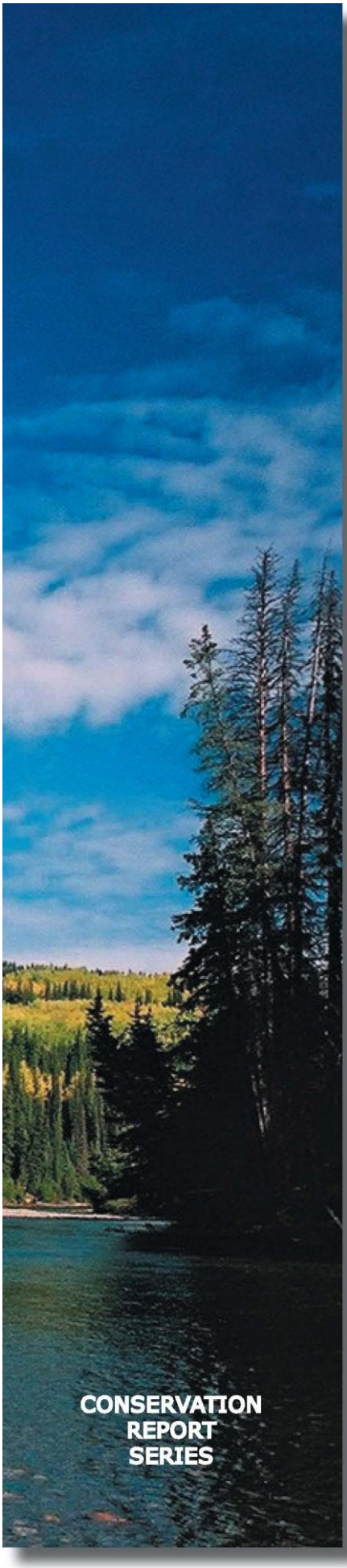

Moose Habitat Enhancement in the Chain Lakes Area, 1983 – 2010

Alberta Conservation Association

Conserving Alberta's Wild Side

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Moose Habitat Enhancement in the Chain Lakes Area, 1983 - 2010

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EXECUTIVE SUMMARY

The Chain Lakes moose habitat enhancement project has been a long-term co-operative venture, initiated within the Government of Alberta's Buck for Wildlife Program during the early 1980s. The project has since involved the Alberta Conservation Association (ACA), Alberta Sustainable Resource Development (ASRD), and several grazing lessees in the Chain Lakes area of southwest Alberta.

Between 1983 and 1991, the Government of Alberta, Fish and Wildlife Division, cleared vegetation on approximately 390 ha, from 170 blocks of land, located on grazing leases in the Chain Lakes area. In 2000 and 2001, approximately 178 ha (of the original 390 ha), from 76 blocks of land (16 priority-1 blocks; 60 priority-2 blocks), were identified as requiring re-clearing, in order to meet project objectives for abundance of moose browse vegetation.

Between 2004 and 2009, approximately 158 ha (of the 178 ha identified in 2000/2001) were re-cleared by ACA. The remaining 20 ha was either re-cleared by lessees, not re-cleared due to logistical and financial constraints, or have remained as open grass areas since the initial clearing. Of the 76 blocks, only four priority-2 blocks (totaling 8 ha) were not re-cleared between 2004 and 2009.

Inspections of priority-1 blocks in 2010 suggest there is marginal value in continuing to clear these small blocks of land for moose habitat enhancement. Overall, the aspen and willow re-growth in the priority-1 blocks is limited and does not appear to restrict wildlife or cattle movement. Where suitable browse vegetation re-growth was noted, browse utilization by wildlife and/or cattle appeared to be low. If there is interest from grazing lease holders in re-clearing priority-1 or priority-2 blocks, for use by livestock, they are encouraged to apply to ASRD Public Lands Division to maintain these blocks as range improvement areas.

