Conservation Offset Pilot (SEACOP) Program to Fall 2013 based on Interview Results[a]

		Assumed Salary (per year)		
		$87,095	$102,465	$117,835
Days	781.9	$261,927	$308,150	$354,372
	919.9	$308,150	$362,529	$416,908
	1057.9	$354,372	$416,908	$479,445

[a]"Days" is the total number of working days spent on SEACOP to Fall 2013, with a 15% sensitivity analysis on the number of days. "Salary" is the assumed average salary of each employee (ALIS 2013), with a 15% sensitivity analysis.

Table 4 above shows the in-kind costs of labour invested in the SEACOP program. A range of assumed salaries, using $102 465[16] per year as an average, with a 15% sensitivity analysis, as well as the actual time calculated to be invested (~920 days), with a 15% upper and lower estimate on this time. These costs are then added to the program expenditure of $100 000 to be spent on the actual offsets, and the TCs as a percentage of program expenditure can be calculated (see Table 5 below).

Table 5: Sensitivity Analysis of the Transactions Costs (TCs) as a Percentage of Total Program Expenditure to Fall 2013 based on Interview Results[b]

		Assumed Salary (per year)		
		$87,095	$102,465	$117,835
Days	781.9	72%	76%	78%
	919.9	76%	78%	81%
	1057.9	78%	81%	83%

[b]"Days" is the total number of working days spent on SEACOP to Fall 2013, with a 15% sensitivity analysis on the number of days. "Salary" is the assumed average salary of each employee (ALIS 2013) with a 15% sensitivity analysis.

The values in Table 5 above are obtained by dividing the TCs from the first figure by the total program expenditure (TCs+ $100 000). As can be seen, the TCs may range from 72% up to 83% with a sensitivity analysis of time spent and average salary. For the actual time spent (919.9 days) TCs estimates range from 76% to 81%. In all of the cases,

[16] $102 465 per year is the average salary of government managers – economic analysis, policy development and program administration in 2013 dollars (ALIS 2013).

TCs represent a substantial component of total program expenditure. While the costs appear to be quite high, it is important to remember that SEACOP is a pilot program. Many of the background and design phase costs are onetime costs that will not grow if the program had a larger implementation budget. If SEACOP had a larger implementation budget, the TCs as a percentage of total program expenditure would decline, increasing the cost effectiveness of the conservation offset program. Another element increasing the TCs for the SEACOP program is the size of the area expected to be enrolled in the program. From interviews, the program was initially expecting to convert 1000 acres of land to native grassland. This estimate changed to 160 acres to 320 acres during the design phase. In either case, the amount of land to be converted (size of the program) may be increasing the TCs, as a larger land change will likely require more research into measuring the value of these sites and the mechanism used to obtain the land to be converted.

At the time of the interviews, SEACOP was still in the design phase. As a result, the time (and therefore TCs) reported in Table 4 is the time spent on both the background (information gathering, designating target area) and design phases. Future TCs will include the time spent on implementation and once the program is operational, monitoring and enforcement costs. Government employees have spent the most time working on SEACOP, followed by conservation groups, consultants, and industry partners in descending order of time invested in the project at the date of the interviews. The time spent by landowners was lowest, however their time involvement will likely rise once they are asked to submit an expression of interest. The government employees had the greatest amount of time invested in SEACOP likely because they are designing and administering the program.

At the time the interviews were conducted landowners had not yet submitted expressions of interest or bids, therefore the time required to participate in a functioning program is not known. In interviews with landowners, participants were asked to estimate the time they believe would be required to design and submit a bid. Responses ranged from a full day to a week (not full days all week, but a week because of waiting to hear from contacts). The cost of landowner participation may prove important because if

the time required to participate is too high, landowners may chose not to participate (see Simpson et al). In addition to time requirements, landowners were also asked if they would require paid outside help or the use of new software. The landowners said they would likely talk to other people, but not hire a consultant and would not update software explicitly to submit a bid for the offset program. As a result, the cost of landowner participation appears to be solely a function of the time required to participate. A second component of landowner participation is the perceived time requirements (Mettepenningen et al 2009, Buckley and Chapman 1997). The estimates provided by landowners for time requirements reflect the perceived time required to participate. None of the landowners indicated that the time required to participate would be a deterrent to their submitting a bid.

An additional component to consider in the SEACOP TCs is the opportunity for protocols and lessons learned from the pilot to be applied to other programs. If the lessons learned in this pilot can be used in another program to decrease the costs (both "real" and TCs), then the TCs represented above may also be overstated.

3.1.4 Discussion

Government staff involved in such projects have generally found that the process of designing and implementing an offset program takes more time and effort than was expected. Those with experience in designing other conservation or offset programs found that the time required was about what they expected. An element that nearly all government and consultant respondents mentioned was the preference for regulation to back the use of offsets. Participants believe that having a mandatory offset program will increase the ES provided through the program. Most government staff and consultants agree that conservation offsets are cost effective and encourage participation of both landowners and industry more effectively than voluntary initiatives.

Some participants felt that MBIs may not be capable of providing ES. These stakeholders also state a preference for the offset to exist in perpetuity (to ensure long term conservation outcomes); SEACOP is using finite term contracts to reflect the

temporary nature of well site disturbance. Thus there is a tension between the desire to obtain permanent offsets, and the practical issue of participation in offset programs by landowners. The preference for temporary or flexible offsets by landowners implies relatively high costs of permanent offsets. But the desire for permanence may be reflected in relatively high premia in terms of agency willingness to pay for such contracts. A program like the DUC revolving land purchase scheme appears to reflect this tension. Rather than engaging in shorter term easements for wetland conservations, DUC is experimenting with land purchase and re-sale, with permanent easements (this issue is addressed in Chapter 4).

Many stakeholders generally agree that conservation offsets encourage participation from both landowners and industry more effectively than voluntary initiatives. All of the participants (government, consultants, and ENGO) generally agree that the time required to participate in an offset program is not a deterrent to participation for either landowners or industry. Because the time required to participate is not viewed as a deterrent the implication is that (perceived) TCs are low.

Landowners prefer short term contracts to allow them to react to changing land and crop prices. Additionally, landowners in contexts like SEACOP are hesitant to participate because of the potentially relatively high profits on cropland (compared to native grassland) and a general disbelief that energy producers (the "buyers" in this case) will be willing to pay enough to compensate landowners for the lost income. There is also a concern expressed in the landholder community that conservation groups, energy producers, and other outside groups will enter the market and buy land to retire or use as offsets (rather than paying a landowner to convert to grassland from cultivation). It is unclear why landowners are concerned about land being removed from agricultural production (or having reduced intensity of production). Some appear to be concerned about the ability of the sector to provide for growing global food demands. Others may be concerned about potential land price increases that may affect their opportunities for expansion, the ability for their children to enter the agricultural sector, and / or the impact on the local community tax base.

The findings presented in Table 3 are consistent with results of a survey of participating and non-participating landowners in an Australian PES program (Comerford 2014). Agricultural producers were found to be less likely to participate because of the high opportunity cost of removing land from production (Comerford 2014). Another similarity is that rigid, perpetual conservation easements are not preferred by landowners (Comerford 2014).

The surveys also gathered information regarding the TCs associated with SEACOP. Development costs are the main component contributing to the TCs of SEACOP, which, based on our assessment, has an estimated TC of 72% to 83% of the total program expenditure, including staff salaries. TCs appear to be very high for SEACOP; however the pilot has a relatively small budget to use for offset creation. If the program had more money and was much larger in scope, the percentage of TCs would likely decrease substantially because the same amount of research and development would take place (keeping TCs the same), but the overall budget would grow, making the percent of the budget represented by TCs smaller. Section 2.2 contains reported TCs as a percentage of program expenditure from other programs. If the TCs of SEACOP were to be proportional to that found by Wunder (2007), 25%, the program budget for restoration would need to increase from $100 000 to $1 100 000, assuming the TCs remain constant and 920 staff days are used with an average annual salary of $102 465. As a result, the program budget for SEACOP would need to increase an order of magnitude in order to keep TCs proportionally similar to the other programs reviewed.

Once SEACOP is operational, the TCs associated with operation will be the staff salaries of the third party administrator and industry representatives. These will be lower than the start-up costs for the program because fewer people and agencies will be involved in the operation stage, reducing TCs as a percentage of program expenditure as the timeframe increases.

3.1.5 SEACOP Summary

The analysis of the SEACOP program reveals that while conservation offset pilots can be costly, many participants still view them as a cost effective way of achieving environmental goals. A majority of participants felt that participating in the program has taken more time than they expected. However this did not affect their perception of the cost effectiveness of conservation offsets. Interviews with landowners reveal the potential for thin markets to arise because of low participation rates from landowners.

The information gathered on the TCs invested in designing the offset program as of fall 2013 reveal that a program like SEACOP is costly to develop. If a program is to have TCs consistent with those reported in the literature, the program expenditure must be greater than what was available to the SEACOP program.

During the research period, the opportunity arose to implement a similar survey to that used in the SEACOP study on a different population using a market based instrument to improve water quality. The survey was adapted to reflect the new program being explored and administered as described in the following section.

3.2 East Interlake Conservation District Interviews

The following section discusses a reverse auction used in Manitoba. Interviews with landowners were completed in addition to a discussion of TCs and how these compare to those found in the SEACOP program.

3.2.1 Introduction

The East Interlake Conservation District of Manitoba conducted a conservation auction in 2012 and early 2013. The identified ES provided by the watershed are: drinking water quality, surface water quality, wildlife and fish habitat, and soil and shoreline maintenance (Packman et al 2013). A conservation auction was designed to protect these ES. An environmental benefits index (EBI) was developed, and bids were

ranked based on their cost per unit of EBI (Packman et al 2013). The decision of which projects to fund was influenced by the EBI ranking; however local knowledge was also considered (Packman et al 2013).

Bids could be submitted for two different project types. The first being a bid to implement a beneficial management practice (BMP), which is tied to a ten year contract to receive funding (Packman et al 2013). The second bid type is for conservation agreements, which are held in perpetuity (Packman et al 2013).

As identified in a report on the conservation auction (Packman et al 2013), the objectives included learning how to use an auction with an (EBI) to achieve cost-effectiveness. Additionally, through the auction mechanism private costs were revealed and other information about the landscape was shared, which will be useful for developing new management tools in the area. The information gathered regarding private costs of providing an improvement in ES provision can be used in a cost-benefit analysis of changes in ecological function and possibly used as estimates of the costs of providing enhanced ecosystem functions (or ideally) services in other jurisdictions. The information about the landscape can be used to identify sensitive areas and target future conservation work. The landscape information may also reveal areas that have a high risk of conversion, and are therefore the most efficient areas to target for conservation.

A report on the EICD auction finds that TCs are approximately 4% of the total project expenditure (Packman et al 2013). These costs are a much lower percentage than the SEACOP program, potentially because the goals of the auction are in line with existing structure and policy in the EICD (Packman et al 2013). Another note when comparing the SEACOP TCs to the EICD TCs is that SEACOP contains an extra element of complexity in the offset mechanism. Conversely, the EICD program does not have an offset mechanism, a factor which may account for some of the reduced TCs. As a result, a direct comparison of TCs between the two programs may not give a fair representation.

The purpose of the current study is to gather information from landowners who participated in the auction process regarding their time commitment (TCs) and their opinion on the auction in general. Of particular interest is if landowners who participated

in the EICD conservation auction would participate in another auction, especially any landowner whose bid was rejected.

3.2.2 Survey Methodology

The landowner surveys used in the Southeastern Alberta Conservation Offset Pilot (SEACOP) case study were adapted to suit the nature of the EICD conservation auction (see Appendix E for the interview questions used in the EICD study). An important distinction between SEACOP and the EICD auction is that SEACOP is intended to be an offset program using an auction mechanism, while the EICD auction does not have an offset component. In addition to changes in wording to reflect the auction (and not offset) nature of the EICD program, several new questions relating to perceptions on the particular auction, as well as conservation auctions in general, were included. The survey included open-ended questions / comments as well as quantitative responses. Landowners were contacted with the assistance of the EICD. Initially, eight landowners agreed to participate in the survey. The questions were sent in advance of the interview to give participants an opportunity to think about their responses. Of the original eight, three landowners were interviewed. All three landowners had participated in the auction, with two of them placing successful bids.

3.2.3 Results

As a result of a small sample size, the following results should not be interpreted as a definitive categorization of landowner perceptions on conservation auctions. However, the interview results may be used to draw broad lessons learned from the EICD conservation auction. Some comparisons between the responses of the EICD sample and the SEACOP sample also provide insights. The landowners interviewed own small (<800 ac each) amounts of mixed use land. The major land use of their land is pasture and hay, although some cultivated cropland is also present. All of the landowners agreed that conservation auctions are an appropriate use of funds, and that more should be

implemented in the future. Generally, landowners felt the program took about as much time and effort to participate in as they expected.

The results to a series of Likert scale questions are summarized here. The participant's responses are coded 1 through 5 to reflect "strongly disagree" to "strongly agree". The mean for each statement is then rounded to the nearest response (ex. 3.3= "neutral", 3.7= "agree"). On average, participants in the interview said they:

- Are neutral towards the steps in the auction being clear
- Agree the auction was conducted at a convenient time of year
- Agree they had enough time to submit an expression of interest (EOI)
- Agree the EOI was easy to complete
- Have a mode response of "don't know" regarding the use of an EBI to rank bids being fair
- Are split between agree and neutral towards "I understood the EBI"
- Agree they are satisfied with their management plan
- Agree they had enough time to review their management plan
- Agree that the management plan meeting was informative
- Agree they had sufficient time to construct a bid price
- Agree they sought out advice form EICD or another third party
- Are neutral to being certain about their submitted bid price
- Are neutral to the auction results being delivered in a timely fashion
- Agree that a conservation auction is an appropriate way to allocate EICD funds
- Are neutral to having concerns about the auction
- Strongly agree the EICD should hold another auction in the future
- Strongly agree the Government of Manitoba should hold similar auctions in other conservation districts
- Strongly agree they would participate in another auction

3.2.4 Discussion

When participants were asked if they thought the use of an environmental benefits index (EBI) was fair, there was some confusion about how the EBI was applied, and therefore the "fairness" of the measure could not be commented on. A follow-up question on if the participant understood the EBI revealed that, on average, landowners did not understand the index (only one participant agreed with the statement "I understood the EBI"). One participant commented that they were unaware the program had an auction element. Coupled with the response that two of the three participants in the survey heard about the EICD auction by word of mouth, it is possible that more advertising and information on the process may increase the number of bids received.

Participants were positive to the idea of another auction in the area, and said they would likely participate. The willingness of landowners to participate does not appear to be an issue with implementing future auctions in the area. To increase the number of bids, participants said that increased awareness and advertising in the region would be beneficial. Participants said a potential weakness of the program is a lack of funding, and that in order to secure more successful bids the budget for the program should be increased.

Landowners interviewed have heterogeneous preferences on how the EICD should maintain the ES that the landowner provides. Two preferences for caveats (easements) on the land enrolled in the program are stated; the first is to have the land remain in conservation for perpetuity, the second is to have a fixed term contract, with the option to buy out early. The preference of some landowners for fixed term contracts as opposed to perpetual easements is consistent with the results of interviews with Alberta landowners who are involved with a land offset program. A perpetual conservation easement will protect the ES provided by the land indefinitely however the rigid structure may deter landowners from participating. A fixed term conservation easement with an option for the landowner to buy out the contract early will likely attract more bids. However, the ES gained from these projects has little long term protection. The auction design allows for bids for either a 10 year contract for a BMP or perpetual easement.

Allowing bids for both fixed term and perpetual contracts will attract bids from both landowners who prefer shorter contracts and those who prefer a perpetual easement.

On average, the landowners interviewed said the time and effort required to participate in the EICD conservation auction was about what they expected. This was also the case in the responses from landowners participating in the SEACOP program, even though it was still in the development phase when the landowners involved were interviewed. Landowners who participated in the auction were interviewed, including information on their time commitment to the program. If the time required to participate is too high, landowners may choose not to participate in future auctions (Mettepenningen et al 2009). The time required to participate in a conservation auction does not appear to be a major deterrent to landowners participating in an auction.

3.2.5 EICD Summary

The EICD conservation auction allowed landowners to submit bids to provide ES. Similar to the SEACOP case study, landowners in the EICD sample are concerned about the permanent nature of offsets. The landowners interviewed who participated in the EICD auction generally did not view the time required to participate as a deterrent. While landowners were neutral towards the clarity of the auction process, in general they were positive to the idea of future auctions. The support of landowners (all the landowners interviewed strongly agreed that future auctions should be run), the sellers of ES, will be important for the success of future auctions. Increasing the sample of respondents would clearly provide additional insights thus a limitation of this study is the low response rate.

3.3 Chapter Summary

The two case studies explored through interviews show that designing and implementing conservation programs is not costless. TCs estimated for the SEACOP

program represent a large proportion of the total program expenditure. However, stakeholders still view conservation offsets as a cost effective method of obtaining ES. The lessons learned from the pilot program may be applied to future programs, therefore lowering the cost of the future program (a benefit that is missing from the calculation of costs associated with SEACOP). The similarity between the EICD and SEACOP interviews with landowners suggest that landowner perceptions are similar across geographic regions. As a result, future programs may be designed using the lessons learned about engaging landowners and designing programs that encourage landowner participation.

Chapter 4: Ducks Unlimited Revolving Land Purchase Program

The following chapter explores a novel approach to obtaining a conservation easement. This is known as the revolving land purchase (RLP) program. The cost of using the RLP program will be calculated for two sites, and compared to the cost of using either a onetime payment for a permanent easement or a series of renewable easements. To explore the effect of land price volatility on the financial viability of the RLP program, a simulation is used to examine the program for each site with forecasted future land values.

4.1 Introduction

The Canadian prairies have lost an estimated 40-70% of wetlands, and the ecosystem goods and services (ES) they provide, since settlement began, with the majority of these losses coming in the settled areas (Dahl and Watmough 2007). In response to this loss of wetlands a number of initiatives have been developed to retain and restore wetland habitats. In Alberta there is a new wetland policy which outlines how offsets should be generated (AESRD 2013b). The goal of the new wetland policy is "to conserve, restore, protect, and manage Alberta's wetlands to sustain the benefits they provide to the environment, society, and the economy" (AESRD 2013b). Because this goal is not specific, evaluating the effectiveness of the policy may be difficult.

In order to protect existing wetlands, conservation easements are suggested as a tool that governments and environmental groups can use to preserve habitat and the environmental goods and services (ES) that these areas provide. A conservation easement (CE) is an agreement between a government or environmental group and a private landowner, where the landowner is paid to preserve an area. CEs can take different forms; some are finite term, renewable agreements, such as the conservation reserve program in the U.S. (CRP) (Alston et al 2013).

Other agencies, such as Ducks Unlimited, use permanent CEs in addition to renewable easements (DU 2014). A permanent CE is a more secure option of providing

ES than temporary CEs because the provision of ES is not subject to the risk of non-renewal of the CE. Obtaining a permanent CE may be difficult because of an unwillingness of landowners to have a permanent easement on their land. However, Lawley and Towe (2012) show that landowners are being adequately compensated for the decline in land value associated with a CE. Note that a permanent CE will be more expensive in the short term than renewable easements, but it is unclear what the difference in costs will be in the long term. Using either a series of renewable easements or a onetime payment negotiated with a landowner carries unknown TCs; the cost of finding a suitable parcel of land, negotiating with the landowner, and other administrative duties associated with designing and implementing a CE. A series of renewable easements and a onetime payment are two methods that have been commonly used to obtain a CE.

A third method that is being tested by DU is the Revolving Land Purchase program (RLP). The RLP program works by purchasing agricultural land, restoring the wetlands and converting cropland to grasses, placing a permanent easement on the land, and then reselling the land via an auction. The eased land can still be used to make hay or graze with livestock. Because funding is finite, it is important to evaluate the cost effectiveness of payment for ES schemes so that ES are provided cost effectively. The economic question being addressed in this chapter is: is the RLP program a cost effective method of obtaining wetland restoration relative to other methods? Answering this question will help determine if the RLP program should be used to obtain CEs.

Further to this question, it is important to explore in which situations the RLP program is the most cost effective method, and why it is the most efficient. Several explanations for why the RLP program may be the most efficient are presented. The first, which is addressed with a land value simulation, is that because land prices can rise while DU owns the land, there is the potential for a profit to be made; by selling the land for more than the purchase cost. The second potential explanation for why the RLP program may be more cost effective than other methods is the discrepancy between willingness to pay (WTP) and willingness to accept (WTA). The WTA of landowners to provide ES may be greater than a developer's WTP for the ES. The third potential explanation for

the RLP program being cost effective is the situation of a thin market (Kinzig et al 2011) where the sellers have market power. A thin market can be addressed by increasing the number of buyers in the market for CEs; in the case of the RLP program the land can be resold on the open market with many buyers, rather than purchasing a CE on private land from a small number of sellers.

In the case of renewable CEs, TCs associated with renegotiating contracts may be substantial, therefore increasing the total cost of obtaining CEs through renewable easements (Mettepenningen et al 2009). However, in this study the TCs are unknown. Additionally there is a risk of the landowner choosing not to renew the CE, and the benefits provided by the eased area may be lost if the land is converted to another use. However, the landowner may also be pleased with the new land use and renew their easement. Two factors contributing to landowners retaining the newly restored wetlands are: draining a wetland and returning the land to cultivation is not costless (Cortus 2005) and there is a well-documented status quo bias where individuals prefer the status quo over new options (Samuelson and Zeckhauser 1988).