We believe that future habitat enhancement and restoration efforts in southwestern Alberta would be better served by focusing on alternative areas within the region. For example, within its Restoring Natural Habitat for Wildlife project, ACA is proposing to develop a landscape level restoration plan for the South Porcupine Hills region. This plan proposes to use an ecosystem management approach for setting hierarchical

objectives and assigning relevant indicators and targets for the restoration of habitat for a diversity of wildlife species. The planning process will ultimately capture the vision of a desired future state for the South Porcupine Hills, which can be used to inform discussions with partners and stakeholders with regards to specific actions. In addition, a multi-stakeholder coordinated plan such as this could be a valuable starting point for future revisions to the C5 Forest Management Plan (which includes the South Porcupine Hills), scheduled for April 2016.

Key words: moose, habitat, browse, utilization, enhancement, ecosystem, restoration

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Shell Canada Ltd., 2005
Compton Petroleum Corp., 2006, 2007, 2008
Alberta's Conservation Collaboration, Ministers Special Licence Program, 2008
Devon Canada Corp., 2009

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1.0 INTRODUCTION

1.1 Background information

The Chain Lakes area, located in the foothills of southwestern Alberta, provides ecological resources that are valued by a wide suite of herbivorous species including moose (*Alces alces*), elk (*Cervus elaphus*), and deer (*Odocoileus* spp.). The southern foothills make up a small portion of Alberta's total moose range; however the habitat and ecological characteristics of this area rank it among some of the most productive for moose (Gudmundson and Russell 1985). With densities commonly above 1 moose/km^2, the Chain Lakes area ranks above average in comparison with many other regions of Alberta (Gudmundson 1982; Westworth 1982; Fitch 1983; Westworth et al. 1983; Gudmundson and Russell 1985; Clark 1992).

In 1982, a moose browse evaluation program was implemented in an attempt to gauge moose population levels, in relation to habitat conditions, in the Chain Lakes area (Townships 13—16 and Ranges 2—3, West of the 5th Meridian) (Gudmundson 1982). The results indicated a declining trend in the quality and quantity of moose habitat in the area (Gudmundson 1982; Fitch 1983; Westworth et al. 1983; Clark 1992). It was determined that deteriorating habitat conditions, including a decline in browse productivity and an over-utilization of browse by all ungulates, would not sustain the increasing moose population (Gudmundson 1982; Fitch 1983). In effect, the carrying capacity for moose in this area was deemed to be in decline.

As a result of these findings, beginning in 1983, the Government of Alberta, Fish and Wildlife Division, in partnership with local grazing lessees, initiated a mechanical vegetation clearing program in order to enhance browse, primarily for moose (Westworth 1982; Fitch 1983; Gudmundson and Russell 1985). Vegetation clearing can potentially improve habitat by opening mature forest and allowing for the re-growth of low-growing, high quality moose browse vegetation (Franzmann and Schwartz 1998). It has been widely documented that moose, as well as other wildlife species, respond favourably to regenerating logged or cleared areas (Green and Salter 1987). Ideal moose habitat includes woody vegetation such as willow (*Salix* spp.), aspen (*Populus tremuloides*), saskatoon (*Amelanchier alnifolia*), dogwood (*Cornus stolonifera*) and

chokecherry (*Prunus virginiana*) (Clark 1992) on moderate to gentle slopes or on poorly drained bottomlands (Green and Salter 1987).

In 1987, additional ground monitoring and evaluation was conducted on the cleared blocks of land, including browse transects, pellet counts, vegetation productivity and aerial surveys (Petherbridge 1987). Aerial survey counts in 1987 found moose densities to be higher on the cleared blocks when compared to nearby control/natural areas (Petherbridge 1987); however, the small relative size of the cleared blocks of land precludes a robust statistical comparison.

In 2000 and 2001, ACA and ASRD staff conducted browse and pellet surveys on all of the previously cleared blocks of land to determine which had the greatest browse value for moose and which required re-clearing in order to maintain those values. Management agreements for the re-clearing activities were then signed by the grazing lessees, ASRD and ACA, in January of 2004.

1.2 Project goal

The goal of the Chain Lakes moose habitat enhancement project is to restore the carrying capacity of habitat for moose, by increasing browse productivity, and thereby the ability of the area to sustain high populations of moose.