In order to evaluate the RLP program, two case study sites are examined[17]. The costs of obtaining easements (and implicitly ES) for each site are simulated under multiple conditions. The RLP program is simulated with and without cash renting the land during restoration, including a "typical" scenario where the RLP process takes two years and the land is rented for hay during the restoration. Additionally, the costs of using the RLP program are simulated for the restoration program taking one to six years to complete. A final scenario is presented where the cost of financing a loan is very low, and therefore the opportunity cost of keeping funds in assets is eliminated. These scenarios are then compared to a onetime payment for a permanent CE as well as a series of renewable 12 year CEs. In the latter two cases, there will be unknown TCs. An estimate of TCs for Canadian programs is included in a sensitivity analysis to compare with an estimate of the TCs associated with using the RLP program. To explore the role

[17] We would like to thank Barry Bishop of Ducks Unlimited Canada for providing background information on the RLP and data on the two case study areas.

that changing land prices have on the expected NPV of the RLP program, a simulation is done that captures the risk of land prices increasing or decreasing.

4.2 Methods

To evaluate the cost effectiveness of the RLP program, two case study RLP sites were examined. The data for the two sites are provided by Ducks Unlimited Canada for sites where the RLP program has been used. The first site is a 160 ac (64.75 ha) piece of cultivated land in Red Deer County, AB. The second site is a 640 ac (259 ha) piece of rangeland in the County of Forty Mile, AB. Both sites were purchased in May 2007 and sold in February 2013. The Forty Mile site had 5.7 ac of wetlands restored and the entire 640 ac is protected by the conservation easement. The Red Deer site had 7 ac of wetland restored and 127.17 ac of cropland is converted to grassland (the remaining 25.83 ac is existing wetlands of upland habitat assumed to not be in need of conversion or restoration).

The costs of obtaining the permanent offsets in the RLP program includes the direct costs of restoration, as well as the opportunity costs of financing the project, the opportunity cost of the land, and the property taxes associated with holding the land. The opportunity cost of financing arises from the need to have funds tied up in assets during the restoration period. This opportunity cost, as well as other discounted values, is calculated using the Treasury Board recommended 8% (TBC 2007). In additional scenarios, a social discount rate of 3% is used for the opportunity cost of holding land, as well as a 0% scenario to represent a low cost of financing loan. Note that the different discount rates only apply to calculating the opportunity cost of land; other future values, such as rent or taxes, are discounted using 8% for all three discount rate scenarios. The discount rate on these future values is held constant to explore the effect of low, or no cost of financing loans on the net present value (NPV) of using the RLP program. The restoration cost includes all of the elements of wetland restoration (surveying, mapping, and the physical restoration). This restoration cost is based on an average $11 000/ha of wetland restored (Tracy Scott, personal communication). The opportunity cost of the land is the result of a permanent conservation easement, which will lower the value of the

land (Lawley and Towe 2012). Because the land is worth less as a result of the easement, there is an opportunity cost of lost resale value.

The costs of the temporary fixed term easements include the payments required to obtain the easement for each period, discounted (r=0.08) to the year 2007, as well as the initial restoration cost. Because these easements are temporary, there is no long-term effect on land value, and therefore the opportunity cost of land described above does not apply. However, returning the land to cropland from a wetland does have a cost. Cortus (2005) collects estimates of surface drainage costs in Alberta from existing literature and finds a high degree of heterogeneity, ranging from $24/ha to $1200/ha. When the landowner is considering renewing their contract, the cost of draining the wetland will likely affect their decision, and may influence them to renew if the cost of draining the wetland is higher than the expected benefits. A factor influencing the decision to drain[18] a wetland is that the cost is immediate, and the benefit in terms in increased land for cultivation is a future value.

Values are adjusted for inflation using the consumer price index (CPI) to 2007. Other costs incorporated into the analysis include property tax (including school taxes in Forty Mile and Red Deer), cash rental values (a potential profit generating activity while the land is held by DU), and trends in land values. When assessing the tax level for the Red Deer site, the county average dollar per acre was used to estimate the assessed value for each year (AARD 2013a). For the Forty Mile site, the assessed value was tied to the rate of growth of land values of a similar soil type.[19] The actual area of the wetlands for the Red Deer county site is approximated at 7 acres based on a map, which included the wetland area in neighbouring parcels of land (therefore, the actual area of wetlands in the quarter section under study is not known).

[18] Note that *The Water Act* may make draining a wetland illegal.
[19] The land in the Forty Mile site is unirrigated rangeland, and the recorded values in the AARD database suggest that their price is influenced by the inclusion of irrigated cropland; therefore the prices given in the AARD database are too high to reflect the value of the rangeland site.

4.2.1 Calculating Cash Rent for the RLP Program

The median value for cash rented agricultural land was used for each year to explore how the financial situation would change if the land was rented during the restoration process (AARD 2013b). For the Forty Mile site, instead of dollars per acre, the cash rent was based on dollars per animal unit month (AUM) from rented rangeland in the neighbouring Cypress County (because no data were available for the county of Forty Mile). The AUMs were estimated based on historic precipitation in the region and the land was assumed to be in "good" condition (0.5 AUM/ac) (AARD 2013c and AARD 1998). A similar process is used to calculate the rent value of the Red Deer site as grazing land, because the land is converted from cropland to grass during the restoration. Based on information provided by DU, a second renting simulation was completed where the standing hay is sold. The price for standing hay is heterogeneous based on plant composition. The price paid for standing hay is approximated from an advertisement on the Alberta Agriculture and Rural Development (AARD) website with the understanding that the price may change based on location and plant community.

4.2.2 Calculating Nuisance and Opportunity Costs

For the estimation of a one-time payment for a permanent easement, several other costs are considered. The first cost is the opportunity cost of decreased land value from the easement. The decreased land value is calculated using Lawley and Towe (2012), where a 1% increase in eased area decreases land value by 0.25% (Lawley and Towe 2012). Because the entire parcel of land is eased (100% of land), we assume that land values decrease by 25%, recognizing that this may overstate the decrease in land value because the elasticity is being used for a large change (100%).

The second opportunity cost considered is the nuisance cost of maneuvering farm equipment around wetlands. Nuisance costs are assumed to be zero on grassland because there is no cost associated with driving large equipment around wetlands. However, nuisance costs will increase the cost of obtaining a conservation easement on cropland,

and therefore may need to be considered if the easement program does not convert cropland to grassland. The opportunity cost is not included in the renewable case because after a contract is over, the landowner is free to not renew, and therefore not have the negative effect on land value.

4.2.3 Calculating the Cost of Renewable Easements

For the simulation of a series of renewable easements, the bid distribution discovered by Hill et al (2011) is used. Hill et al (2011) used a reverse auction mechanism to obtain wetland easements (12 year terms or permanent) in the Assiniboine region of Saskatchewan. They received bids from landowners to allow a CE on their land. Using water holding capacity, which is dictated by soil type, as a proxy, soil in the Assiniboine region is generally equivalent to soil in both Forty Mile county and Red Deer county (De Jong and Shields 1988)[20]. Although the two sites are modeled using different soil types, the bids from the Hill et al (2011) auction can only be used if the land is of comparable value. First, the bids are separated by land type, either cropland or forage, which will then be applied to either the Red Deer or Forty Mile site respectively. Each distribution of bids is split into three approximately equal groups based on the bid submitted and averaged, to create an average low, medium, and high bid for each land type. These values are given in dollars/ac/year, so each is multiplied by the eased area for the site, and then discounted. The results are then aggregated into 12 year groups of payments (based on contract length) and can now be compared to the RLP program.

Although the Red Deer site is converted from cropland to grassland, the bids for restoring a wetland on cropland are still used. The cropland bids are used because they reflect the value of the land at the time of restoration. To compensate the landowner for converting the cropland to grassland, the difference in land value ($/ac as cropland - $/ac as grassland) is calculated. The value of the land as grassland is taken from the sale price

[20] The provincial average land prices in Saskatchewan are lower than Alberta. However at the time of purchase (2007) they are more similar than today (Assinaboia 2014). Sales data from the Assiniboine region shows that land prices are lower than in Alberta, but are still comparable for pasture land (Lane Realty). However, because these bids are for temporary easements, the opportunity cost of not producing crops (tied to commodity prices) likely has a greater impact on the bid than the land price (because at the end of the contract the land may be returned to cropping, assuming it is legal to drain the wetland).

of the 160 ac observed in the RLP program. The cost of converting the cropland to grassland is included in the first contract, and is assumed to be paid in the first year of the contract.

Two additional elements may affect the cost of using renewable easements. The first are the TCs of repeated contract negotiations. The second is that if land prices increase, future contracts with landowners will likely be more costly. Higher land prices will increase the opportunity cost of restricting land use with a CE, therefore increasing the amount of compensation a landowner requires to allow a CE on private land. However, land prices are not always increasing; this is explored in section 4.4. These additional costs are not included in this analysis, however it is recognized that they will likely have an effect on the cost of using renewable easements.

4.2.4 Simulation Methods

The land value simulation is based on historical land prices for the two assumed soil types. The Red Deer county site is assumed to be CLI 1 soil, or high quality cropland, and the Forty Mile county site is assumed to be CLI 6 soil, or lower quality soil used for grazing. The data on land prices come from Alberta Agriculture. The prices are provincial averages for each soil type based on the sale price of land per acre (AESRD 2013a) The historical values, beginning at 1979, are adjusted to real values using the CPI to 2007. As a result, there are now two time series of real land values, one for CLI 1 and another for CLI 6. To determine the most appropriate statistical model to use to assess land value trends, a modified Box-Jenkins selection method is used as described in Enders (1995). A number of lag structures are explored for each set of land values. The AIC and BIC scores are then compared. For CLI 1, the lowest AIC and BIC are found with one lag[21]. For CLI 6, the AIC and BIC both chose an AR (2) model. Each series is tested using an augmented Dickey-Fuller unit root test to check for stationarity (Enders 1995). Initially, neither series is stationary; we fail to reject the null hypothesis of the data being non-stationary, and we conclude that the data are non-stationary. To correct for the non-stationarity, the first difference of each series is used in the ARIMA

[21] See Appendix B for detailed information on model selection.

regression. After taking the first difference, the Dickey-Fuller unit root test is estimated again, and now we reject the null hypothesis and conclude the data are stationary.

Using the ARIMA function in the statistical software R, the next 10 years of land values are forecasted with a probability distribution. Next, the simulate function is used to generate 1000 series of the next six years for each soil type. Because the observed purchase price per acre for either site does not perfectly match historical land prices for any soil type, the soil type at each site is assumed based on the closest historical values. To correct for the difference in absolute land prices, the rate of change in land prices is used. The real purchase price in 2007 is brought forward to 2013 using the percentage increase in land values for each soil type from historical data. The purchase year is now assumed to be 2013, and the simulated values use this price as a baseline. The rate of change between each simulated year and the baseline is calculated. For example, if the simulated value for year 3 is $1200/ac and the baseline is $1000/ac, the rate of growth from year 1 to year 3 is 20% (recall that all values have been adjusted for inflation to 2007). The new land price estimate is created by multiplying the base year by the forecasted growth rate (e.g. a baseline price of $800/ac would increase to $960/ac at year 3). The price that the land is sold for is adjusted to account for the lower land value as a result of the CE based on Lawley and Towe (2012). The result is a price per acre that changes at the same rate as the simulated values (based on historical prices), but uses an observed baseline to correct for the difference between observed and historical prices.

For the Red Deer site, the value of the land as grassland is found using the sale price observed by DU when the site was sold following the RLP program. The values are calculated using the rates of change described above. To capture the increased productivity of the land (because it started as cropland, and is likelier of a higher quality than the Forty Mile site) the starting price is higher than what the land would be worth if it was assumed to be CLI 6.

4.3 Results

The results of calculations of the present value of costs for different methods of obtaining conservation easements on private land are presented here, and compared in the discussion section. The first set of results is for the cost of using the RLP program (Tables 6 through 13) and the second set of results is for renewable finite term easements and onetime payment for a permanent easement (Tables 14 and 15). Tables 7, 9, 11, 13, and 15 contain the costs of using the specific method on a per hectare basis. Because the two sites are different sizes (the Forty Mile site is 259 ha and the Red Deer site is 64.75 ha), the costs need to be expressed on a per unit basis for a fair comparison to be made. Note that these costs could also be expressed on a per hectare of wetland restored basis as well. While a major goal of these CEs is to restore and protect wetlands, the costs include easing the entire parcel of land, which contains other benefits than just the wetland. Therefore the costs per hectare of wetland restored would be misleading in the analysis below because the total costs associated with each method secure more than just wetland restoration and protection.

Table 6: Cost of using the Revolving Land Purchase (RLP) program to secure a conservation easement at the Forty Mile site in 2007 Dollars, r=0.08, with and without cash renting and optional rental for hay[a]

Sold (Year End)	Land Use During Restoration		
	Rented for Grazing	Not Rented	Rented for Hay
2008	$99,640	$117,080	$101,620
2009	$116,897	$141,075	
2010	$134,656	$165,815	
2011	$147,333	$184,808	
2012	$168,781	$212,043	

[a]The costs reported in Table 6 use observed land prices.

Table 7:Cost of using the Revolving Land Purchase (RLP) program to secure a conservation easement at the Forty Mile site in 2007 Dollars, r=0.08, with and without cash renting and optional rental for hay expressed on a per hectare basis[a]

Sold (Year End)	Land Use During Restoration		
	Rented for Grazing	Not Rented	Rented for Hay
2008	$385	$452	$392
2009	$451	$545	
2010	$520	$640	
2011	$569	$714	
2012	$652	$819	

[a]The costs reported in Table 7 use observed land prices. The costs in Table 7 are per hectare of eased land (259 ha).

Table 6, above, reports the cost of using the RLP program at the Forty Mile site, for different lengths of time to complete the restoration, with all values discounted to 2007 dollars. At each site, the benefit of renting the land during restoration can be seen by comparing the "rented for grazing" and "not rented" columns. As the length of time to complete the program increases, the total cost increases. If the land is rented for grazing, the cost decreases compared to if the land is not rented. The "rented for hay" column represents a typical case, where the program is completed in two years and rented for hay during the period that DU holds the land. Renting for hay (the "rented for hay" column in the table) decreases the cost, but renting for grazing decreases the cost more compared to not renting. Table 7 shows the costs reported in Table 6 on a per hectare of eased land basis.

Table 8: Cost of using the Revolving Land Purchase (RLP) program to secure a conservation easement at the Red Deer site in 2007 Dollars, r=0.08, with and without cash renting and optional rental for hay[a]

Sold (Year End)	Land Use During Restoration		
	Rented for Grazing	Not Rented	Rented for Hay
2008	$145,812	$151,604	$148,990
2009	$212,773	$221,104	
2010	$166,822	$177,327	
2011	$229,898	$242,088	
2012	$243,844	$257,578	

[a]The costs reported in Table 8 use observed land prices. Land prices fell between 2008 and 2009 and recovered in 2010, therefore the cost of using the RLP program is higher in 2009 than in 2010.

Table 9: Cost of using the Revolving Land Purchase (RLP) program to secure a conservation easement at the Red Deer site in 2007 Dollars, r=0.08, with and without cash renting and optional rental for hay[b] expressed on a per hectare basis

Sold (Year End)	Land Use During Restoration		
	Rented for Grazing	Not Rented	Rented for Hay
2008	$2,252	$2,341	$2,301
2009	$3,286	$3,415	
2010	$2,576	$2,739	
2011	$3,551	$3,739	
2012	$3,766	$3,978	

[b]The costs reported in Table 9 use observed land prices. Land prices fell between 2008 and 2009 and recovered in 2010, therefore the cost of using the RLP program is higher in 2009 than in 2010. The costs reported in Table 9are per hectare of eased land (64.75 ha).

The results of the RLP program calculations for the Forty Mile and Red Deer site using an 8% discount rate are presented in Tables 6 and 8 respectively. At each site, the benefit of renting the land during restoration can be seen by comparing the "rented for grazing" and "not rented" columns. As seen in Table 8, the amount of time taken to complete the restoration program increases, the cost increases. Additionally the cost of using the RLP program can be reduced if the land is rented during the holding period, as represented by the "rented for grazing" column under cash rent. Overall, it is less expensive to use the RLP method on the Forty Mile site (rangeland) than the Red Deer site (cropland). See Tables 7 and 9 for a cost per hectare of eased land for each site.

Renting the land for hay during the restoration phase reduces costs, however renting for cattle grazing is more effective at reducing costs. As the time to completion increases, the total cost of the program increases. Tables 10 through 13 below show the results of the costs of using the RLP program where a low cost of financing loan is obtained, here assumed to be 0%.

Table 10: Cost of using the Revolving Land Purchase (RLP) program to secure a conservation easement at the Forty Mile site in 2007 Dollars, r=0, with and without cash renting and optional rental for hay[a]

Sold (Year End)	Land Use During Restoration		
	Rented for Grazing	Not Rented	Rented for Hay
2008	$79,861	$97,301	$81,841
2009	$75,723	$99,901	
2010	$71,004	$102,163	
2011	$61,010	$98,485	
2012	$57,558	$100,820	

[a]The costs reported in Table 10 use observed land prices.

Table 11: Cost of using the Revolving Land Purchase (RLP) program to secure a conservation easement at the Forty Mile site in 2007 Dollars, r=0, with and without cash renting and optional rental for hay expressed on a per hectare basis[b]

Sold (Year End)	Land Use During Restoration		
	Rented for Grazing	Not Rented	Rented for Hay
2008	$308	$376	$316
2009	$292	$386	
2010	$274	$394	
2011	$236	$380	
2012	$222	$389	

[b]The costs reported in Table 11 use observed land prices. The costs reported in Table 11 are per hectare of eased land (259 ha).

Table 12: Cost of using the Revolving Land Purchase (RLP) program to secure a conservation easement at the Red Deer site in 2007 Dollars, r=0, with and without cash renting and optional rental for hay[a]

Sold (Year End)	Land Use During Restoration		
	Rented for Grazing	Not Rented	Rented for Hay
2008	$125,645	$131,437	$128,823
2009	$170,792	$179,123	
2010	$101,921	$112,426	
2011	$141,882	$154,072	
2012	$130,440	$144,174	

[a]The costs reported in Table 12 use observed land prices.

Table 13: Cost of using the Revolving Land Purchase (RLP) program to secure a conservation easement at the Red Deer site in 2007 Dollars, r=0, with and without cash renting and optional rental for hay expressed on a per hectare basis[b]

Sold (Year End)	Land Use During Restoration		
	Rented for Grazing	Not Rented	Rented for Hay
2008	$1,940	$2,030	$1,990
2009	$2,638	$2,766	
2010	$1,574	$1,736	
2011	$2,191	$2,379	
2012	$2,015	$2,227	

[b]The costs reported in Table 13 use observed land prices. The costs reported in Table 13 are per hectare of eased land (64.75 ha).

When the opportunity cost of having funds tied into holding the land is removed from the simulation, as seen in Tables 10 through 13, the overall cost of using the RLP program is reduced compared to what is presented in Tables 6 through 9. If the Forty Mile property is sold at the end of 2008, the cost of the program is $79 861, but when the opportunity cost is included the effective cost increases to $99 640. There is a similar level of cost reduction for the Red Deer site when the opportunity cost is removed.

Table 14: Cost of Using Renewable Fixed Term Easements to secure a conservation easement in 2007 Dollars for 96 years[a]

	Forty Mile	Red Deer
Low	$75,616	$140,340
Mid	$77,452	$158,892
High	$89,310	$189,522
Onetime	$91,019	$135,755

[a]The low, mid, and high rows split the bids into three approximately equal groups and take the mean of each group. An 8% discount rate is used to discount future values.

Table 15: Cost of Using Renewable Fixed Term Easements to secure a conservation easement in 2007 Dollars for 96 years expressed on a per hectare basis[b]

	Forty Mile	Red Deer
Low	$292	$2,167
Mid	$299	$2,454
High	$345	$2,927
Onetime	$351	$2,097

[b]The low, mid, and high rows split the bids into three approximately equal groups and take the mean of each group. The costs reported in Table 15 are per hectare of eased land (259 for Forty Mile and 64.75 for Red Deer). An 8% discount rate is used to discount future values.

Tables 14 and 15 above shows the results of using the bids from Hill et al (2011) to simulate 12 year renewable CEs. For each site there is a low, mid, and high bid based on splitting the bids received by Hill et al (2011) into three groups and taking the average of each group. Each number in Table 14 represents the cost of using renewable easements at that particular site with an averaged bid for 96 years (the last agreement is made at year 84 and lasts another 12 years). All values are discounted (using an 8% rate) to the present so the renewable easement design can be compared to the RLP program. The last row in Table 14 shows the cost of using a onetime payment to secure a permanent easement at either site. Table 15 shows the cost of using either a series of renewable easements or a onetime payment for a permeant easement for each site per hectare of land eased.

TCs for a land-diversion program in Canada have been found to be about 25% of the total program expenditure (Wunder 2007). In the onetime payment for a permanent easement, this additional TC is assumed to occur only once. For the series of renewable easements, it is assumed that this 25% of total costs reoccurs at each contract renewal. The TCs associated with using the RLP program range from approximately 3.75% to 12.5%, depending on what the total program cost is. These costs are added to those presented in Tables 6 through 15 above, and presented in Tables 16 and 17 below. By including the approximate TCs of each method of obtaining a conservation easement, a more realistic comparison can be made about the costs of each method.

Table 16: Cost of Using the Revolving Land Purchase (RLP) Program at each site including Transactions Costs (TCs)[a]

Year of Sale	0% Discount Rate		8% Discount Rate	
	Forty Mile	Red Deer	Forty Mile	Red Deer
2008	$87,361	$133,145	$107,140	$153,312
2009	$83,223	$178,292	$124,397	$220,273
2010	$78,504	$109,421	$142,156	$174,322
2011	$68,510	$149,382	$154,833	$237,398
2012	$65,058	$137,940	$176,281	$251,344

[a]The costs in Table 11 assume the land is rented for grazing during the holding period.

Table 17: Cost of Using a Onetime Payment or a Series of Renewable Easements to Obtain a CE, Including an Estimate of Transactions Costs (TCs)[b]

Type of CE	Forty Mile	Red Deer
Onetime	$113,773	$169,693
Low Renewable	$94,520	$175,425
Mid Renewable	$96,815	$198,615
High Renewable	$111,638	$236,902

[b]The costs in the table above assume TCs increase total costs by 25% (Wunder 2007). TCs occur once for the onetime payment, and at each contract renewal for the series of renewable easements (the cost of 1 initial contract and 7 renewals are reported here).

4.4 Simulation

The results of the above analysis of the costs of using various methods to obtain CEs on private land are dependent on land prices. When comparing the RLP program to renewable easements, the change in land prices during the program period will influence which program is more cost effective. The RLP program will be more (less) cost effective than using renewable easements if real land prices increase (decrease) over the period that DU holds the land, assuming a 0% discount rate. However, when interest rates are high, holding the land for longer periods of time makes the RLP program more expensive. In order to explore the potential for land prices to be higher or lower than what was observed over the six year period (see Figures 6 and 7 below for a graphical representation of historic and forecasted land prices), a simulation on land prices was completed.

The simulations reveal what the cost of using the RLP program would be at each site if it started in 2013, under different land value scenarios. The average net present value, as well as the chance of gaining or losing more than a threshold value is reported. The average NPV and distribution of NPVs will show the potential risk of using the RLP program, relative to other approaches.

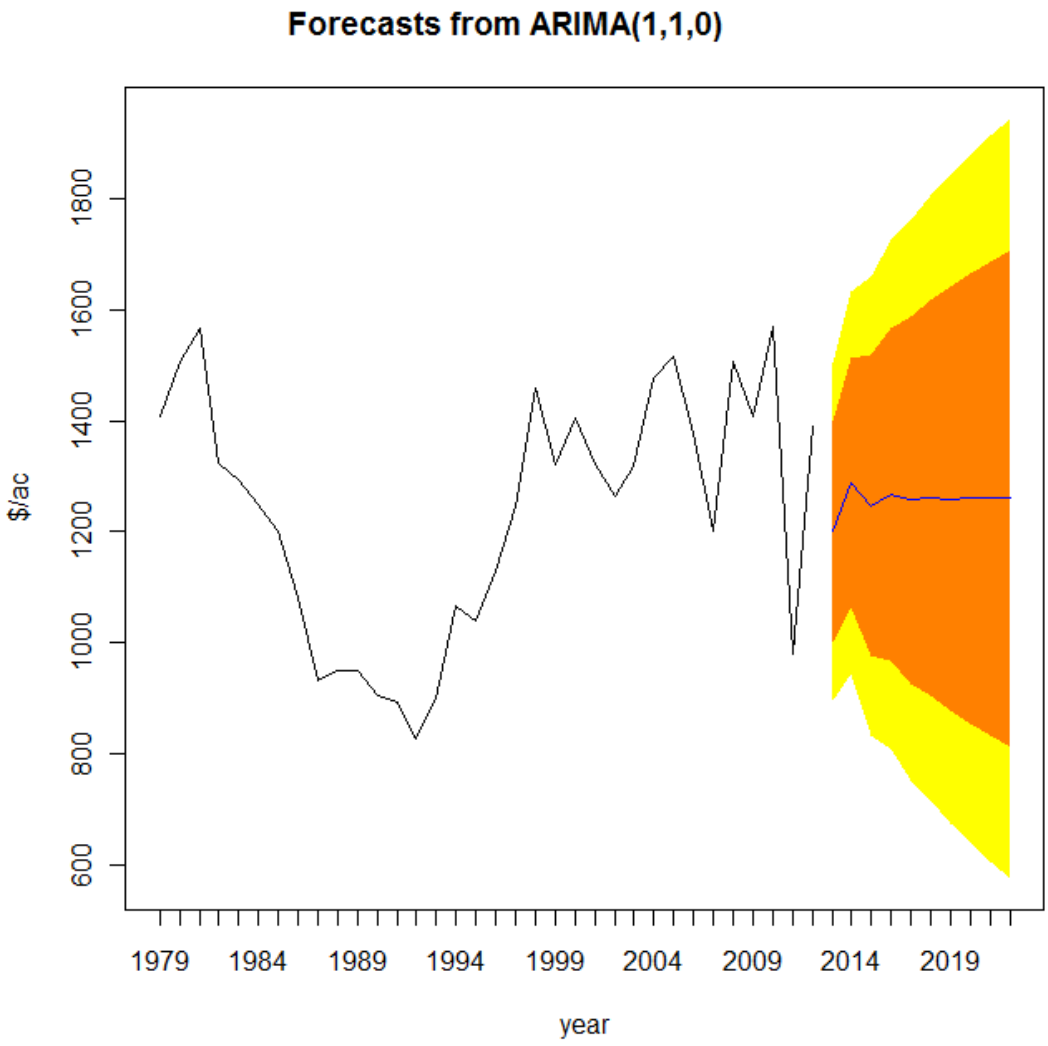

Figure 6: Real observed and forecasted land prices ($/ac) for CLI 1[a]

[a]Orange area represents 80% confidence, yellow area 95%.

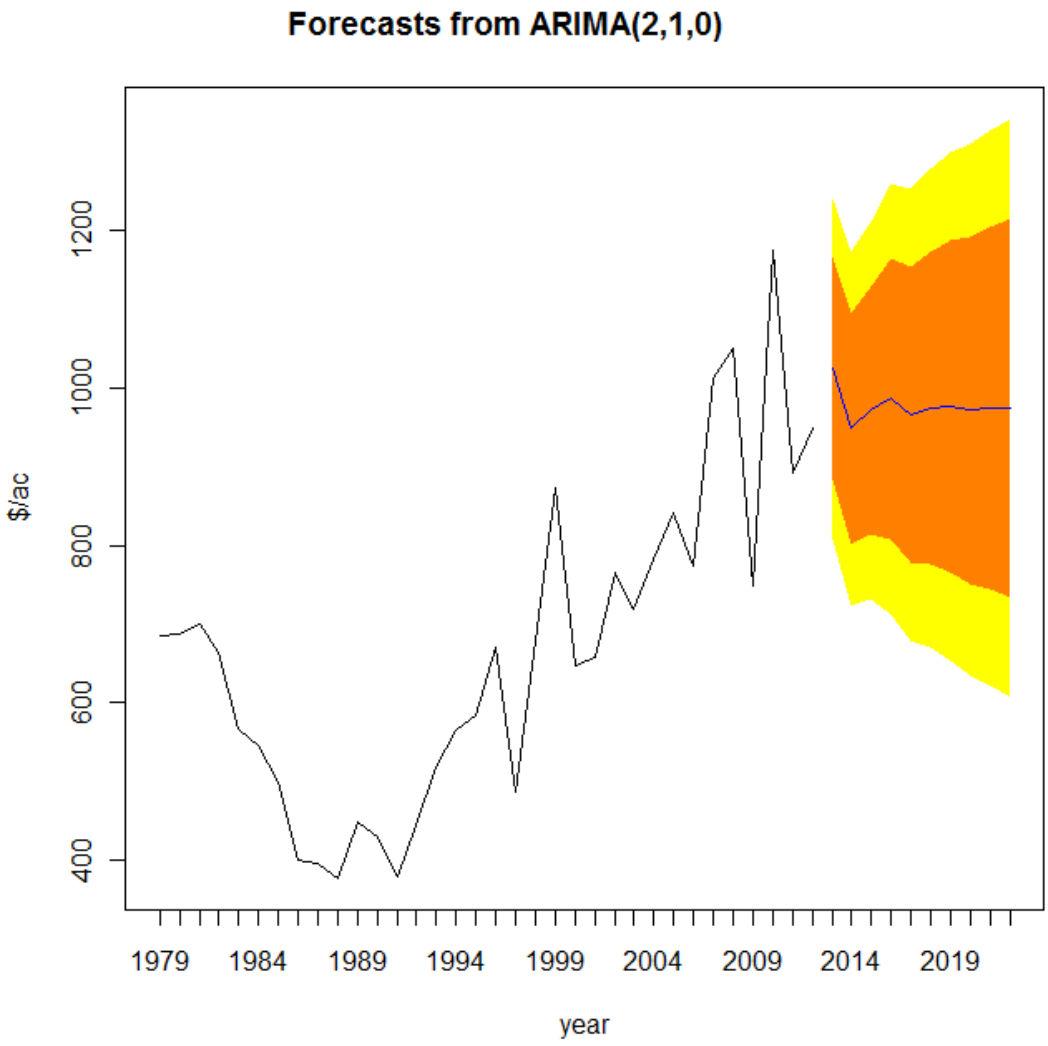

Figure 7: Real observed and forecasted land prices ($/ac) for CLI 6[a]

[a]Orange area represents 80% confidence, yellow area 95%.

Table 18: Simulation results for the expected cost of using the Revolving Land Purchase (RLP) program to secure a conservation easement at the Red Deer (CLI 1) site for wetland restoration[a]

	t=6, r=0	t=6, r=0.03	t=6, r=0.08	t=2, r=0	t=2, r=0.03	t=2, r=0.08
Average Cost of using RLP Program ($)	$138,770 (±58498)	$162,691 (±50352)	$194,383 (±39561)	$148,557 (±47913)	$153,524 (±46510)	$161,189 (±44344)
Probability (%) Cost > $140 340	49.5	81.7	99.6	66.7	72.4	83.0
Probability (%) Cost > $135 755	55.5	86.4	99.6	71.5	78.3	88.4

[a]The last two rows represent the chance of the RLP program costing more than using a onetime payment ($135 755) or a series of renewable easements for 96 years ($140 340). t is the time required to complete the RLP program and r is the discount rate used. Parentheses contain a 95% confidence interval.

Table 18, above, shows the results of the simulation for the Red Deer site, assuming land prices follow the same rate of change as the provincial average for CLI 6 after the land is converted to grassland. The six columns represent six different scenarios, where the land is either sold at the end of the second or sixth year, and whether a discount rate of 0%, 3%, or 8% is used on the future land prices. The three rows show the average net present value of the cost of each scenario, the chance of the program costing more than a onetime payment ($140 340) or a series of renewable payments, here represented by the average low bid ($135 755) in the operation of the RLP program.

The 95% confidence interval reported in parentheses in Tables 18 and 19 shows the wide range of potential values. A worst case scenario is represented by the RLP program costing two standard deviations more than the mean (the upper limit of the 95% confidence interval). In the worst case scenario the cost of using the RLP program will increase by up to $58 498 (Red Deer site, 0% discount rate, 6 year timeframe). In the first column of Table 14 below (Forty Mile site, 0% discount rate, 6 year timeframe), the worst case scenario will make using the RLP program more costly than either the onetime payment for a permanent easement or the series of renewable easements. The uncertainty in future land prices shows the risk taken on by DU when using the RLP program.

During the period that the land at the two sites is held, land prices increased, which may give a false sense of the cost effectiveness of the RLP program. The results show what using the RLP program would cost if the process was started at the beginning of 2013, and the dollar values are reported in $2007, so they can be easily compared to the other calculations. Table 19 below reports on the costs of using the RLP program, with the same scenarios described here, for the Forty Mile site, assuming land prices change at the same rate as CLI 6.

Table 19: Simulation results for the expected cost of using the Revolving Land Purchase (RLP) program at the Forty Mile (CLI 6) site for wetland restoration[a]

	t=6, r=0	t=6, r=0.03	t=6, r=0.08	t=2, r=0	t=2, r=0.03	t=2, r=0.08
Average Cost of using RLP Program ($)	$34,963 (±55174)	$77,926 (±47393)	$108,206 (±37086)	$79,919 (±45526)	$84,665 (±44185)	$91,988 (±42116)
Probability (%) Cost > $75 616	6.5	55.4	95.1	60.5	68.3	78.7
Probability (%) Cost > $91 019	1.6	30.5	82.7	32.3	40.3	54.6

[a]The last two rows represent the chance of the RLP program costing more than using a onetime payment ($91 019) or a series of renewable easements for 96 years ($75 616). t is the time required to complete the RLP program and r is the discount rate used. Parentheses contain a 95% confidence interval.

In both simulations, when a discount rate of 0% is used, the RLP program will be less costly if it takes six years to complete rather than two. However, if a discount rate of 8% is used, the six year timeline is more negative than the two year timeline. The 8% discount rate increases the chance of the cost being greater than the cost with lower discount rates, and increases the chance of using the RLP program costing more than either of the alternative methods available to obtain a conservation easement. As expected, using a social discount rate of 3% increases cost compared to 0%, but not by the same magnitude as and 8% rate. For a graphical representation of the simulation results, see appendix B.

The simulation results presented in Tables 18 and 19 above also show the chance of the RLP program being more costly than either a onetime payment or a series of

renewable easements. In both simulations, if the time to complete the RLP program is six years, the chance of the RLP program costing more than either other method is higher than if it only takes two years to complete. Additionally, as the discount rate used increases, the chance of the RLP program costing more than either other method increases. Therefore, the length of time taken to complete the RLP program, and the discount rate used will influence which method is the least costly (or least risky) at a particular site. Using expected values, when the chance that the RLP program will cost more than another method is greater than 50%, the alternate method will be more cost effective.

4.5 Discussion

The RLP program has been compared to both a onetime payment for a permanent easement and a series of renewable fixed term easements. The results of these comparisons suggest that the potential advantage of the RLP program is subject to the length of time required to complete the RLP program as well as the discount rate used to calculate the opportunity cost of the funds used to purchase the land. The cost effectiveness of each method has been described for both sites. However, a comparison of the cost of using the RLP program at each site also reveals interesting results. Using the RLP program on the Red Deer site is more expensive than the Forty Mile site, even though the Forty Mile site is four times larger; 640 ac (259 ha) vs. 160 ac (64.75 ha), for each discount rate (see results above). Two factors are driving the higher cost of using the RLP on the Red Deer site. The first factor is that the restoration costs $5 610 more on the Red Deer site. The second factor that increases the cost of using the RLP program at the Red Deer site is that the Red Deer site has 127.17 ac that are converted from cropland to grassland, further decreasing the land value. To compare the cost of obtaining a CE on these two sites fairly, the cost per hectare of restored land is provided in Tables 7, 9, 11, 13, and 15. When the sale price is deflated to 2007 dollars, the Red Deer site is sold at a loss of $43 409 while the loss from the Forty Mile site is only $16 603. The sale price here is what was observed in early 2013, however the assumed land values for the Red Deer site generally decline in real value over the six years more than at the Forty Mile

site. Combined, these two factors help explain why the cost of using the RLP program on the Red Deer site is more costly than using the same procedure on the Forty Mile site.

The costs reported here show that restoring wetlands, regardless of the method used, is costly. An important note is that these calculations focus on the costs of restoring and easing wetlands. Under the new Alberta Wetland Policy, developers who disturb an existing wetland have the offset option of paying into a fund the market value of the area of wetland they disturbed (AESRD 2013b). These payments can then be used to restore wetlands elsewhere, which will be considered in the net calculation of the cost of restoring a wetland.

The cost of using 12 year renewable easements reported in Table 5 above is based on securing the easements up to 96 years, where the last contract begins (and is paid) at year 84. When a discount rate of 8% is used, the RLP program is less cost effective on the Forty Mile site than either a onetime payment or a series of renewable payments. If a discount rate of 0% is used, the RLP program is more cost effective than the renewable easements or onetime payment in more circumstances. A cost that could further increase the expense of using the renewable easements is that every 12 years there is a risk that the landowner will not renew the contract, and the environmental goods and services provided by the wetland may be lost[22]. The risk of non-renewal is avoided in the RLP because the CEs are permanent. However, returning the land back to agricultural uses is not costless (Cortus 2005); a factor that may encourage repeated contract renewals. Another element that may contribute to contract renewal is status quo bias; where landowners may choose to renew their CE based on familiarity with the status quo (Samuelson and Zeckhauser 1988). A further complicating factor in assessing the cost of the renewable easements is the unknown TCs of repeated negotiations and contracts (approximate TCs are included in Table 16 and 17).

To summarize, there are three methods of obtaining a CE: a series of renewable easements, a onetime payment for a permanent easement, and the RLP program. The

[22] While the contract may not be renewed, the cost of obtaining a CE this way may be lower than for a permanent easement because the landowner retains the option to not renew.

RLP program can be the most cost effective method of obtaining a CE under the following conditions:

- More cost effective than a onetime payment if r=0% at the Forty Mile site
- More cost effective than a series of renewable easements at the Forty Mile site with a 0% discount rate if the year of sale takes advantage of rising land values and the land is cash rented
- More cost effective than a onetime payment if r=0% at the Red Deer site if the land is cash rented

Because the RLP program is the most cost effective method of obtaining a CE in some scenarios, presented above, but not in others, it is important to evaluate the length of time required to complete the RLP program as well as the discount rate to be used so that to most cost effective method can be chosen. The ability of the RLP program to outperform other methods in certain situations may be because of rising land prices, allowing the land to be sold for more than it was purchased for. The following discussion centres around the simulations presented above to explore the risk associated with land prices changing, and as a result increasing the cost of using the RLP program.

Tables 18 and 19 show that if the discount rate is 0%, the cost of using the RLP program is less for the six year period than the two year period; if there is no opportunity cost of using funds to hold the land and the cash rent is greater than the taxes, the cost will decrease over time. The simulation results show that there is a risk of the RLP program being more costly than the other methods, where the chance of the RLP program costing more than either alternative method increases as the discount rate increases. Therefore as the discount rate rises, the RLP program is less likely to be chosen.

Tables 18 and 19 show that the financial viability of the RLP program is dependent on the combination of the time taken to complete the program and the discount rate. When a discount rate of 0% is used, rising land prices make holding the land for a longer period less costly than trying to sell the land quickly. When a discount rate of 8% is used, land prices do not increase quickly enough to offset the opportunity cost of money, and it is now less costly to sell the land quickly. If the time to completion is held

constant, the different discount rate (0%, 3%, or 8%) scenarios show that the cost of using the RLP program is rising in either the two or six year timeframe. These increasing costs with respect to increasing discount rates reflect the opportunity cost of money becoming greater than the increasing real price of land. With a non-zero discount rate, the cost of holding land increases with the discount rate.

Because both the discount rate and the time when the land is resold influence the cost effectiveness of the RLP program, it is important to address these issues from the perspective of DU. As a conservation agency, DU may be eligible for low cost of financing loans, represented here by the 0% scenarios. The 3% and 8% scenarios are included to explore the effect of discount rates on the cost of using the RLP program if a low interest rate loan is not available. A note on when the land is sold; in the simulations presented here, the date of sale is fixed at either two or six years. In reality, DU may choose to sell the land at any point once the restoration is complete. The land may be held for longer periods of time to attempt to take advantage or rising land prices, however there is a risk that land prices will decrease, and the program will be more costly as a result of waiting.

While the RLP program may not appear to be the most cost effective method of obtaining a CE in a number of scenarios (Tables 18 and 19), there are non-monetary benefits to the program. The restored wetland can be located anywhere that agricultural land is for sale, rather than being dependent on finding a landowner willing to participate. Tables 16 and 17 include information on TCs, and how when TCs are included the RLP program becomes more cost effective than the other programs in more situations. Because the RLP program has lower TCs than the other methods, when the TCs are accounted for, the RLP program becomes more financially viable in comparison to the other methods than when TCs are excluded from the analysis. Additionally, by not using a reverse auction DU will save the learning costs associated with using a new mechanism; section 3.2 reveals that a reverse auction can be difficult to understand.

As shown, the RLP program can be the most cost effective method of obtaining a CE if a 0% discount rate is used. This finding answers the first research question; that the RLP program can be cost effective in certain scenarios. The next question is why the

RLP program can be the most cost effective method; additionally, while the RLP program is less cost effective than the other methods is some scenarios based on the calculations presented here, DU may benefit in a not quantified way by avoiding the following issues. The first potential explanation is the presence of thin markets[23]. Using the renewable easements method has the potential for a thin market to arise, where landowners bid higher than they would in a competitive market (Kinzig et al 2011). If landowners (sellers) submit higher bids as a result of their market power, the conservation agency (buyer) will be forced to accept these bids if they want to fund any projects at all. As a result, fewer projects can be funded because of the thin market that allows for landowners to gain a premium associated with the small number of sellers. The Hill et al (2011) study had 20 landowners submit bids. While ranking the bids based on cost per unit of ES or habitat supplied will allow for the most cost effective bids to be chosen, it is likely than even the lowest cost bids are greater than what would be submitted in a large, competitive market. By reselling the eased land in an open auction, many buyers can bid on the land. With many buyers competing to purchase the same parcel of land, there is an incentive to bid as close as they can to their valuation of the land. The competition created by an open auction minimizes the influence of a thin market.