1.3 Project components

The Chain Lakes moose habitat enhancement project has consisted of several distinct phases or components;

1. Assessment of existing habitat conditions and identification of priority habitat enhancement blocks within the project area - Government of Alberta, Fish and Wildlife Division and D.A. Westworth and Associates Ltd. (1982).

2. Initial mechanical clearing activities implemented on 170 blocks of land (390 ha) to increase the abundance of regenerating browse species in the project area - Government of Alberta, Fish and Wildlife Division (1983 - 1991).

3. Follow up assessment of browse abundance and prioritization of blocks of land that would benefit from re-clearing - ACA (2000 - 2001).

4. Re-clearing of priority-1 and priority-2 habitat enhancement blocks (72 blocks of land totaling 158 ha) - ACA (2004 - 2009).

2.0 STUDY AREA

The project area is situated in southwest Alberta, near Chain Lakes Provincial Park, approximately 100 kilometers southwest of Calgary (Figure 1). The project area boundaries are located within Wildlife Management Units (WMU) 304, 308 and 310. The area is part of the Oldman River drainage and is primarily drained by Willow Creek. The ecology of the area is characterized primarily by the montane, and foothills parkland natural subregions, with small components of foothills fescue and sub-alpine subregions along the east and west boundaries, respectively. The montane subregion is characterized by open forests of lodgepole pine (*Pinus contorta*), Douglas fir (*Pseudotsuga menziesii*), aspen (*Populus tremuloides*), and white spruce (*Picea glauca*) and the foothills fescue subregion by grasslands of mountain rough fescue (*Festuca campestris*), bluebunch fescue (*Festuca idahoensis*) and Parry oatgrass (*Danthonia parryi*). Vegetation communities within the foothills parkland subregion are similar to those described for the montane and foothills fescue subregions in terms of species composition; however, the diversity in soil moisture and nutrient regimes makes it difficult to describe just one characteristic vegetation community. The Chain Lakes project area involves nine grazing lessees and 170 blocks of land, totaling 390 ha (Appendix 1).