The second explanation for why the RLP program can, in certain situations, outperform the other methods is the disparity between willingness-to-pay and willingness-to-accept. Landowners face a private cost associated with wetland restoration, but providing a restored wetland will generate a public benefit. In order to bring about this action, positive incentives are necessary (Pannell 2008). In reality, when there is not an established market price, sellers tend to value the good much higher than buyers are willing to pay for the good (Knetsch 1990). The disparity exhibited in valuation may diminish the potential gains from trade, which can further reduce the effectiveness of conservation offsets as compared to extension or no action (Knetsch 1990). Empirical evidence suggests the bids used to generate the cost of using renewable

[23] To get "thick" markets, more landowners need to participate. Comerford (2014) finds that previous experience with these mechanisms, and higher levels of education increase the chance of a landowner participating.

easements on each site may be higher than what would have been received in a competitive market, and therefore reduce the efficiency of using them. If landowner's WTA is higher than what developers are willing to pay, the offsets will cost more than in a competitive market, and potentially exclude developers with a low WTP from the market (if buying an offset is mandatory for developers), or the number of offsets purchased will be fewer than in a competitive market (if buying an offset is voluntary for developers). As a result, when the RLP program is compared to methods that require bids, the RLP program may avoid issues of the WTA of landowners not being equal to the WTP of developers. By avoiding these costs, the RLP program is reorganizing the institution for obtaining a CE, which is described in Chapter 2 as transactions costs economics. The actual cause of the RLP program being more cost effective in certain scenarios than the other two methods may be a result of one or both of the situations described above.

4.6 Summary

When obtaining CEs, multiple methods exist. This paper quantifies the cost of generating ES (restored wetland, protected or restored grassland) in addition to comparing three methods of obtaining a CE. We simulate and compare three methods used: a onetime payment, a series of renewable easements, and the RLP program. Under the conditions presented, the RLP program can be more cost effective than renewable easements and onetime payments:

- If the RLP program can be completed in a short time frame (with a high discount rate) or the land is sold when land prices have increased to reduce costs (with a low discount rate)
- When the land is rented for agricultural production, the RLP program costs less (improving its comparison to a onetime payment or a series of renewable CEs)

The RLP program can be more or less cost effective than the other methods of obtaining a CE. This finding emphasizes the importance of understanding how the discount rate and time to completion interact to achieve a CE at least cost. The

simulation of land prices shows that there is a risk of the RLP program costing more than what was observed at the two sites analyzed here. Potential reasons for the RLP program outperforming (in certain scenarios) the other two methods of obtaining a CE are presented in the discussion; the RLP program avoids thin markets[24] and a WTP/WTA disparity. While the other two methods are more cost effective than the RLP program in a number of scenarios, there may be non-monetary benefits of using the RLP program that are not accounted for here (e.g. locating a wetland restoration project anywhere rather than being constrained by where a landowner is willing to participate, avoiding thin markets). Future work may include a more detailed analysis of the TCs of each method of obtaining a conservation easement.

[24] A caveat on the RLP program avoiding thin markets is that sometimes restoring a wetland in a certain area is required to offset an impact in that particular region. In that case, the market may be thin even for the RLP program.

Chapter 5: Discussion and Conclusion

The introduction provides a background and framework for the TCs and revolving land purchase program Chapters. Both Chapter 3 and 4 have potential policy implications. These potential implications are summarized in the following sections. The limitations and extensions of the research are also presented, followed by a broad set of conclusions.

5.1 Transactions Costs Policy Implications

Through the survey analysis, including the calculation of TCs, several elements emerge with policy implications. Two key policy implications are (1) the proportionally large TCs associated with a pilot program and (2) buyers and sellers of offsets not fully endorsing an offset scheme. Although the SEACOP program has between 72% and 83% of total program expenditure consumed by TCs, the total program expenditure is less than $600 000 (~$480 000 TCs in the most expensive scenario and $100 000 budget for restoration). If the budget for actual offset creation was increased from $100 000 to $1 100 000, the TCs of SEACOP would be in line with Wunder (2007), assuming design costs do not increase with an increased budget. This finding suggests that total budgets for these programs should be larger to take advantage of economies of scale. The policy implication of this finding is that pilots (SEACOP) should not be judged for cost effectiveness when they cannot take advantage of the economies of scale present with larger budgets. However, this study reveals the costs of initiating an offset program, indicating that future programs should be relatively large and designed in a way that takes advantage of economies of scale. If there is a small operating budget, the agency designing the program should expect TCs to be proportionally large. The high TCs of pilots can also be justified as necessary learning costs, which can be applied to future full size programs.

The second policy implication raised by the study of the SEACOP program is that low participation rates based on skeptical landowners[25] may lead to thin markets. Thin markets occur when there are a small number of buyers or sellers, and as a result that group gains market power to alter the price (Kinzig et al 2011). The issue of thin markets also appears in the following Ducks Unlimited case study. In order for an offset market to function economically efficiently, there needs to be heterogeneity in the bids received from landowners, so that projects are chosen that provide the most benefit for the least cost. Therefore a successful offset program will operate in a way that encourages both landowner and industry participation.

5.2 Revolving Land Purchase Policy Implications

Chapter 4 reveals what obtaining a CE using three different methods will cost. The RLP program can be a more cost effective method of obtaining conservation easements than either renewable easements or a onetime payment, under certain circumstances. The effectiveness of the RLP program is contingent on whether there is an opportunity cost of funds tied to an asset. If DU is using their own funds, there is an opportunity cost of keeping those funds tied to the land being held. However, if DU can obtain a low cost of financing loan, this opportunity cost is no longer applicable. If a low discount rate loan is obtained, and real land prices rise, the cost of using the RLP program to obtain an easement can be inexpensive, particularly on the Forty Mile site. A second element affecting the cost effectiveness of the RLP program is how long it takes for the program to be completed. When discount rates are low, the RLP program is less costly over longer periods. The opposite is also true, when discount rates are high, the RLP program is more costly over longer periods.

The simulation of land prices, and how these affect the NPV of using the RLP program, shows that using the RLP program is not without risk. Given that money for conservation is limited, the risk of the RLP program being more costly than previous experiences needs to be accounted for. Conversely, there is a chance that land prices will

[25] Landowners are skeptical that energy companies will be willing to pay them enough to offset the loss in income from using the land for crops.

increase over the holding period of the RLP program, in which case DU may realize a profit as well as generating an easement. The policy implication of the simulations is that the risk of the real price of land declining should be accounted for in the decision making process of which method to use to obtain a conservation easement. Even with uncertainty in future land prices, the RLP program can still be the most cost effective method of obtaining a conservation easement if a 0% discount rate is used and the land is sold at a time which takes advantage of rising land prices. While the other two methods are more cost effective than the RLP program in a number of scenarios, non-monetary benefits of the RLP program (e.g. restored wetland location) may increase the benefit of using the RLP program.

The RLP program may be able to avoid the issue of thin markets (Kinzig et al 2011) by engaging landowners in a market they are familiar with, the land market (and therefore more participants). Comerford (2014) explores factors that influence a landowner's decision to participate in PES program; these may used to develop thicker markets and therefore increase the cost effectiveness of a onetime payment or a series of renewable payments to obtain a CE.

While the RLP program may benefit from thicker markets and lower TCs, DU is also taking on the risk associated with land price volatility. The simulations presented in section 4.4 explore this risk; however using the RLP program transfers the risk of changing land prices from the landowner to DU. Landowners will also have expectations about future land prices, and the risks associated with land markets, which will influence their WTA payments for either a onetime payment for a permanent CE or a series of renewable CEs.

5.3 Limitations and Extensions

Both Chapters 3 and 4 have limitations. The TCs calculated in Chapter 3 are based on the best available information from stakeholders about the time spent working on the offset pilot. However, the amount of time required to design and implement the program may be incomplete. Because the question about time invested in the program so

far was asked in the middle of design, past time spent on the design phase had to be approximated by respondents, and future time required to implement the program is not captured. Additionally, the results on perceptions of conservation offsets could be bolstered by a larger sample size. In both the SEACOP and EICD interviews a larger sample of landowners was expected. However, at the time of interviews the SEACOP program was still in the designing phase and changes to the program (i.e. building a bank instead of creating an ongoing market for offsets) have limited the number of landowners involved. Both the SEACOP and EICD interviews had a small sample size; more participants could provide more robust results.

Chapter 4, the analysis of the RLP program, uses a number of assumptions about the soil type of the land at each site, the agricultural productivity, and the price of output from the land. Site specific data could be used to increase the accuracy of these estimates. The Hill et al (2011) bids are from Saskatchewan; a similar auction in Alberta could generate more accurate bids for CEs in Alberta. Additionally, statements about the cost effectiveness of the RLP program in different locations could be strengthened by exploring the costs of using the RLP program at more sites, including better information on observed land prices and soil type.

Future work in the cost effectiveness of conservation offsets/easements could benefit from more detailed information on the costs associated with designing and implementing the program. To this end, detailed information on time spent working on a program could be requested before the work begins, as suggested by Mettepenningen et al (2009). The work on the cost effectiveness of the RLP program would benefit from the collection of site specific variables as well as increasing the number of sites where this program has been used.

5.4 Conclusions

Chapters 3 and 4 describe the importance of considering the cost effectiveness of conservation programs. Because conservation dollars are limited, it is important to spend them in a way that maximizes the ES secured by them.

The emergence of a conservation offset program (SEACOP) and the RLP program represent new institutions forming to address an externality. The cost of using either of these programs is calculated and discussed in Chapters 3 and 4 respectively, and both programs have positive TCs. These institutions may be a result of reorganization to reduce TCs (Coase 1960, Fox 2007). An understanding of transactions costs economics can explain the reorganization of institutions, including the emergence of new institutions, to address an externality that would not efficiently be addressed through individual transactions (Fox 2007).

The review of offset programs finds that consideration for cost effectiveness and formal program review are lacking in several programs. If these programs are touted as a low cost method of obtaining ES, it is important to evaluate that claim through formal program reviews. Results from Chapter 3 show that while pilots can be expensive, they also allow for learning. The TCs of SEACOP are estimated at $360 000. A numeric value for the cost of designing and implementing a conservation offset pilot will be useful to those planning future offset programs. The cost of designing an offset program can be used to show that these programs may benefit from economies of scale; given the magnitude of start-up costs, a larger budget may take advantage of the lessons learned through the development. The EICD case study reveals the importance of advertising and clear communication with landowners to increase participation rates. The analysis of the RLP program in Chapter 4 finds that the RLP program is the least costly method of obtaining a CE only in low discount rate scenarios. As discussed in 4.5, there may be a non-monetary benefit missing from the RLP analysis that may explain why the RLP program is being used.

Different programs and methods of obtaining ES have varying costs. These costs vary with location, program type, and other factors (time, discount rate). As a result, it is important to understand the costs associated with various conservation programs so that the lowest cost program or method can be used.

Appendix A

Below are the detailed applications of the developed framework to selected case studies.

Case 1: HADD

1. *[Mitigation hierarchy employed]* The HADD program emphasizes a mitigation hierarchy approach, where compensation is the last resort for unavoidable impacts (Harper and Quigley 2005, Quigley and Harper 2006).
2. *[Incorporates risk of program failure]* Harper and Quigley (2005) found that the offset ratio does not change between critical, important, or marginal habitat, suggesting no accounting for risk in terms of high value habitat. The use of financial securities may be used to cover the risk of compensation failure; however these have never been cashed (Harper and Quigley 2005).
3. *[Landscape scale]* There is no evidence of considering offsets above a case by case basis.
4. *[No net loss or explicit target]* NNL is explicitly stated, and is met in approximately 75% of the projects (Harper and Quigley 2005).
5. *[Additionality]* In an audit, the majority of the offsets either created new habitat or increased the productivity of existing habitat, therefore creating additional conservation outcomes.
6. *[Stakeholders aid in design]* It is unclear which stakeholders were included in the design.
7. *[Equity considerations in design]* It is unclear if equity is included in the design.
8. *[Long term focus]* The "offsets" are permanent; providing long term conservation.
9. *[Transparency]* In order to compensate for the loss of fish habitat, several options are available to industry, with a preference given to like-for-like compensation, which if done correctly should be a long term conservation offset (Harper and Quigley 2005). However, several other options are more short term in nature (e.g. Artificial propagation), and may not meet the criteria of long term conservation. The HADD program has been shown to have inconsistent decisions on impacts

and compensation, as well as poor record keeping leading to a lack of transparency (Harper and Quigley 2005).

10. *[Employs best available science / traditional knowledge]* There is no evidence of traditional knowledge being used, but there is evidence of knowledge of fish breeding and habitat requirements being accounted for (Harper and Quigley 2005).
11. *[Economic efficiency / cost effectiveness]* It is unclear if the HADD program is cost effective. However, because it is done on a case by case basis, it is likely there could be efficiency gains if an approach that allowed for the most cost effective offset location / approach was taken. While the offsets are established on a case by case basis, offset ratios are designed to account for the temporal lag between impact and offset (Quigley and Harper 2006).
12. *[Addresses multiple ecosystem services]* There is no evidence that multiple species or services are considered; while the program identifies different habitat types, in only 48% of HADD reports was the fish species affected listed (Harper and Quigley 2005).
13. *[Effective monitoring and enforcement]* Over 90% of HADDs reviewed by Harper and Quigley (2005) required post-construction monitoring.
14. *[Incorporates program evaluation]* It is unclear if the program has a system built in for review, however the Harper and Quigley (2005) (and Quigley and Harper 2006) report is a detailed evaluation process.

Case 2: Alberta's Carbon Offsets

1. *[Mitigation hierarchy employed]* A mitigation hierarchy approach cannot easily be applied to carbon offset program. The nature of the program is such that large emitters have an option of either reducing emissions (internally) or purchasing offsets and as such the emissions levy provides an incentive for them to reduce emissions directly.
2. *[Incorporates risk of program failure]* Offset factors (ratios, risk factors) are calculated for each activity conservatively according to a set of carefully designed

protocols (AESRD 2013a). The risks associated with different offset activities are accounted for in the verifier's guide (AESRD 2013c).

3. *[Landscape scale]* Offsets are created by landowners, and there is no evidence of spatial analysis of offset locations. The carbon dioxide reductions are not affected by offset location; however there may be other impacts to the offset location in terms of local amenities. As a result, the criteria does not directly apply to a carbon offset but may apply to other ES affected by the carbon offset program.
4. *[No net loss or explicit target]* The carbon offset has a well-defined goal of lowering emissions intensity for large emitters.
5. *[Additionality]* Additionality is considered and evaluated through the rigorous protocol system. The protocols identify the mechanisms used to establish additionality and the methods for dealing with other concerns like leakage (AESRD 2013a). There is also an established verification system and third party monitor to evaluate projects (AESRD 2013c).
6. *[Stakeholders aid in design]* Stakeholders, including the general public, were included in the design phase, and there is an ongoing effort to include stakeholder participation in developing new protocols (AESRD 2013a).
7. *[Equity considerations in design]* The program is not designed to have associated equity or distributional goals Equity in terms of access to programs and information is incorporated into the protocol design.
8. *[Long term focus]* Many of the offsetting activities provide long term reductions, for example recycling materials used in upgrading gravel and light surfaced roads, and afforestation (currently being revised) (AESRD 2013a).
9. *[Transparent]* Alberta's carbon offset program is very transparent, with relevant information found on the ESRD website, including offset calculations for different practices.
10. *[Employs best available science / traditional knowledge]* There is no evidence of traditional knowledge being used, however the protocols show a detailed approach to calculating emissions and reductions (AESRD 2013).
11. *[Economic efficiency / cost effectiveness]* There has not been an analysis of the cost effectiveness of the carbon offset program to the best of our knowledge. The

calculations for offset values are given in an extensive library. Efficiency may be improved by standardizing the contract process under a third party (currently the third party acts as a verifier). The potential issue of leakage[26], or other risks, is addressed is a detailed risk management section for verifiers, including practices to minimize the different types of risk (AESRD 2013c).

12. *[Addresses multiple ecosystem services]* There have been concerns that offset programs that focus on carbon may create adverse impacts on other ES. However, in many cases carbon sequestration can be associated with improvements in valued ES. Afforestation, for example, can generate habitat benefits or other services. To the best of our knowledge, however, there are no assessments of the indirect impacts of the carbon offset program on other ES.
13. *[Effective monitoring and enforcement]* The requirements for data collection and reporting are laid out in a straightforward manner, including which party is responsible for certain pieces.
14. *[Incorporates program evaluation]* There is a mechanism for individual project auditing, but the system as a whole does not include a program evaluation.

Case 3: Alberta's wetland offset program

1. *[Mitigation hierarchy employed]* The mitigation hierarchy is included in the policy framework (AESRD 2013b).
2. *[Incorporates risk of program failure]* Offset ratios based on the ecological function provided by a wetland reflect the importance of preserving high value wetlands (AESRD 2013b).
3. *[Landscape scale]* The need for regional planning and relative abundance is explicitly included in the offset program when determining wetland value (AESRD 2013b).
4. *[No net loss or explicit target]* NNL is not explicitly a goal, but the ratios are designed to, at minimum, "conserve, restore, protect, and manage" wetlands in Alberta (AESRD 2013b).

[26] Leakage and stacking are explained in the main body of the report. Leakage in this case would be a farmer selling offsets, then removing bush to increase the cultivated area. Stacking in this case could be a landholder restoring a wetland and receiving both carbon credits and wetland credits.

5. *[Additionality]* Restoring wetlands will be additional as long as there is not a subsequent loss of wetlands (leakage).
6. *[Stakeholders aid in design]* The development of the new policy included various stakeholders, including industry, environmental groups, and aboriginal groups (AESRD 2013b).
7. *[Equity considerations in design]* There is a stated goal of maintaining equitable roles and responsibilities in administering the program (2013b).
8. *[Long term focus]* The policy states a focus on managing wetlands for long term service provision (AESRD 2013b).
9. *[Transparent]* The ratios of areas of wetlands lost and area of restoration required for the offset, mitigation hierarchy, and other information are easily accessible. Additional detail on the ratios in particular will likely emerge as the policy is implemented.
10. *[Employs best available science]* The ratios for assessing equivalent offsets use an approach that includes various elements for determining the value of a wetland from multiple fields (AESRD 2013b).
11. *[Economic efficiency / cost effectiveness]* It is a stated goal that the program will be cost effective (2013b), but not specified as to how efficiency will be achieved. There is no explicit discussion of how to control for leakage, TCs, or discounting for the time lag between impact and offset.
12. *[Addresses multiple ecosystem services]* Multiple ES are included for justification in preserving wetlands, such as providing safe drinking water, healthy ecosystems, and water for industry (AESRD 2013b).
13. *[Effective monitoring and enforcement]* Monitoring, including adaptive management, is included in the program (AESRD 2013b).
14. *[Incorporates program evaluation]* There is mention of program evaluation, with the exact method to still be determined (AESRD 2013b).

Case 4: SEACOP

1. *[Mitigation hierarchy employed]* Because energy producers lease the land, there is an incentive to minimize the areal impact, indicating that the hierarchy is likely

to be followed. SEACOP is a pilot to test an offset mechanism, therefore it will not likely include the mitigation hierarchy, but future programs that employ aspects of the SEACOP pilot will likely include the mitigation hierarchy.

2. *[Incorporates risk of program failure]* The program has incorporated offset ratios in part to reflect risks of failure, as well as habitat quality. Impacts such as the sounds associated with the long term operation of energy infrastructure and structure height (windmills, transmission line, and posts) have been considered, but cannot be offset by an increase in area. Other issues, such as the time lag between impact and offset and the risk of offset failure have been addressed with the potential use of a conservation bank.
3. *[Landscape scale]* Landscape scale is being considered to the extent that the pilot is operating within the larger context of the regional habitat scarcity issues surrounding species at risk. There is also a preference for clustering offsets with contiguous grasslands which indicates alignment with concerns about scale.
4. *[No net loss or explicit target]* This is explicitly part of the offset, including varying offset ratios to reflect the different values of habitat based on location, soil type, etc.
5. *[Additionality]* Any offset created will be from seeding native grass on previously cultivated land, which meets additionality.
6. *[Stakeholders aid in design]* There is participation from government, industry, landowners, and NGOs. Planning meetings have engaged various stakeholders groups over a 1 year period.
7. *[Equity considerations in design]* Through stakeholder meetings, various concerns about the "fairness" of the program have been raised, which can be incorporated into the program design. Landowners have raised concerns that energy companies will simply buy cropland, convert it native grass, and use this as their offset. A potential outcome of the above practice is that land prices will rise, increasing taxes, and making it difficult for agricultural producers to remain profitable. The increase in the price of land is a pecuniary externality, which is a distributional issue and not an economic inefficiency.

8. *[Long term focus]* This is a pilot program, so there are not necessarily long-term perspectives for this pilot. But the lessons learned can be applied to a continuous program in the future. The offsets are designed to be temporary, as the industrial impact is also assumed to be temporary.
9. *[Transparent]* Because the pilot is still being developed it is difficult to assess the transparency of the program.
10. *[Employs best available science]* There is no known use of traditional knowledge; however the offset ratios are based on recommendations from an interdisciplinary group of experts.
11. *[Economic efficiency / cost effectiveness]* To achieve cost effectiveness, easy to use calculators, standardized contracts, and a third party administrator are being used. Using a streamlined approach should reduce TCs, therefore making the program more efficient. The current contract includes provisions to avoid leakage. Conservation groups have raised concerns about crowding out landowners currently providing ES for free.
12. *[Addresses multiple ecosystem services]* The focus of the program is the provision of habitat, which may include increasing numbers of endangered species. It does not appear that there are unintended negative consequences on other ES.
13. *[Effective monitoring and enforcement]* Monitoring will be done using an existing system by the third party.
14. *[Incorporates program evaluation]* Currently there is no formal consideration of a program evaluation, but this may be forthcoming as the pilot is still being developed.

Case 5: Australian Case Studies - BushBroker

1. *[Mitigation hierarchy employed]* The BushBroker program states that a mitigation hierarchy will be followed (BushBroker 2013).
2. *[Incorporates risk of program failure]* BushBroker includes standards for management to help minimize risk. Additionally, "habitat acres" (i.e. a ratio) are

used as a unit to control for heterogeneity between disturbed area and offset area (BushBroker 2013).

3. *[Landscape scale]* There is no evidence of the scale of approach and whether a landscape perspective is adopted, but it is possible that the landscape scale is employed.
4. *[No net loss or explicit target]* No net loss is an explicitly stated goal (BushBroker 2013).
5. *[Additionality]* While the program is intended to provide additionality, a recent survey of non-landholders that have worked on Australian conservation offsets reinforces the need to ensure additionality, suggesting it may not always be met (Blackmore et al 2013).
6. *[Stakeholders aid in design]* It is unknown how and if stakeholders were included in design, but program reviews have included surveys of landowners (Blackmore and Doole 2013, Doole et al 2013).
7. *[Equity considerations in design]* The degree to which equity of stakeholders was included in the design is unknown but there is discussion of consultation with stakeholders as part of the program design and evaluation. .
8. *[Long term focus]* The intention of the program is to provide long term conservation benefits. However, reviews of conservation offsets in general find that non-landowners prefer a longer term contract while landowners favour short contracts for a more flexible management plan (Blackmore and Doole 2013, Doole et al 2013).
9. *[Transparent]* Programs such as BushBroker have easily accessible information online (BushBroker 2013); however it appears that landowners would like to have even more information (Blackmore et al 2013).
10. *[Employs best available science]* The standards for creating and managing offsets incorporate a variety of scientific and technical issues and appear to use best available science.
11. *[Economic efficiency / cost effectiveness]* BushBroker is designed to be cost effective, an attribute which is also identified as valuable by survey participants (Blackmore and Doole 2013, Doole et al 2013). BushBroker also includes

methods to reward landowners already providing ES, which should limit the crowding out effect.

12. *[Addresses multiple ecosystem services]* BushBroker allows for fire management to limit the unintended consequence of increased vegetation (BushBroker 2013). The offset land can also be grazed to provide another use for the land (besides ecological function provision). As such the benefits from Bushbroker are correlated with other important ES which should reduce unintended consequences.
13. *[Effective monitoring and enforcement]* The review of conservation tenders (Blackmore and Doole 2013; Doole 2013) revealed that landowners and non-landowners would like to see a more cost effective approach to monitoring (Blackmore and Doole 2013, Doole et al 2013), suggesting that monitoring has been costly in the current programs. However, the programs clearly include monitoring and enforcement within their frameworks.
14. *[Incorporates program evaluation]* There have been multiple evaluations of the BushBroker program, both internally and more broadly with the review of conservation offsets and conservation tenders in Australia (BushBroker 2013, Blackmore et al 2013). The extent to which the program has been formally evaluated with clear controls or through quasi-experimental methods is unclear.

Appendix B

A modified Box-Jenkins selection method was used to determine the best structure for forecasting land prices as described in Enders (1995). The data were visually inspected, tested for stationarity, and then several models were compared to find the best fit for the data. For the CLI 6 land values, the data was found to be non-stationary; the augmented Dickey-Fuller (ADF), as described in Enders (1995), test for unit root has a p-value=0.8305. When the first difference is taken, the ADF test for unit root has a p-value=0, and we therefore reject the null hypothesis and conclude the data is stationary after taking a first difference. The ADF test for unit root is also done on the CLI 1 data, and initially it is found to be non-stationary; p-value=0.1540. After the first difference is taken, the CLI 1 data is stationary; ADF p-value=0. To determine the appropriate number of lags in the AR model, several models are run, and those with the lowest AIC and BIC are used, see Table 20 below.

Table 20: AIC and BIC values for AR models

	CLI 1		CLI 6	
	AIC	BIC	AIC	BIC
AR (1,1,0)	432.63	437.12	415.96	420.45
AR (2,1,0)	434.37	440.35	411.73	417.71
AR (3,1,0)	n/a	n/a	410.97	418.46

Note that in Table 20, the values for AR (3,1,0) for CLI 1 are not feasible. Additionally, the AIC for CLI 6 is lower than for AR (3,1,0) than AR (2,1,0), however, the BIC is higher and AIC tends to favour over specified models. Therefore, AR (2,1,0) is chosen as both AIC and BIC are lowest for this model. Table 21 below shows the coefficients of the best fitting ARIMA models for CLI 1 and CLI 6, including the results of the Portmanteau white noise test (in both models we fail to reject the null hypothesis and conclude the error term is white noise).

Table 21:ARIMA Coefficients for Final Models as Identified in Table 20, Including White Noise Tests

	CLI 1	CLI 6
Constant	-5.55 (20.55)	9.07 (9.02)
AR (1)	-0.469** (0.187)	-0.728*** (0.137)
AR (2)		-0.434** (0.199)
Q (6)	0.366	0.571
Q (12)	0.7157	0.801

P<0.01=***, P<0.05=**, P<0.1*. The model CLI 1 is AR (1,1,0) and CLI 6 is AR (2,1,0). The Portmanteau Q statistic shows that the error term in each model is white noise.

Appendix C

The following graphs (Figures 8-19) are the distribution of the present value of costs under varying timeframes and discount rates. The dollar values are reported in 2007 dollars. The first six graphs are for the Forty Mile site (CLI 6), and the last six graphs are for the Red Deer site (CLI 6, but starting at a value of $1354/ac).

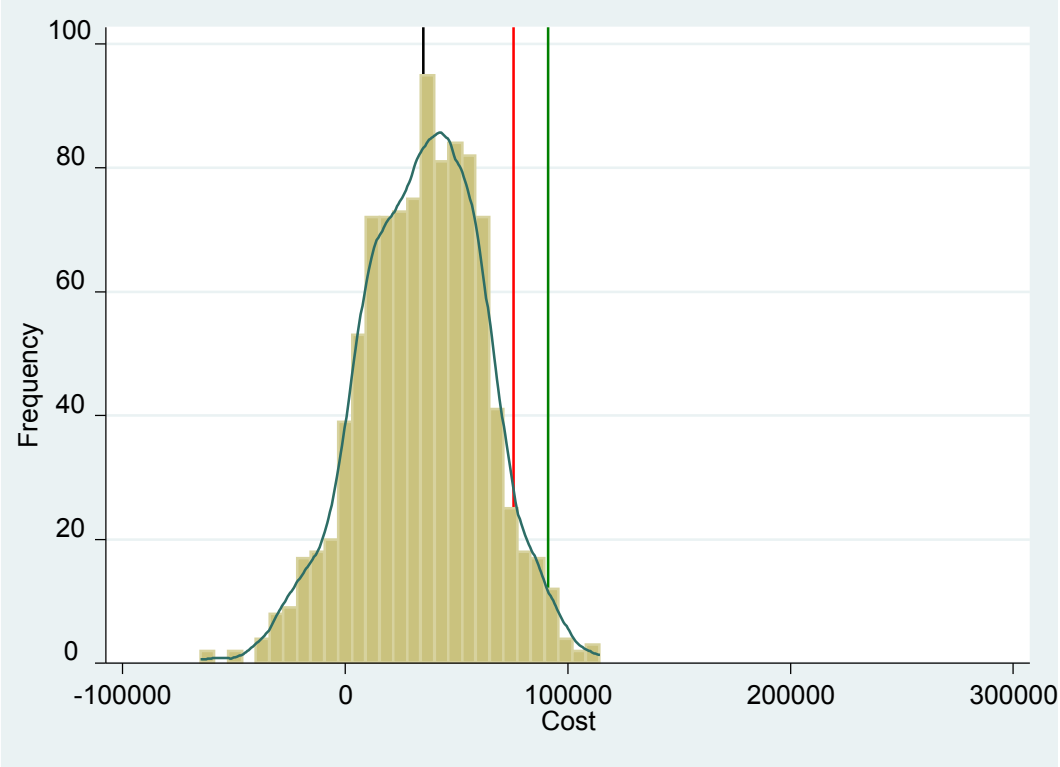

Figure 8: Distribution of costs for the revolving land purchase (RLP) program at the Forty Mile site with a discount rate of 0% and a 6 year completion time[a]

[a]The black line represents the mean, while the red and green lines represent the cost of using a renewable ($75 616) or onetime payment ($91 019) respectively. A negative cost is a positive value.

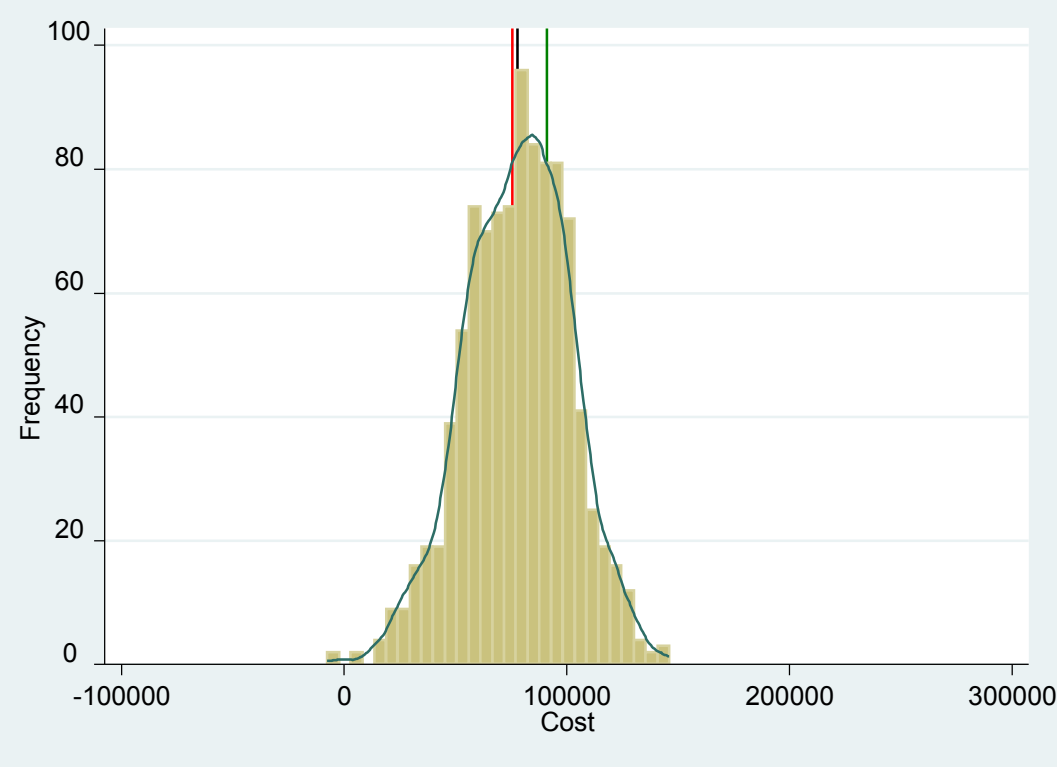

Figure 9: Distribution of costs for the revolving land purchase (RLP) program at the Forty Mile site with a discount rate of 3% and a 6 year completion time[a]

[a]The black line represents the mean, while the red and green lines represent the cost of using a renewable ($75 616) or onetime payment ($91 019) respectively. A negative cost is a positive value.

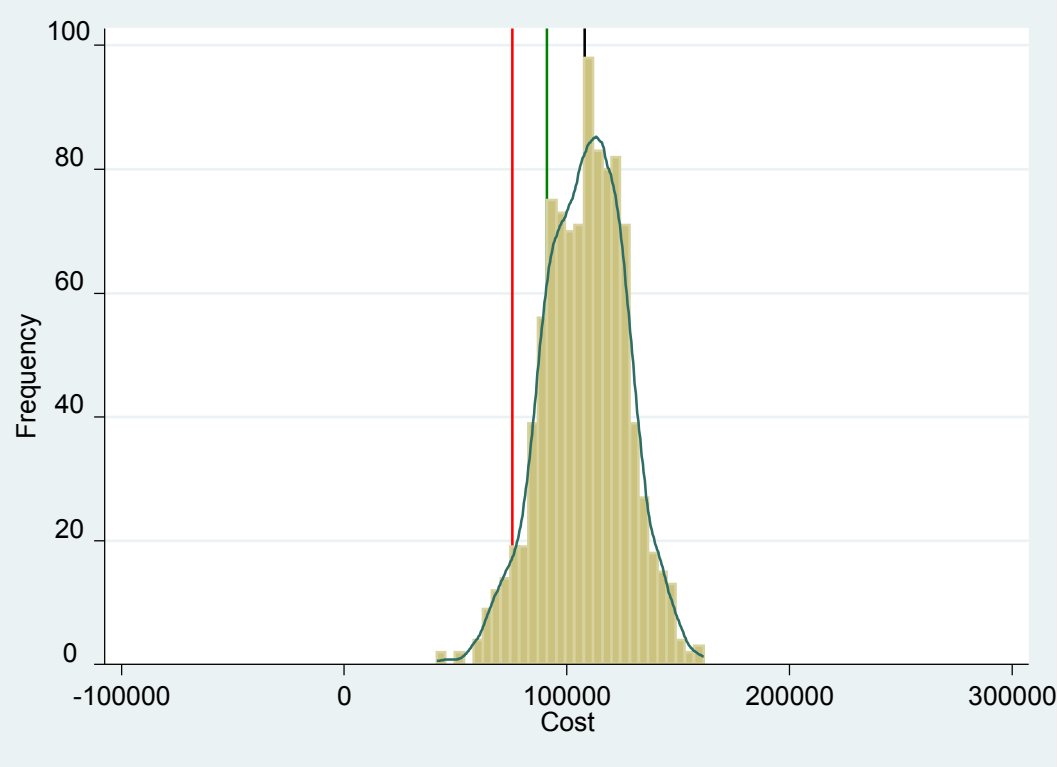

Figure 10: Distribution of costs for the revolving land purchase (RLP) program at the Forty Mile site with a discount rate of 8% and a 6 year completion time[a]

[a]The black line represents the mean, while the red and green lines represent the cost of using a renewable ($75 616) or onetime payment ($91 019) respectively.

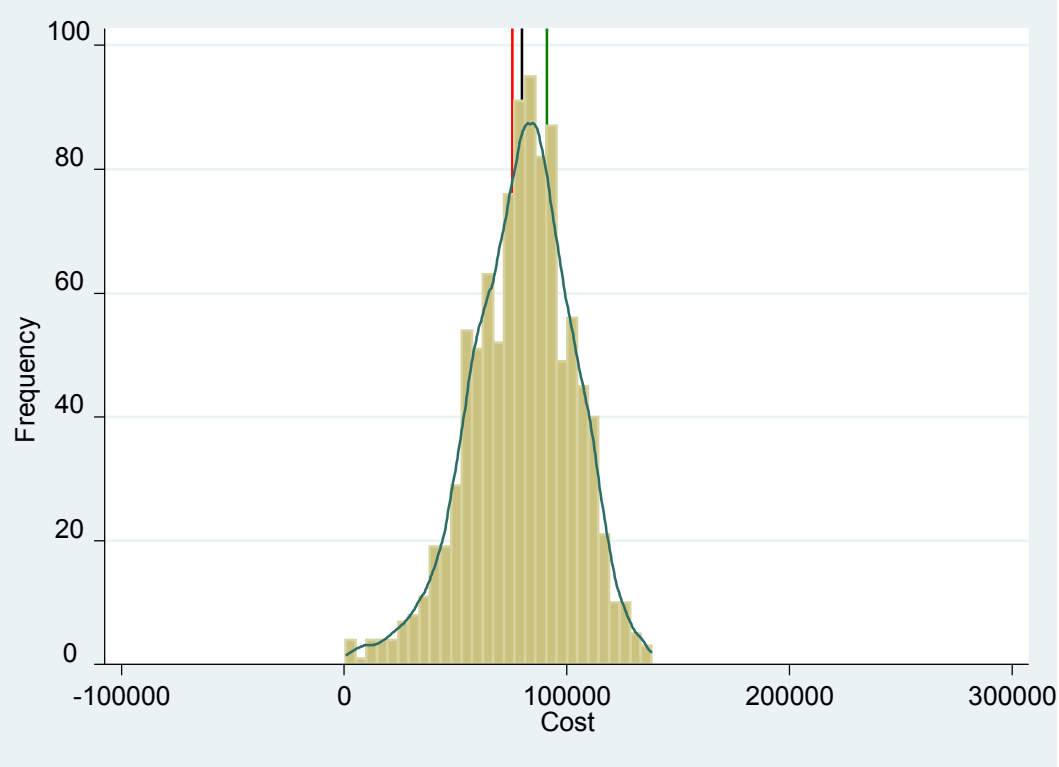

Figure 11: Distribution of costs for the revolving land purchase (RLP) program at the Forty Mile site with a discount rate of 0% and a 2 year completion time[a]

[a]The black line represents the mean, while the red and green lines represent the cost of using a renewable ($75 616) or onetime payment ($91 019) respectively.

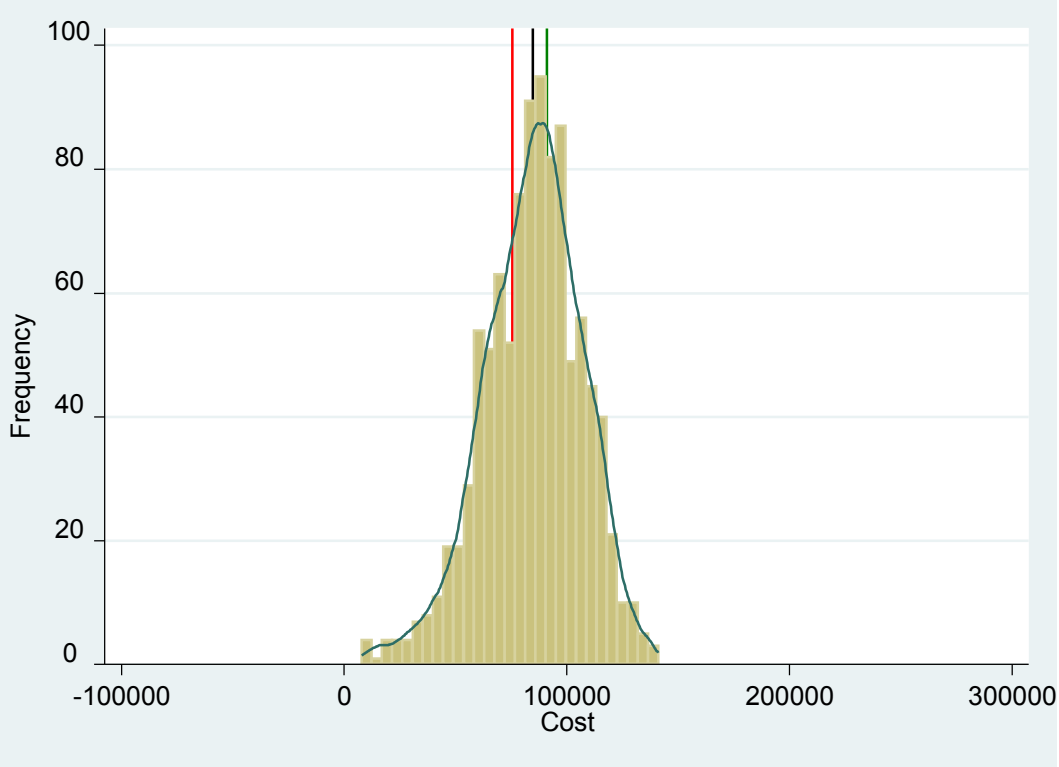

Figure 12: Distribution of costs for the revolving land purchase (RLP) program at the Forty Mile site with a discount rate of 3% and a 2 year completion time[a]

[a]The black line represents the mean, while the red and green lines represent the cost of using a renewable ($75 616) or onetime payment ($91 019) respectively.