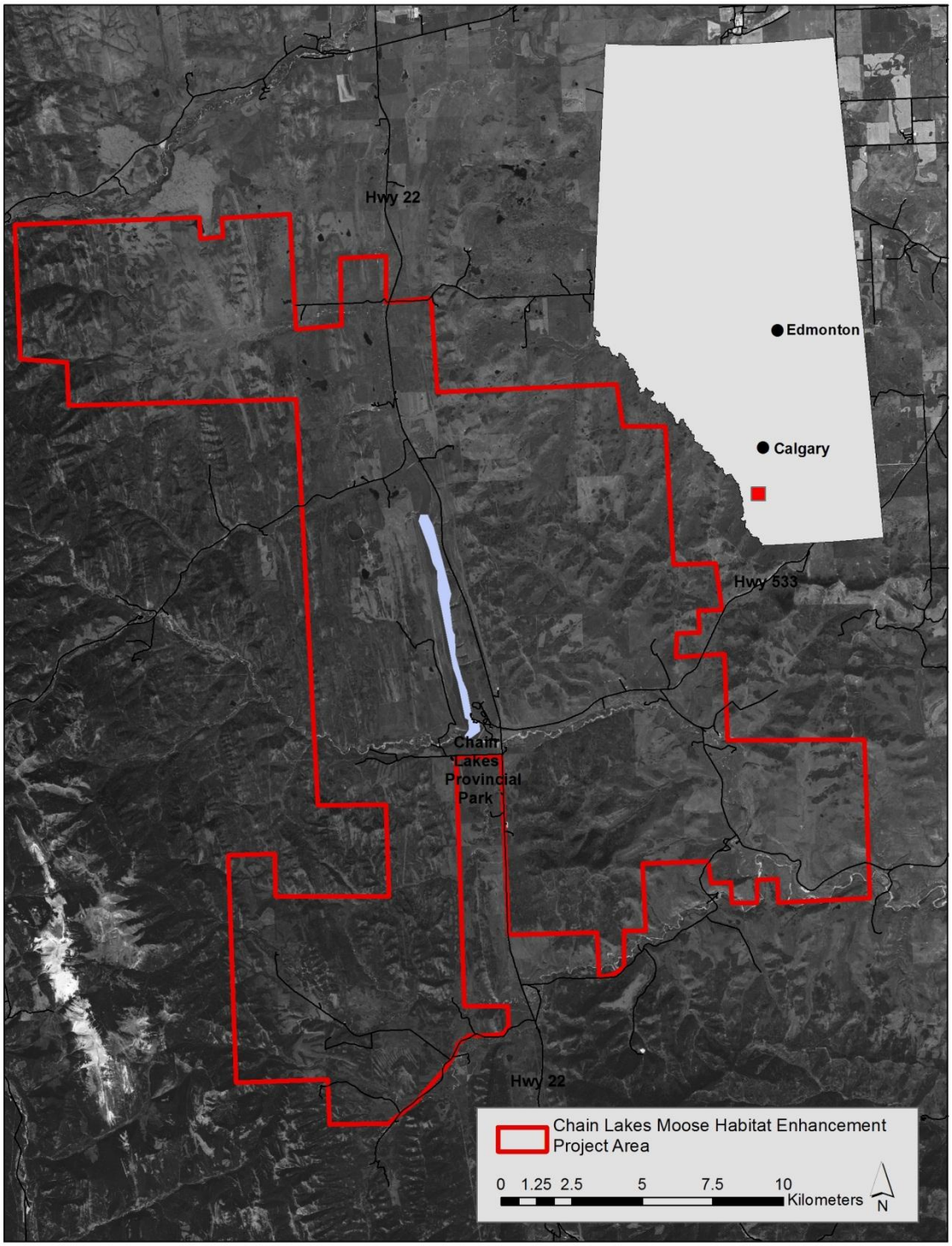

Figure 1. Chain Lakes moose habitat enhancement project area, Alberta, Canada.

3.0 METHODS

3.1 Assessment of moose habitat

In 1982, the Government of Alberta, Fish and Wildlife Division engaged D.A. Westworth and Associates Ltd. to complete an evaluation of moose habitat conditions in the Chain Lakes area and to provide detailed specifications for a long-term habitat enhancement project. The approach and study design included air photo interpretation and field surveys to measure key indicators of habitat condition, productivity and use, as well as the development of a biophysical model for selecting and prioritizing potential habitat enhancement sites. Site selection focused on mature and over mature aspen and willow stands with the highest potential productivity for preferred browse species (Westworth et. al 1983).

3.2 Initial mechanical clearing activities

Within the sites selected by Westworth et al. (1983), specific browse enhancement blocks of land were established using the following design criteria; blocks should not be greater than 150 m in width, inter-block spacing should be 150 m or greater, appropriate stream buffers should be maintained, areas with 45% slope or greater should be avoided, appropriate vegetation buffers should be left along roads, and blocks should be designed in a variety of sizes and shapes (Westworth et al. 1983).

Bulldozers were used to clear the enhancement blocks during the winter months between 1983 and 1991. The woody vegetation cleared from the blocks were piled in windrows or slash piles. The windrows were either burned under appropriate conditions and re-piled, or left to decompose naturally.

3.3 Follow-up assessment

The relative abundance of moose browse habitat in the Chain Lakes area was evaluated by means of browse surveys and pellet group counts during the 2000 to 2001 browse assessment survey. The assessment was conducted during April and May of 2000 and May 2001 (unpublished data).

The browse survey determined the percentage of each preferred browse species (willow, aspen, saskatoon, dogwood and chokecherry) present within each enhancement block. Ten individuals of each browse species were randomly selected for sampling. Sampling included the height of the stem in meters, the total number of new leaders and the total number of the new leaders that were browsed. The overall condition of each shrub or tree sampled was recorded as not hedged, lightly hedged, moderately hedged, or severely hedged (Appendix 2).