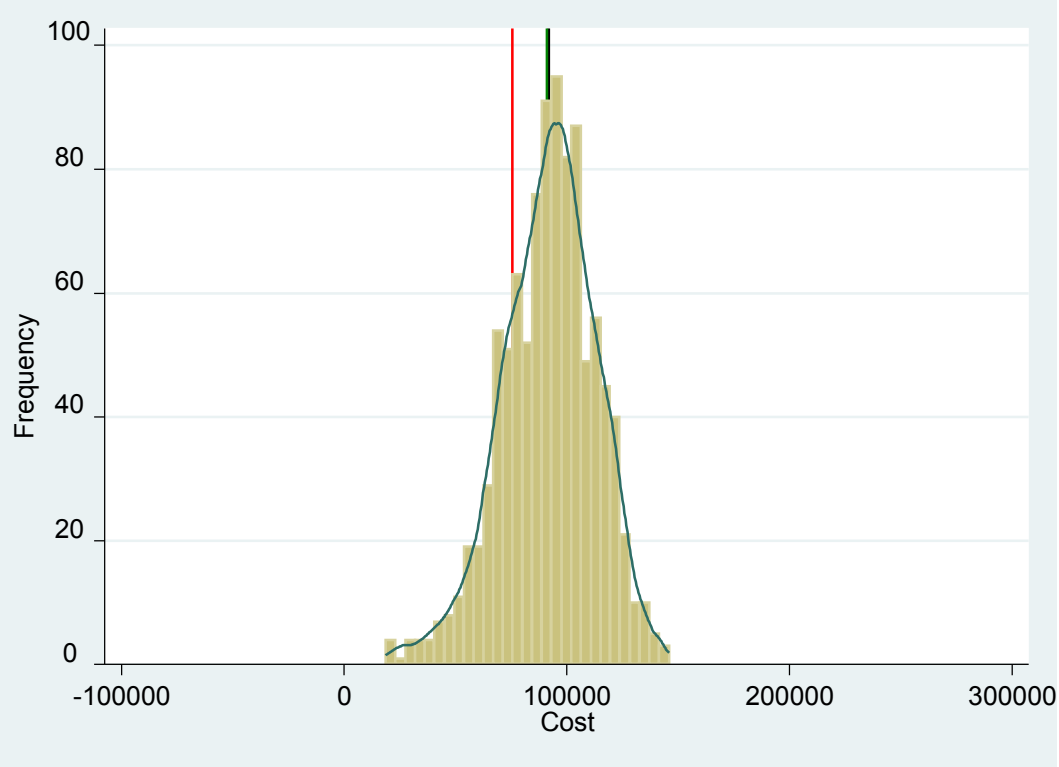

Figure 13: Distribution of costs for the revolving land purchase (RLP) program at the Forty Mile site with a discount rate of 8% and a 2 year completion time[a]

[a]The black line represents the mean, while the red and green lines represent the cost of using a renewable ($75 616) or onetime payment ($91 019) respectively.

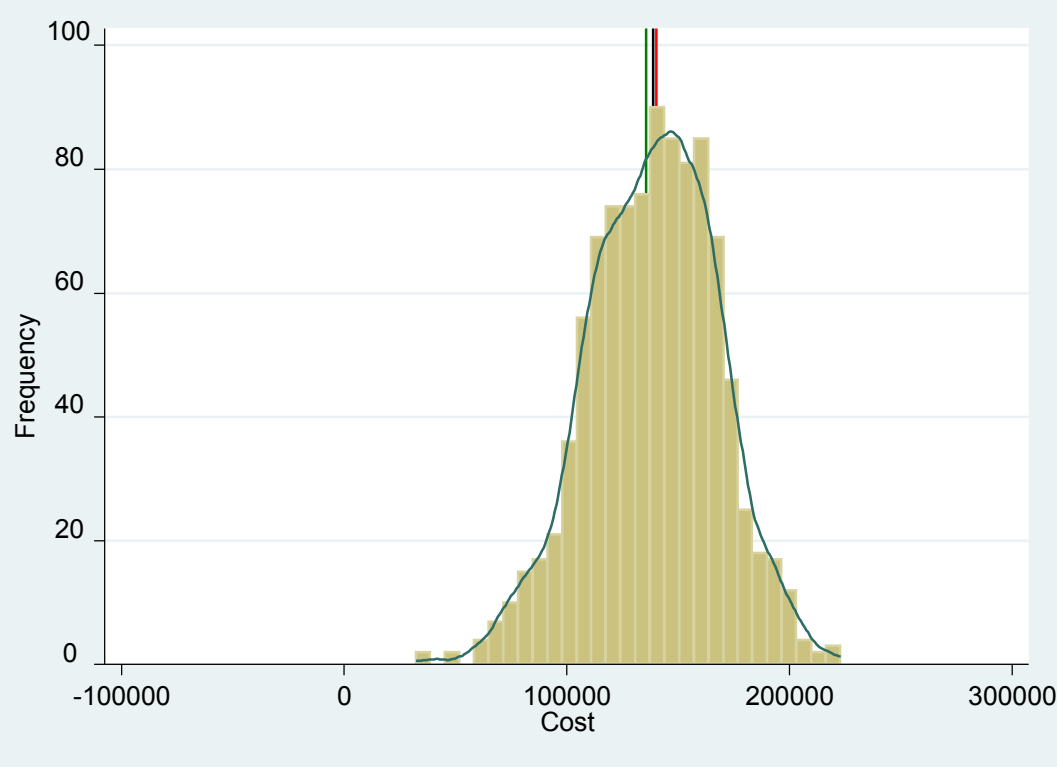

Figure 14: Distribution of costs for the revolving land purchase (RLP) program at the Red Deer site with a discount rate of 0% and a 6 year completion time[a]

[a]The black line represents the mean, while the red and green lines represent the cost of using a renewable ($140 340) or onetime payment ($135 755) respectively.

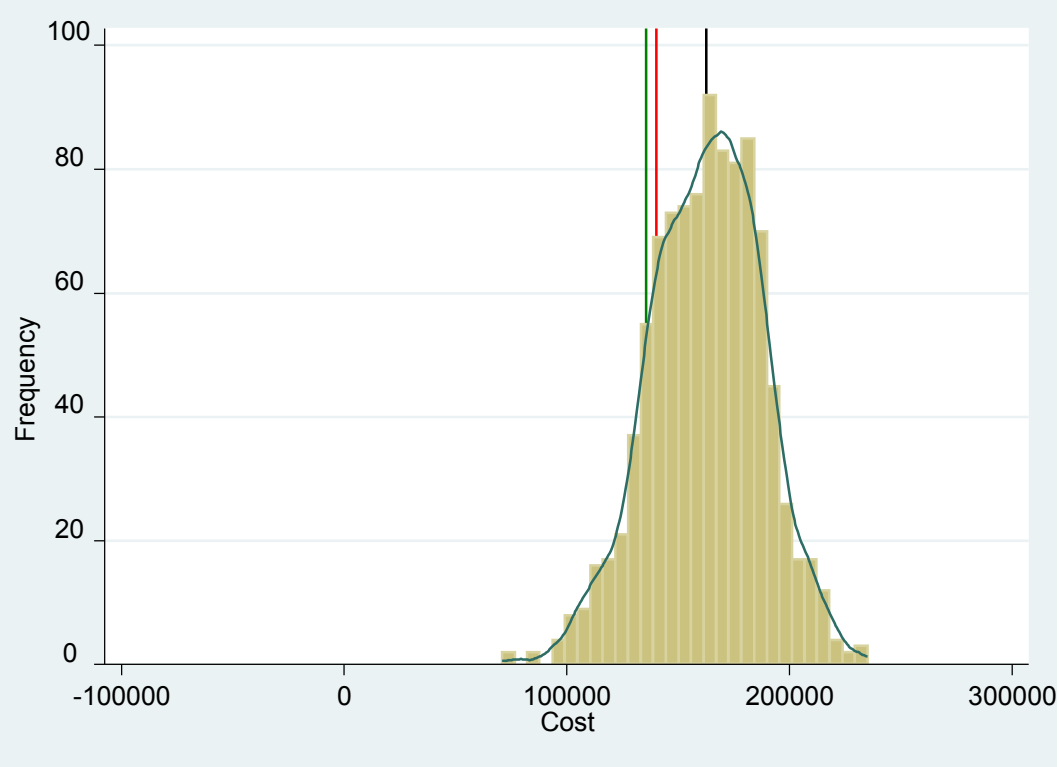

Figure 15: Distribution of costs for the revolving land purchase (RLP) program at the Red Deer site with a discount rate of 3% and a 6 year completion time[a]

[a]The black line represents the mean, while the red and green lines represent the cost of using a renewable ($140 340) or onetime payment ($135 755) respectively.

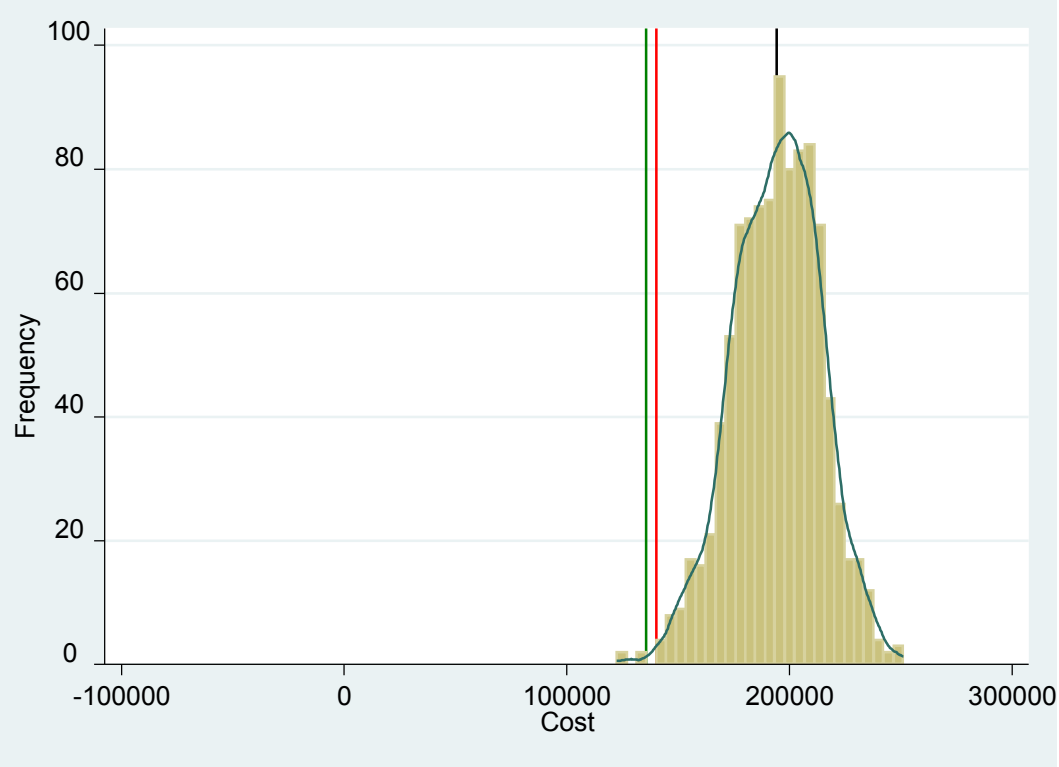

Figure 16: Distribution of costs for the revolving land purchase (RLP) program at the Red Deer site with a discount rate of 8% and a 6 year completion time[a]

[a]The black line represents the mean, while the red and green lines represent the cost of using a renewable ($140 340) or onetime payment ($135 755) respectively.

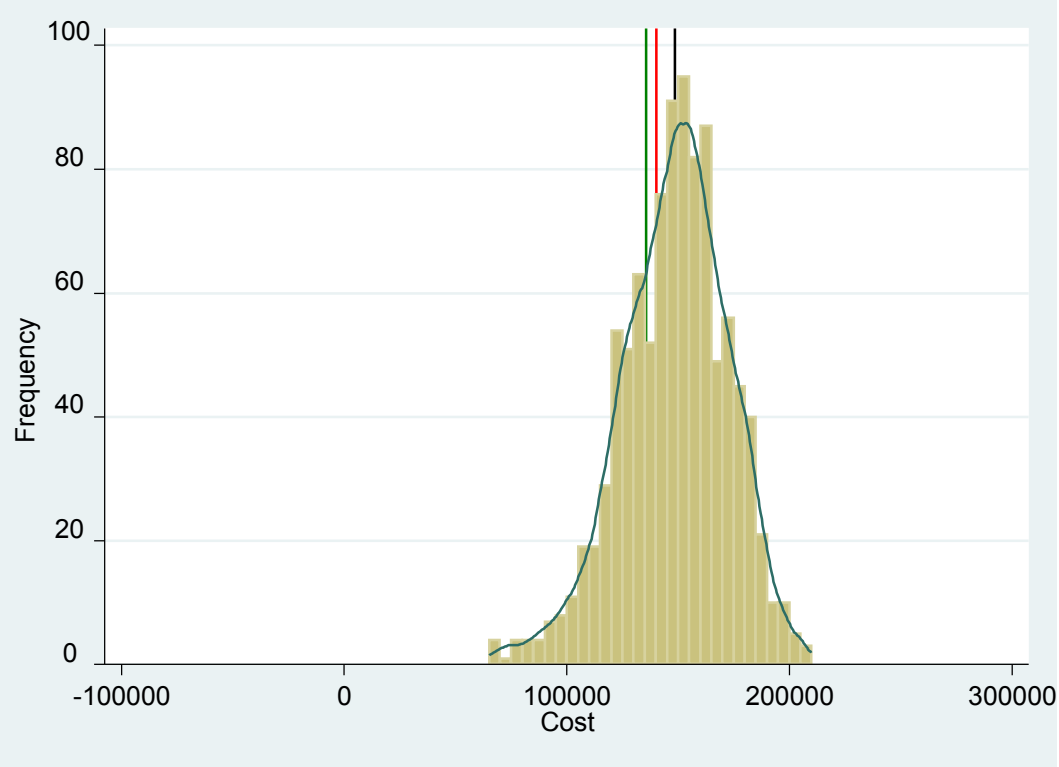

Figure 17: Distribution of costs for the revolving land purchase (RLP) program at the Red Deer site with a discount rate of 0% and a 2 year completion time[a]

[a]The black line represents the mean, while the red and green lines represent the cost of using a renewable ($140 340) or onetime payment ($135 755) respectively.

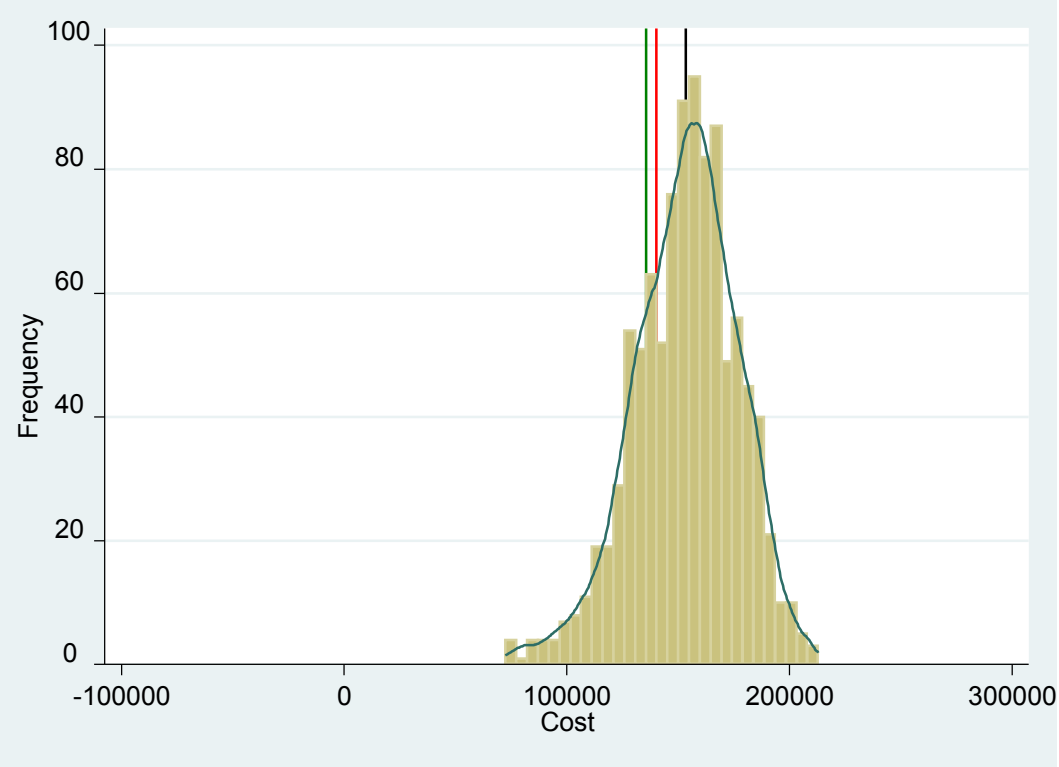

Figure 18: Distribution of costs for the revolving land purchase (RLP) program at the Red Deer site with a discount rate of 3% and a 2 year completion time[a]

[a]The black line represents the mean, while the red and green lines represent the cost of using a renewable ($140 340) or onetime payment ($135 755) respectively.

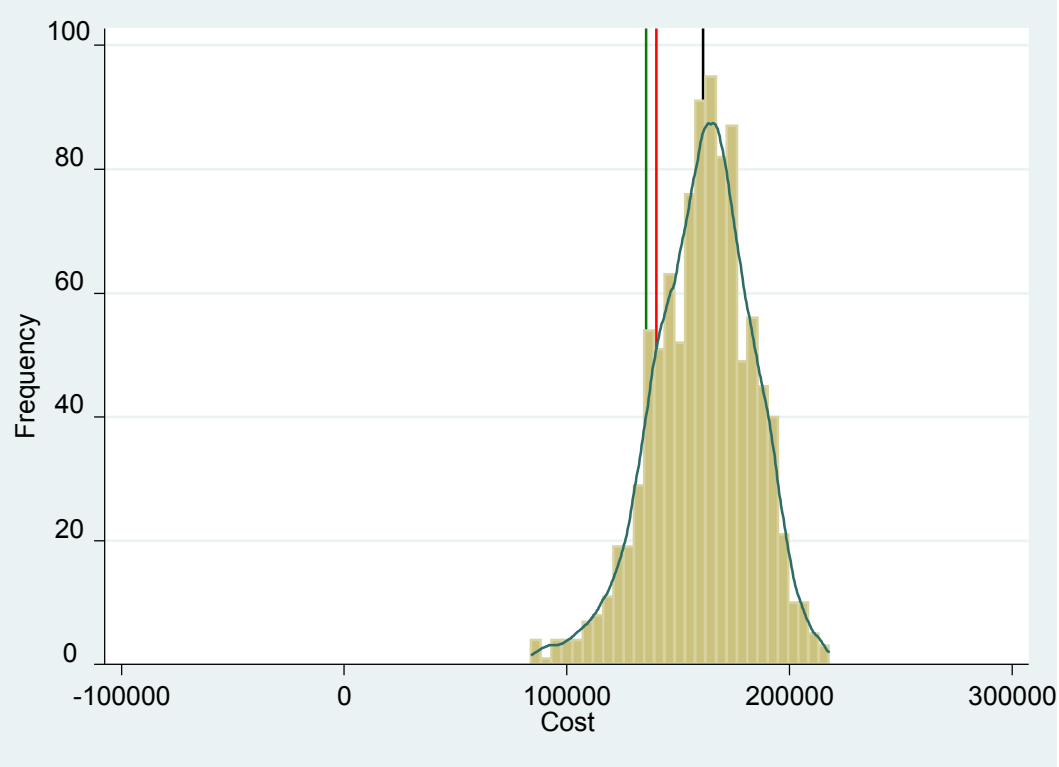

Figure 19: Distribution of costs for the revolving land purchase (RLP) program at the Red Deer site with a discount rate of 8% and a 2 year completion time[a]

[a]The black line represents the mean, while the red and green lines represent the cost of using a renewable ($140 340) or onetime payment ($135 755) respectively.

Appendix D

The following appendix contains the interview questions used to explore the SEACOP program case study, as well as the interview used to explore other offset programs. There are five versions, adapted for different stakeholders. In addition to these documents, participants also received an information letter/consent form. After the interview was completed, there was a separate sheet which gives the option for the participant to leave their name and affiliation to be thanked in an acknowledgements section.

UNIVERSITY OF ALBERTA

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An Evaluation of Transaction Costs and Lessons Learned from Biodiversity Offset Programs

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Background

You are invited to participate in a survey which will be used to evaluate biodiversity or ecological offset programs. You are being contacted because you expressed interest in participating, were/are part of an offset program, or own land within a region with an offset program.

Purpose

The purpose of this research is to evaluate offset programs, and determine what lessons can be learned. This will include an estimation of the setup costs associated with an offset program as well as design, policy, and implementation methods that are linked to successful programs. Government and non-government institutions will benefit from the lessons learned.

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Study Procedures

The data for this study will be gathered by structured interviews (either in person or by telephone). You are asked to complete the survey as accurately as possible. The survey is estimated to take 20 minutes to complete, and will likely be a one-time engagement. For interviews conducted over the phone, oral consent will be obtained before beginning the interview. A note taker may be present to assist with recording your responses.

Benefits

There are no perceived direct benefits to you for participating in the study. We hope that through this research offset programs can be better understood and implemented more effectively. There are no anticipated costs associated with participation.

Risks

There are no foreseeable risks of participating in this study.

Voluntary Participation

Your participation in the survey is completely voluntary. You are free to withdraw at any time, or choose not to answer any particular question. The data cannot be withdrawn if you withdraw consent once the survey is complete.

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Confidentiality & Anonymity

There will be no way to personally identify you in any reports, presentation or publications from this research. The data will be confidential, with access given to myself and Vic Adamowicz. The results will be stored anonymously (with no names in the data files), and you will not be identified in the presentation of results. Hard copies of the data will be stored in a locked filing cabinet, and electronic versions on a secure server for potential use in future studies by Vic Adamowicz.

If you wish to be acknowledged for your participation at the end of the report, there will be a separate sheet to leave your name and affiliation information on. This is completely voluntary. Your identifying information will not be attached to your responses. This information will only be used in the acknowledgements section.

Use of Data

The results of the study and your responses on the survey will be used to complete my thesis, as well as a "lessons learned" report which will be submitted to my funding agency, Sustainable Prosperity. Additionally, the data may be used in presentations at academic or professional conferences.

Further Information

If you have any questions, please contact either myself (Warren Noga) or Vic Adamowicz.

UNIVERSITY OF ALBERTA

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The plan for this study has been reviewed for its adherence to ethical guidelines by a Research Ethics Board at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Research Ethics Office at (780) 492-2615.

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Please circle your answers.

Do you consent to participating in an interview/survey about the costs of establishing an offset program and your experiences with them?

Yes *No*

Do you understand that you have been asked to participate in an interview/survey?

Yes *No*

Have you received and read the Information Sheet?

Yes *No*

Do you understand the benefits and risks involved in taking part in this interview/survey?

Yes *No*

Do you understand that you can quit this interview at any time? You do not have to say why.

Yes *No*

Do you understand that your responses will be confidential?

Yes *No*

UNIVERSITY OF ALBERTA

RESOURCE ECONOMICS AND ENVIRONMENTAL SOCIOLOGY

FACULTY OF AGRICULTURAL, LIFE AND ENVIRONMENTAL SCIENCES

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Do you know what the information you provide will be used for?

Yes *No*

Do you give us permission to use your data for the purposes specified?

Yes *No*

I agree to take part in the interview.

_____ _____

Signature Date

Farmers who have not participated in a conservation offset

My name is Warren Noga, and I am currently a Master's student at the University of Alberta in the department of Resource Economics and Environmental Sociology. I am studying with Vic Adamowicz, a professor in the department. The funding for this research is provided by Sustainable Prosperity, a research group based out of the University of Ottawa.

Ecosystem services are processes that benefit people and are provided by functioning ecosystems. Because these services are usually provided for free, they are undervalued in most decisions, and thus often too little of these services is provided. One way to maintain these services is to pay for them. When development must disturb an ecosystem service, it is possible for the developers to offset their impact by creating new ecosystems elsewhere which provide the same services. This is known as a conservation offset; protecting the total stock of services while allowing for flexibility in development decisions.

This is a case study of a pilot program for a biodiversity offset scheme in Southeastern Alberta (known as the South East Alberta Conservation Offset Pilot [SEACOP]) that is currently being developed in your area. The goal of this program is to increase native grasslands in the region by having industries (typically energy industries) that disturb grasslands in their operations offset this loss by paying for the development of grasslands on private land. Conservation offsets are used in Europe, South America, and Australia, however given the differences in legal processes and local issues; it is useful to test one in Alberta. The focus of the case study is to determine what lessons can be learned for designing better offset programs in the future. This study will centre largely on transaction costs (TCs), which are the costs associated with building and maintaining a policy or program. Through better understanding TCs, it will be possible to design future programs in a way that minimizes these costs so that system is more efficient, and more offsets are established at lower costs.

In order to determine the TCs of the program, stakeholders are being contacted in order to measure the time, energy, and resources used to participate in the program so far. This

will be done through surveys[27]. The farmers participating in the SEACOP program are being surveyed – but we were also interested in surveying some farmers who were not directly participating in the pilot. We are interested in how farmers who are not directly involved view the program and how costly they feel it would be to participate in such programs. You are being asked to complete a brief survey which will help us learn about the potential for such offset programs and will allow for the estimation of the transaction costs of establishing such programs.

[27] Several questions have been adapted from surveys by **Blackmore and Doole (Drivers of landholder participation in tender programs for Australian biodiversity conservation) and Alberta Innovates- Technology Futures.**

The survey below includes a number of open-ended questions as well as some that ask you to circle responses or indicate categories. You do not need to fill in the open ended questions as I will take notes on these during our interview. However, feel free to write notes or responses in response to these questions if you wish.

When planning and implementing an offset program, it is important for the design to encourage participation from landowners. If the process is too complicated or time consuming, many people will not participate. At the same time, the process must ensure that program objectives are met and the program rules are clear and understandable. In order to design programs that are better at engaging landowners and are less costly for landowners to participate in, we are interested in knowing how much time and effort you feel would be required to participate in this offset program. The information you provide on what you think the costs of an offset program are may be used to help design more cost effective programs in the future.

1. Are you aware of any habitat or ecological conservation programs in your area? If so, please specify.

_____

_____

_____

2. Are you aware of the South East Alberta Conservation Offset Pilot?

□ Yes □ No

In order to calculate the costs of this offset program, it is useful to know how much time and effort you think you would have to put into this project. Please answer the following questions:

3. How many hours or days do you think you would have to spend doing background research or gathering information about this program (including analysis of the impact on your farming costs, gathering information, etc.)?

_____

_____

4. Do you think any of this research would require outside help (consultant or representative)? If so, what do you think the cost of this outside help would be?

_____

_____

Designing a bid may require examining financial statements, crop input use, and maps of your farm.

5. Do you think you would incur any direct expenses related solely to the program (software, mapping, etc.)?_____

_____

6. What recommendations do you have for improving the efficiency of the program and ensuring participation from landowners?

_____

_____

_____

_____

7. Have you ever participated in an offset or conservation program before?

□ Yes □ No

If Yes, what was your experience with the program?

_____

_____

_____

_____

8. Based on you experience with other offset of conservation program, and what you know about the South East Alberta Conservation Offset Pilot, what do you feel are the advantages and disadvantages of the South East Alberta Conservation Offset Pilot relative to the other program(s) you have been involved in?

_____

_____

_____

If NO, what has kept you from participating in an offset or conservation program (including no opportunity to participate)?

_____

_____

_____

_____

Please answer the following questions about your farm (from the Census of Agriculture)

9. What are your top 3 farming goals, in decreasing order?

Goal 1: _____

Goal 2: _____

Goal 3: _____

The units used below are:

□ Hectares □ Acres

10. Total area owned (workable and non-workable):

_____

11. Area leased from governments:

_____

12. Rented or leased from others:

_____

13. Crop-shared land used by this operation:

_____

14. Other areas used by this operation:

_____

Please answer the following questions for 2013:

15. Total area in:

a) Field Crops _____

b) Hay _____

c) Vegetables _____

16. If you have any livestock for commercial purposes, please specify the type and total number of each below:

_____

_____

_____

17. Acres in summerfallow:

---

18. Acres in Tame or Seeded pasture:

---

19. Acres of Natural land for pasture:

---

20. Acres of Woodlands and wetlands:

---

21. All other land area in acres (buildings, idle land, home gardens, etc.):

We would like to know a bit about you to help us classify responses. Please complete the questions below about you and your background.

Please circle your answers

22. Gender

- Female
- Male

23. Age

- <25
- 25-35
- 36-45
- 46-55
- >55

24. Please indicate the highest level of education you have received:

- High School
- Trade Certificate
- Post-Secondary diploma or certificate
- Bachelor's degree
- Master's degree
- PhD.

25. Are there any other comments you would like to provide regarding conservation offsets, their transactions costs, and/or any other lessons that can be learned from your recent experience with offset programs?

Thank you for participating in this survey.

Industry Stakeholders

My name is Warren Noga, and I am currently a Master's student at the University of Alberta in the department of Resource Economics and Environmental Sociology. I am studying with Vic Adamowicz, a professor in the department. The funding for this research is provided by Sustainable Prosperity, a research group based out of the University of Ottawa.

This is a case study of a pilot program for a land offset scheme in Southeastern Alberta (known as the South East Alberta Conservation Offset Pilot [SEACOP]). The focus of the case study is to determine what lessons can be learned for designing better offset programs in the future. This study will centre largely on transaction costs (TCs), which are the costs associated with building and maintaining a policy or program. Through better understanding TCs, it will be possible to design future programs in a way that minimizes these costs so that system is more efficient, and more offsets are established at lower costs.

In order to determine the TCs of the program, stakeholders are being contacted in order to measure the time, energy, and resources used to participate in the program so far. This will be done through surveys[28]. You are being asked to complete a brief survey which will allow for the estimation of the transaction cost of establishing this program.

The survey below includes a number of open-ended questions as well as some that ask you to circle responses or indicate categories. You do not need to fill in the open ended questions as I will take notes on these during our interview. However, feel free to write notes or responses in response to these questions if you wish.

[28] Several questions have been adapted from surveys by **Blackmore and Doole (Drivers of landholder participation in tender programs for Australian biodiversity conservation) and Alberta Innovates- Technology Futures.**

When planning and implementing an offset program, it is important for the design to be efficient from an industry perspective. If the program is voluntary, and the process is too complicated or time consuming, many firms will not participate. In order to design programs that are less costly for industry stakeholders to participate in, we are interested in knowing how much time and effort was required to participate in this offset program. This information, and suggestions you have for making the process more efficient, will help in designing future programs.

1. What energy sources does your company operate in (please check all that apply)?

□ Oil □ Natural Gas □ Wind □Other_____

2. How did your firm hear about South East Alberta Conservation Offset Pilot?

_____

_____

_____

In order to calculate the transaction costs of the South East Alberta Conservation Offset Pilot, information on time and effort spent by you, industry stakeholders, will be useful. Please approximate the time invested by your company into this offset pilot.

3. Please fill in the following table as accurately as possible:

Phase	Number of Employees	Department(s)	Hours per Week	Number of Weeks
Background (Research, identifying target area)				
Design				
Implementation (Recruiting landowners, contract negotiation)				
Monitoring and Enforcement				

4. What best reflects how you felt about the time and effort you put into the entire process:

☐ A lot more than I expected

☐ More than I expected

☐ About what I expected

☐ Less than I expected

☐ A lot less than I expected

If you felt it took more or less time than expected, please identify which areas took more or less time than expected

_____

_____

5. Why has your firm chosen to participate in the South East Alberta Conservation Offset Pilot and how would you describe your role in the project to date?

6. What are the program's:

Strengths?

Weaknesses?

Opportunities (e.g. For expansion, application to future projects, learning by doing)?

Threats (e.g. Political issues, funding instability)?

We are interested in your view of the role of conservation offsets and similar programs in conservation. Please circle one response to each question below:

7. Conservation offset programs are cost effective way of achieving environmental goals.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

8. Conservation offset programs encourage landowner participation more effectively than voluntary initiatives .

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

9. Conservation offset programs encourage industry participation more effectively than voluntary initiatives.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

10. The time required to participate is a deterrent to landowner participation.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

11. The time required to participate is a deterrent to industry participation.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

12. Have you participated in the design or implementation of any other offset programs (or similar programs)? Please outline what you feel are the advantages and disadvantages of the South East Alberta Conservation Offset Pilot relative to the other program(s) you have been involved in.

_____

_____

_____

We would like to know a bit about your role in the organization to help us classify responses. Please complete the questions below about your institution and your background.

Please circle your answers

13. Gender

- Female
- Male

14. Age

- <25
- 25-35
- 36-45
- 46-55
- >55

15. Please indicate the highest level of education you have received:

- High School
- Trade Certificate
- Post-Secondary diploma or certificate
- Bachelor's degree
- Master's degree
- PhD.

16. Are there any other comments you would like to provide regarding conservation offsets, their transactions costs, and/or any other lessons that can be learned from your recent experience with offset programs?

Thank you for participating in this survey.

Those who worked an offset program other than SEACOP

My name is Warren Noga, and I am currently a Master's student at the University of Alberta in the department of Resource Economics and Environmental Sociology. I am studying with Vic Adamowicz, a professor in the department. The funding for this research is provided by Sustainable Prosperity, a research group based out of the University of Ottawa.

The focus of my research is to determine what lessons can be learned for designing better conservation offset programs in the future. A central element is a case study of a pilot program for a biodiversity land offset scheme in Southeastern Alberta (known as the South East Alberta Conservation Offset Pilot [SEACOP]) and this study will centre largely on transaction costs (TCs), which are the costs associated with building and maintaining a policy or program. Through better understanding of TCs, it will be possible to design future programs in a way that minimizes these costs so that the system is more efficient, and more offsets are established at lower costs. Although you may not have been directly or indirectly involved in SEACOP, I am interested in your opinions about conservation offsets because of your experience in this area.

In order to determine the TCs of the program, stakeholders are being contacted in order to measure the time, energy, and resources used to participate in the program so far. This will be done through surveys[29]. You are being asked to complete a brief survey which will allow for the estimation of the transaction cost of establishing this program.

The survey below includes a number of open-ended questions as well as some that ask you to circle responses or indicate categories. You do not need to fill in the open ended questions as I will take notes on these during our interview. However, feel free to write notes or responses in response to these questions if you wish.

[29] Several questions have been adapted from surveys by **Blackmore and Doole (Drivers of landholder participation in tender programs for Australian biodiversity conservation) and Alberta Innovates- Technology Futures.**

Please answer the following questions.

1. What is the name of the conservation offset (or similar) program(s) you worked on, and which ministry or NGO did you work for at the time?

_____

_____

2. Please briefly describe the program(s).

_____

_____

_____

_____

_____

3. How would you describe the objectives of the program(s)?

_____

_____

_____

_____

_____

In order to determine the relative size of the program(s), please answer the following as accurately as possible. If you did not have access to such information or don't know it, please respond – Don't Know.

4. Approximately how many acres were expected to be enrolled in the program(s)?

_____

5. Approximately what was the overall budget for the program(s)?

_____

6. Please list all funding sources used to support development, implementation or monitoring for the program(s):

_____

_____

_____

7. Does/did this program occur under any regulatory framework? Is so please specify which acts or policies govern the program.

_____

_____

8. What do you feel are the program's:

Strengths

_____

_____

_____

Weaknesses

_____

_____

_____

Opportunities (e.g. For expansion, application to future projects, learning by doing)?

_____

_____

_____

Threats (e.g. Political issues, funding instability)?

_____

_____

_____

9. If you were planning a program with similar goals, what would you change? What has been learned from the design and practice/enforcement of this program?

_____

_____

_____

_____

10. If you are the head of your department, or responsible for the program for your agency, please fill in table A below (and complete question B with regards to yourself). If you are not the department head, please proceed to part B.

A) Please fill in the following table as accurately as possible indicating how many individuals and hours / weeks were devoted to the program, in each of the categories:

Phase	Number of Employees	Department(s)	Hours per Week	Number of Weeks
Background (Research, identifying target area)				
Design				
Implementation (Recruiting landowners, contract negotiation)				
Monitoring and Enforcement				

B)Please fill in the table below based on your personal time allocation.?

Phase	Hours per Week	Number of Weeks
Background (Research, identifying target area)		
Design		
Implementation (Recruiting landowners, contract negotiation)		
Monitoring and Enforcement		

11. Were there any direct costs associated with the program (contracts, legal counsel, etc.)? If so, do you know the dollar value of these costs?

_____

_____

12. What best reflects how you felt about the time and effort you put into the entire process:

☐ A lot more than I expected

☐ More than I expected

☐ About what I expected

☐ Less than I expected

☐ A lot less than I expected

If you felt it took more or less time than expected, please identify which areas took more or less time than expected

_____

_____

13. In the operation of this program, has there ever been a situation where a contract was breached and legal enforcement was pursued?

_____

_____

_____

We are interested in your view of the role of conservation offsets and similar programs in conservation. Please circle one response to each question below:

14. Conservation offset programs are cost effective ways of achieving environmental goals.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

15. Conservation offset programs encourage landowner participation more effectively than voluntary initiatives.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

16. Conservation offset programs encourage industry participation more effectively than voluntary initiatives.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

17. The time required to participate in the offset program is a deterrent to landowner participation.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

18. The time required to participate in the offset program is a deterrent to industry participation

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

We would like to know a bit about your role in the organization to help us classify responses. Please complete the questions below about your institution and your background.

Please circle your answers

19. What type of institution do you work for?

- Provincial Government
- Federal Government
- Conservation Group
- Consultant
- Other (Please specify):_____

20. Gender

- Female
- Male

21. Age

- <25
- 25-35
- 36-45
- 46-55
- >55

22. Please indicate the highest level of education you have received:

- High School
- Trade Certificate
- Post-Secondary diploma or certificate
- Bachelor's degree
- Master's degree
- PhD.

23. Are there any other comments you would like to provide regarding conservation offsets, their transactions costs, and/or any other lessons that can be learned from your recent experience with offset programs?

_____

_____

Thank you for participating in this survey.

Participating Farmers

My name is Warren Noga, and I am currently a Master's student at the University of Alberta in the department of Resource Economics and Environmental Sociology. I am studying with Vic Adamowicz, a professor in the department. The funding for this research is provided by Sustainable Prosperity, a research group based out of the University of Ottawa.

This is a case study of a pilot program for a land offset scheme in Southeastern Alberta (known as the South East Alberta Conservation Offset Pilot [SEACOP]). Conservation offsets are used in Europe, South America, and Australia, however given the differences in legal processes and local issues, it is necessary to test one in Alberta. The focus of the case study is to determine what lessons can be learned for designing better offset programs in the future. This study will centre largely on transaction costs (TCs), which are the costs associated with building and maintaining a policy or program. Through better understanding TCs, it will be possible to design future programs in a way that minimizes these costs so that system is more efficient, and more offsets are established at lower costs.

In order to determine the TCs of the program, stakeholders are being contacted in order to measure the time, energy, and resources used to participate in the program so far. This will be done through surveys[30]. You are being asked to complete a brief survey which will allow for the estimation of the transaction cost of establishing this program.

The survey below includes a number of open-ended questions as well as some that ask you to circle responses or indicate categories. You do not need to fill in the open ended questions as I will take notes on these during our interview. However, feel free to write notes or responses in response to these questions if you wish.

[30] Several questions have been adapted from surveys by **Blackmore and Doole (Drivers of landholder participation in tender programs for Australian biodiversity conservation) and Alberta Innovates- Technology Futures.**

When planning and implementing an offset program, it is important for the design to encourage participation from landowners. If the process is too complicated or time consuming, many people will not participate. At the same time, the process must ensure that program objectives are met and the program rules are clear and understandable. In order to design programs that are better at engaging landowners and are less costly for landowners to participate in, we are interested in knowing how much time and effort was required to participate in this offset program. This information, and suggestions you have for making the process more efficient, will help in designing future programs.

1. How did you first hear about the South East Alberta Conservation Offset Pilot?

_____

_____

2. What do you feel are the South East Alberta Conservation Offset Pilot program's:

Strengths

_____

_____

_____

Weaknesses

_____

_____

_____

Opportunities (e.g. For expansion, application to future projects, learning by doing)?

_____

_____

_____

Threats (e.g. Political issues, funding instability)?

3. If you were planning a program with similar goals, what would you change? What has been learned from the design and practice/enforcement of this program?

In order to calculate the costs of this offset program, it is useful to know how much time and effort you have put into this project. Please answer the following questions:

4. How many hours or days have you spent doing background research or gathering information about this program (including analysis of the impact on your farming costs, gathering information, etc.)?

5. What parts of the program were the most time consuming? (e.g. doing background research on offset programs, preparing for meetings, attending meetings, evaluating the financial costs of participating in the program, etc.?)

6. Did any of your background research or preparation for the program require outside help (consultant or representative)? If so, what was the cost of this outside help?

_____

_____

7. Have you had any direct expenses related solely to the program (software, mapping, etc.)?

_____

_____

8. What best reflects how you felt about the time and effort you put into the bidding process and/or the calculation of how much the offset will affect your farming expenses and profits:

☐ A lot more than I expected

☐ More than I expected

☐ About what I expected

☐ Less than I expected

☐ A lot less than I expected

If you felt it took more or less time than expected, please identify which areas took more or less time than expected

_____

_____

9. What recommendations do you have for improving the efficiency of the program and ensuring participation from landowners?

_____

_____

10. Have you participated in any other offset programs (or similar programs)? Please outline what you feel are the advantages and disadvantages of the South East Alberta Conservation Offset Pilot relative to the other program(s) you have been involved in.

_____

_____

_____

We would like to know a bit about your farm and you to help us classify responses. Please complete the questions below about your farm and your background.

11. What are your top 3 farming goals, in decreasing order?

Goal 1: _____

Goal 2: _____

Goal 3: _____

Please answer the following questions about your farm (from the Census of Agriculture)

The units used below are:

□ Hectares □ Acres

12. Total area owned (workable and non-workable):

_____

13. Area leased from governments:

_____

14. Rented or leased from others:

---

15. Crop-shared land used by this operation:

---

16. Other areas used by this operation:

Please answer the following questions for 2013:

17. Total area in:

a) Field Crops _____

b) Hay _____

c) Vegetables _____

If you have any livestock for commercial purposes, please specify the type and total number of each below:

---

18. Acres in summerfallow:

---

19. Acres in Tame or Seeded pasture:

---

20. Acres of Natural land for pasture:

---

21. Acres of Woodlands and wetlands:

---

22. All other land area in acres (buildings, idle land, home gardens, etc.):

Please circle your answers to the following questions

23. Gender

- Female
- Male

24. Age

- <25
- 25-35
- 36-45
- 46-55
- >55

25. Please indicate the highest level of education you have received:

- High School
- Trade Certificate
- Post-Secondary diploma or certificate
- Bachelor's degree
- Master's degree
- PhD.

26. Are there any other comments you would like to provide regarding conservation offsets, their transactions costs, and/or any other lessons that can be learned from your recent experience with offset programs?

_____

_____

_____

Thank you for participating in this survey.

SEACOP

My name is Warren Noga, and I am currently a Master's student at the University of Alberta in the department of Resource Economics and Environmental Sociology. I am studying with Vic Adamowicz, a professor in the department. The funding for this research is provided by Sustainable Prosperity, a research group based out of the University of Ottawa.

This is a case study of a pilot program for a biodiversity land offset scheme in Southeastern Alberta (known as the South East Alberta Conservation Offset Pilot [SEACOP]). The focus of the case study is to determine what lessons can be learned for designing better offset programs in the future. This study will centre largely on transaction costs (TCs), which are the costs associated with building and maintaining a policy or program. Through better understanding of TCs, it will be possible to design future programs in a way that minimizes these costs so that the system is more efficient, and more offsets are established at lower costs.

In order to determine the TCs of the program, stakeholders are being contacted in order to measure the time, energy, and resources used to participate in the program so far. This will be done through surveys[31]. You are being asked to complete a brief survey which will allow for the estimation of the transaction cost of establishing this program.

The survey below includes a number of open-ended questions as well as some that ask you to circle responses or indicate categories. You do not need to fill in the open ended questions as I will take notes on these during our interview. However, feel free to write notes or responses in response to these questions if you wish.

[31] Several questions have been adapted from surveys by **Blackmore and Doole (Drivers of landholder participation in tender programs for Australian biodiversity conservation) and Alberta Innovates- Technology Futures.**

This interview will cover your experience with SEACOP, as well as any other conservation offset programs you have been involved with.

Please answer the following questions.

1. How would you describe the objectives of the program?

_____

_____

_____

_____

_____

In order to determine the relative size of the program, please answer the following questions as accurately as possible. If you did not have access to such information or don't know it, please respond – Don't Know.

2. Approximately how many acres were expected to be enrolled in the program?

_____

3. Approximately what was the overall budget for the program?

_____

4. Please list all funding sources used to support development, implementation or monitoring for the program:

_____

_____

_____

5. Does/did this program occur under any regulatory framework? Is so please specify which acts or policies govern the program.

_____

_____

6. What do you feel are the program's:

Strengths

_____

_____

_____

Weaknesses

_____

_____

_____

Opportunities (e.g. For expansion, application to future projects, learning by doing)?

_____

_____

_____

Threats (e.g. Political issues, funding instability)?

_____

_____

_____

7. If you were planning a program with similar goals, what would you change? What has been learned from the design and practice/enforcement of this program?

_____

_____

_____

_____

8. If you are the head of your department, or responsible for the program for your agency, please fill in table A below (and complete question B with regards to yourself). If you are not the department head, please proceed to part B.

A) Please fill in the following table as accurately as possible indicating how many individuals and hours / weeks were devoted to the program, in each of the categories:

Phase	Number of Employees	Department(s)	Hours per Week	Number of Weeks
Background (Research, identifying target area)				
Design				
Implementation (Recruiting landowners, contract negotiation)				
Monitoring and Enforcement				

B)Please fill in the table below based on your personal time allocation.?

Phase	Hours per Week	Number of Weeks
Background (Research, identifying target area)		
Design		
Implementation (Recruiting landowners, contract negotiation)		
Monitoring and Enforcement		

9. Were there any direct costs associated with the program (contracts, legal counsel, etc.)? If so, do you know the dollar value of these costs?

_____

_____

10. What best reflects how you felt about the time and effort you put into the entire process:

☐ A lot more than I expected

☐ More than I expected

☐ About what I expected

☐ Less than I expected

☐ A lot less than I expected

If you felt it took more or less time than expected, please identify which areas took more or less time than expected

_____

_____

11. In the operation of this program, has there ever been a situation where a contract was breached and legal enforcement was pursued?

_____

_____

_____

We are interested in your view of the role of conservation offsets and similar programs in conservation. Please circle one response to each question below:

12. Conservation offset programs are cost effective ways of achieving environmental goals.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

13. Conservation offset programs encourage landowner participation more effectively than voluntary initiatives.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

14. Conservation offset programs encourage industry participation more effectively than voluntary initiatives.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

15. The time required to participate in the offset program is a deterrent to landowner participation.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

16. The time required to participate in the offset program is a deterrent to industry participation

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
1	2	3	4	5	DK

Please explain_____

17. Have you participated in the design or implementation of any other offset programs (or similar programs)? Please outline what you feel are the advantages and disadvantages of the South East Alberta Conservation Offset Pilot relative to the other program(s) you have been involved in.

_____

_____

_____

We would like to know a bit about your role in the organization to help us classify responses. Please complete the questions below about your institution and your background.

Please circle your answers

18. What type of institution do you work for?

- Provincial Government
- Federal Government
- Conservation Group
- Consultant
- Other (Please specify):_____

19. Gender

- Female
- Male

20. Age

- <25
- 25-35
- 36-45
- 46-55
- >55

21. Please indicate the highest level of education you have received:

- High School
- Trade Certificate
- Post-Secondary diploma or certificate
- Bachelor's degree
- Master's degree
- PhD.

22. Are there any other comments you would like to provide regarding conservation offsets, their transactions costs, and/or any other lessons that can be learned from your recent experience with offset programs?

_____

_____

_____

Thank you for participating in this survey.

Appendix E

The following two surveys were altered from those presented in Appendix D to reflect the nature of the EICD conservation auction. There are different versions for both participating and non-participating landowners.

UNIVERSITY OF ALBERTA

RESOURCE ECONOMICS AND ENVIRONMENTAL SOCIOLOGY

FACULTY OF AGRICULTURAL, LIFE AND ENVIRONMENTAL SCIENCES

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An Evaluation of Transaction Costs and Lessons Learned from a Conservation Auction

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Background

You are invited to participate in a survey which will be used to evaluate conservation auctions. You are being contacted because you expressed interest in participating, were/are part of a conservation auction, or own land within a region with a conservation auction program.

Purpose

The purpose of this research is to evaluate conservation auctions, and determine what lessons can be learned. This will include an estimation of the setup costs associated with a conservation auction as well as design, policy, and implementation methods that are linked to successful programs. Government and non-government institutions will benefit from the lessons learned.

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Study Procedures

The data for this study will be gathered by structured interviews (either in person or by telephone). You are asked to complete the survey as accurately as possible. The survey is estimated to take 20 minutes to complete, and will likely be a one-time engagement. For interviews conducted over the phone, oral consent will be obtained before beginning the interview. A note taker may be present to assist with recording your responses.

Benefits

There are no perceived direct benefits to you for participating in the study. We hope that through this research conservation auctions can be better understood and implemented more effectively. There are no anticipated costs associated with participation.

Risks

There are no foreseeable risks of participating in this study.

Voluntary Participation

Your participation in the survey is completely voluntary. You are free to withdraw at any time, or choose not to answer any particular question. The data cannot be withdrawn if you withdraw consent once the survey is complete.

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Confidentiality & Anonymity

There will be no way to personally identify you in any reports, presentation or publications from this research. The data will be confidential, with access given to myself and Vic Adamowicz. The results will be stored anonymously (with no names in the data files), and you will not be identified in the presentation of results. Hard copies of the data will be stored in a locked filing cabinet, and electronic versions on a secure server for potential use in future studies by Vic Adamowicz.

If you wish to be acknowledged for your participation at the end of the report, there will be a separate sheet to leave your name and affiliation information on. This is completely voluntary. Your identifying information will not be attached to your responses. This information will only be used in the acknowledgements section.

Use of Data

The results of the study and your responses on the survey will be used to complete my thesis, as well as a "lessons learned" report which will be submitted to my funding agency, Sustainable Prosperity. Additionally, the data may be used in presentations at academic or professional conferences.

Further Information

If you have any questions, please contact either myself (Warren Noga) or Vic Adamowicz.

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The plan for this study has been reviewed for its adherence to ethical guidelines by a Research Ethics Board at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Research Ethics Office at (780) 492-2615.

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Please circle your answers.

Do you consent to participating in an interview/survey about conservation auctions and your experiences with them?

Yes *No*

Do you understand that you have been asked to participate in an interview/survey?

Yes *No*

Have you received and read the Information Sheet?

Yes *No*

Do you understand the benefits and risks involved in taking part in this interview/survey?

Yes *No*

Do you understand that you can quit this interview at any time? You do not have to say why.

Yes *No*

Do you understand that your responses will be confidential?

Yes *No*

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Do you know what the information you provide will be used for?

Yes *No*

Do you give us permission to use your data for the purposes specified?

Yes *No*

I agree to take part in the interview.

_____ _____

Signature Date

Farmers who did not participate in Dennis Lake auction

My name is Warren Noga, and I am currently a Master's student at the University of Alberta in the department of Resource Economics and Environmental Sociology. I am studying with Vic Adamowicz, a professor in the department. The funding for this research is provided by Sustainable Prosperity, a research group based out of the University of Ottawa.

Ecosystem services are processes that benefit people and are provided by functioning ecosystems, such as water storage and provision of wildlife habitat. Because these services are usually provided for free, they are undervalued in most decisions, and thus often not enough of these services are provided. One way to maintain these services is to pay landowners for them through a program like a conservation auction or conservation incentive program. Conservation auctions are often used as part of conservation offset programs to generate new ecosystem services.

This survey is part of a case study of the Dennis Lake conservation incentive program that was piloted by the East Interlake Conservation District (EICD) from November 2012 to April 2013. The goal of the auction was to fund projects in the Willow Creek Sub-Watershed that would contribute to EICD watershed management planning goals including: Surface Water Management, Drinking Water Quality, Surface Water Quality, Fish and Wildlife Habitat Conservation, and Soil and Shoreline Management. Conservation auctions are used in Europe, South America, and Australia, however given the lack of experience with such auction here; it was useful to test one in Manitoba before fully implementing such a program. The focus of the case study is to determine what lessons can be learned for designing better conservation auction and related programs in the future. This study will centre largely on transaction costs (TCs), which are the costs associated with building and maintaining a policy or program. Through a better understanding of TCs, it will be possible to design future programs in a way that minimizes these costs so that system is more efficient, and more conservation auctions can operate at lower costs.

In order to determine the TCs of the program, stakeholders are being contacted in order to measure the time, energy, and resources used to participate in the program so far. This will be done through surveys[32]. The landowners who participated in the conservation auction are being surveyed – but we were also interested in surveying some farmers who were not directly participating in the program. We are interested in how farmers who are not directly involved view the program and how costly they feel it would be to participate in such programs. You are being asked to complete a brief survey which will help us learn about the potential for such conservation auctions and will allow for the estimation of the transaction costs of establishing such programs.

The survey below includes a number of open-ended questions as well as some that ask you to circle responses or indicate categories. You do not need to fill in the open ended questions as I will take notes on these during our interview. However, feel free to write notes or responses to these questions if you wish.

When planning and implementing a conservation auction, it is important for the design to encourage participation from landowners. If the process is too complicated or time consuming, many people will not participate. At the same time, the process must ensure that program objectives are met and the program rules are clear and understandable. In order to design programs that are better at engaging landowners and are less costly for landowners, we are interested in knowing how much time and effort you feel would be required to participate in this conservation auction. The information you provide on what you think the costs of a conservation auction are may be used to help design more cost effective programs in the future.

[32] Several questions have been adapted from surveys by **Blackmore and Doole (Drivers of landholder participation in tender programs for Australian biodiversity conservation) and Alberta Innovates- Technology Futures.**

1. Are you aware of any habitat or ecological conservation programs in your area? If so, please specify.

_____

_____

_____

2. Are you aware of the Dennis Lake conservation auction?

□ Yes □ No

In order to calculate the costs of this conservation auction, it is useful to know how much time and effort you think you would have to put into this project. Please answer the following questions:

3. How many hours or days do you think you would have to spend doing background research or gathering information about this program (including analysis of the impact on your farming costs, gathering information, etc.)?

_____

_____

4. Do you think any of this research would require outside help (consultant or representative)? If so, what do you think the cost of this outside help would be?

_____

_____

Designing a bid may require examining financial statements, crop input use, and maps of your farm.

5. Do you think you would incur any direct expenses related solely to the program (software, mapping, etc.)?_____

_____

6. What recommendations do you have for improving the efficiency of the program and ensuring participation from landowners?

_____

_____

7. Have you ever participated in a conservation auction or other conservation program before?

□ Yes □ No

If Yes, what was your experience with the program?

_____

_____

_____

_____

8. Based on you experience with other conservation auctions or other conservation programs, and what you know about the Dennis Lake conservation auction, what do you feel are the advantages and disadvantages of the Dennis Lake conservation auction relative to the other program(s) you have been involved in?

_____

_____

_____

If NO, what has kept you from participating in a conservation auction or other conservation program?

☐ I was not aware of the conservation auction

☐ I did not have time to participate

☐ I was not interested in undertaking the types of projects being funded

☐ The process was too time consuming

☐ I did not understand the process

☐ I did not think I would be a successful bidder

☐ I want to see the outcome of this auction first before I participate

☐ I have concerns with the auction

☐ Other (please state):_____

9. Please indicate your level of agreement with the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The conservation auction is an appropriate way to allocate EICD funds					
I have concerns about the conservation auction					
The EICD should hold another auction in the future					
The Government of Manitoba should hold similar auctions in other CDs					
I would participate in another auction					

Please answer the following questions about your farm (from the Census of Agriculture)

10. What are your top 3 farming goals, in decreasing order?

Goal 1: _____

Goal 2: _____

Goal 3: _____

The units used below are:

□ Hectares □ Acres

11. Total area owned (workable and non-workable):

_____

12. Area leased from governments:

_____

13. Rented or leased from others:

_____

14. Crop-shared land used by this operation:

_____

15. Other areas used by this operation:

_____

Please answer the following questions for 2013:

16. Total area in:

a) Field Crops _____

b) Hay _____

c) Vegetables _____

17. If you have any livestock for commercial purposes, please specify the type and total number of each below:

_____

_____

_____

18. Acres in summerfallow:

_____

19. Acres in Tame or Seeded pasture:

_____

20. Acres of Natural land for pasture:

_____

21. Acres of Woodlands and wetlands:

_____

22. All other land area in acres (buildings, idle land, home gardens, etc.):

_____

We would like to know a bit about you to help us classify responses. Please complete the questions below about you and your background.

Please circle your answers

22. Gender

- Female
- Male

23. Age

- <25
- 25-35
- 36-45
- 46-55
- 55-65
- 65-75
- >75

24. Please indicate the highest level of education you have received:

- High School
- Trade Certificate
- Post-Secondary diploma or certificate
- Bachelor's degree
- Master's degree
- PhD.

25. Are there any other comments you would like to provide regarding conservation auctions, their transactions costs, and/or any other lessons that can be learned from your recent experience with conservation auction?

_____

_____

_____

Thank you for participating in this survey.

Participating Farmers

My name is Warren Noga, and I am currently a Master's student at the University of Alberta in the department of Resource Economics and Environmental Sociology. I am studying with Vic Adamowicz, a professor in the department. The funding for this research is provided by Sustainable Prosperity, a research group based out of the University of Ottawa.

Ecosystem services are processes that benefit people and are provided by functioning ecosystems, such as water storage and provision of wildlife habitat. Because these services are usually provided for free, they are undervalued in most decisions, and thus often not enough of these services are provided. One way to maintain these services is to pay landowners for them through a program like a conservation auction or conservation incentive program. Conservation auctions are often used as part of conservation offset programs to generate new ecosystem services.

This survey is part of a case study of the Dennis Lake conservation incentive program that was piloted by the East Interlake Conservation District (EICD) from November 2012 to April 2013. Conservation auctions are used in Europe, South America, and Australia; however given the lack of experience with such auctions here, it was necessary to test one in Manitoba before fully implementing such a program. The focus of the case study is to determine what lessons can be learned for designing better conservation auctions and related programs in the future. This study will centre largely on transaction costs (TCs), which are the costs associated with building and maintaining a policy or program. Through a better understanding of TCs, it will be possible to design future programs in a way that minimizes these costs so that system is more efficient, and more conservation auctions can operate at lower costs.

In order to determine the TCs of the program, stakeholders are being contacted in order to measure the time, energy, and resources used to participate in the program so far. This

will be done through surveys[33]. You are being asked to complete a brief survey which will allow for the estimation of the transaction cost of establishing this program.

The survey below includes a number of open-ended questions as well as some that ask you to circle responses or indicate categories. You do not need to fill in the open ended questions as I will take notes on these during our interview. However, feel free to write notes or responses to these questions if you wish.

[33] Several questions have been adapted from surveys by **Blackmore and Doole (Drivers of landholder participation in tender programs for Australian biodiversity conservation) and Alberta Innovates- Technology Futures.**

When planning and implementing a conservation auction, it is important for the design to encourage participation from landowners. If the process is too complicated or time consuming, many people will not participate. At the same time, the process must ensure that program objectives are met and the program rules are clear and understandable. In order to design programs that are better at engaging landowners and are less costly for landowners, we are interested in knowing how much time and effort was required to participate in this conservation auction. This information, and suggestions you have for making the process more efficient, will help in designing future programs.

1. How did you first hear about the Dennis Lake conservation auction?

_____

_____

2. What do you feel are the Dennis Lake conservation auction's:

Strengths

_____

_____

_____

_____

Weaknesses

_____

_____

_____

_____

Opportunities (e.g. For expansion, application to future projects, learning by doing)?

_____

_____

Threats (e.g. Political issues, funding instability)?

_____

_____

_____

_____

3. If you were planning a program with similar goals, what would you change? What has been learned from the design and practice of this program?

_____

_____

_____

_____

_____

In order to calculate the costs of this conservation auction, it is useful to know how much time and effort you have put into this project. Please answer the following questions:

4. How many hours or days have you spent doing background research or gathering information about this program (including analysis of the impact on your farming costs, gathering information, etc.)?

_____

_____

5. What parts of the program were the most time consuming? (e.g. doing background research on conservation programs, preparing for meetings, attending meetings, evaluating the financial costs of participating in the program, etc.?)

_____

_____

6. Did any of your background research or preparation for the program require outside help (consultant or representative)? If so, what was the cost of this outside help?

_____

_____

7. Have you had any direct expenses related solely to the program (software, mapping, etc.)?

_____

_____

8. What best reflects how you felt about the time and effort you put into the bidding process and/or the calculation of how much the altered land use will affect your farming expenses and profits:

☐ A lot more than I expected

☐ More than I expected

☐ About what I expected

☐ Less than I expected

☐ A lot less than I expected

If you felt it took more or less time than expected, please identify which areas took more or less time than expected

_____

_____

9. What recommendations do you have for improving the efficiency of the program and ensuring participation from landowners?

_____

_____

_____

_____

10. The following questions ask your opinion about the conservation auction process including the Expression of Interest (EOI), management plans, Environmental Benefits Index (EBI) used to rank bids, and bidding process.

Please indicate your level of agreement with the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The steps in the auction process were clear					
The auction was conducted at a convenient time of year					
I had enough time to submit an EOI					
The EOI was easy to complete					

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The use of an EBI to rank projects was fair					
I understood the EBI					
I was satisfied with my management plan					
I had enough time to review my management plan					
The management plan meeting was informative					
I had sufficient information to construct my bid price					
I sought out advice from EICD or a third party when I was developing my bid					
I was certain about the bid price that I submitted					
The results of the auction were delivered in a timely fashion					

11. Please indicate your level of agreement with the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The conservation auction is an appropriate way to allocate EICD funds					
I have concerns about the conservation auction					
The EICD should hold another auction in the future					
The Government of Manitoba should hold similar auctions in other CDs					
I would participate in another auction					

12. Have you participated in any other conservation programs? Please outline what you feel are the advantages and disadvantages of the Dennis Lake auction relative to the other program(s) you have been involved in.

_____

_____

_____

We would like to know a bit about your farm and you to help us classify responses. Please complete the questions below about your farm and your background.

13. What are your top 3 farming goals, in decreasing order?

Goal 1: _____

Goal 2: _____

Goal 3: _____

Please answer the following questions about your farm (from the Census of Agriculture)

The units used below are:

□ Hectares □ Acres

14. Total area owned (workable and non-workable):

_____

15. Area leased from governments:

_____

16. Rented or leased from others:

_____

17. Crop-shared land used by this operation:

_____

18. Other areas used by this operation:

_____

Please answer the following questions for 2013:

19. Total area in:

a) Field Crops _____

b) Hay _____

c) Vegetables _____

If you have any livestock for commercial purposes, please specify the type and total number of each below:

_____

_____

_____

20. Acres in summerfallow:

_____

21. Acres in Tame or Seeded pasture:

_____

22. Acres of Natural land for pasture:

_____

23. Acres of Woodlands and wetlands:

_____

24. All other land area in acres (buildings, idle land, home gardens, etc.):

_____

Please circle your answers to the following questions

25. Gender

- Female
- Male

26. Age

- <25
- 25-35
- 36-45
- 46-55
- 55-65
- 65-75
- >75

27. Please indicate the highest level of education you have received:

- High School
- Trade Certificate
- Post-Secondary diploma or certificate
- Bachelor's degree
- Master's degree
- PhD.

28. Are there any other comments you would like to provide regarding conservation auctions, their transactions costs, and/or any other lessons that can be learned from your recent experience with a conservation auction?

_____

_____

_____

Thank you for participating in this survey.

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