Pellet group counts were conducted along two transects, 100 m in length, in each enhancement block. All moose, elk, deer, grouse, and domestic cattle droppings within 1 meter of each side of the transect were recorded. A sketch map showing transect locations, game trails, plant communities and other physical characteristics of the enhancement block was also completed (Appendix 3).

Based on the species composition of the plant community, the browse survey, and the pellet count survey, each enhancement block was given a priority rating. Priority-1 blocks are those blocks with the highest value for browse, based on the browse species present, the condition of those shrubs and trees, and the amount of wildlife use. Priority-2 blocks were ranked lower than priority-1 blocks, but were still considered to provide sufficient amounts of browse habitat. Blocks with limited or no suitable moose browse values were not rated. Priority-1 and priority-2 blocks were selected to be re-cleared.

3.4 Re-clearing of priority-1 and priority-2 habitat enhancement blocks

In January 2004, agreements detailing which enhancement blocks were to be re-cleared and maintained were signed by each lessee, ASRD Fish and Wildlife Division, ASRD Public Lands and Forest Division and ACA.

These agreements stated that ACA and ASRD would re-clear priority-1 blocks within 5 years and manage for browse for the following 7 years. Browse management within a priority-1 block would include site visitation, photo documentation and if deemed necessary by all parties, additional clearing, if funds permitted. Priority-2 blocks would only be re-cleared, funds and access permitting, but would not be managed. If priority-2 blocks were not re-cleared, or if the lessee wished to continue maintenance of these

blocks, the lessee could apply to ASRD Public Lands to re-clear and maintain these blocks as range improvement areas.

Tender packages for re-clearing the enhancement blocks were sent out to contractors each year, typically in June or July. Prior to clearing, ACA staff or a hired consultant contacted each lessee or property manager to map block locations and potential access routes. Each block was visited prior to re-clearing activities to validate the need for re-clearing and determine preferred access routes for the contractor.

Two Gyro-Trac GT-18XP, Series II heavy-duty mulchers (Figure 2), with 2.72 meter cutting heads, were used to re-clear enhancement blocks from 2004 to 2007. From 2007 to 2009, a slightly larger Gyro-Trac (GT-25XP) was used for re-clearing, due to the increased size of the re-growth within the blocks. The timing of re-clearing activities occurred in the late summer to early fall in order to minimize re-growth density. Clearing during the dormant period (winter) can lead to more vigorous sprouting and higher density re-growth than clearing during the summer. This is the result of increased carbohydrate reserves in the roots during the winter compared to the growing season, when energy is allocated to the growth and maintenance of leaves and shoots (Kramer and Kozlowski, 1979; Smith, 1986). Dense (high number of stems per hectare) re-growth can restrict access to browse in the center of the block by obstructing wildlife and cattle movement.

Most enhancement blocks were re-cleared in the original rectangular shape, at the request of the grazing lessee. Occasionally smaller trees along block edges and some islands of trees were left standing, in order to mimic natural clearings and provide cover habitat for ungulates, small fur-bearing mammals, birds, and cattle.

Figure 2. Gyro-Trac mulcher used to re-clear enhancement blocks.

3.5 Re-growth assessment of priority-1 blocks

In the summer of 2010, ACA revisited all the priority-1 blocks that had been re-cleared since 2004 (excluding blocks identified as re-cleared by lessee or blocks re-cleared in 2009), to assess and document the level of regrowth and determine the need for future treatment. Vegetation regrowth was visually assessed during a walk-through inspection, and the abundance, distribution and structure of regenerating aspen and willow were noted. Evidence of ungulate browse within and adjacent to the enhancement block, as well as the level of decomposition of the re-clearing debris was also noted. The dominant vegetation communities were photographed to document the successional development of regrowth.

4.0 RESULTS

Between 1983 and 1991, the Government of Alberta, Fish and Wildlife Division cleared approximately 390 ha, from 170 blocks of land, located on grazing leases in the Chain Lakes area. In 2000 and 2001, 76 blocks (16 priority-1; 60 priority-2), totaling approximately 178 ha of the original 390 ha of cleared land, were identified as requiring re-clearing, in order to meet objectives for abundance of moose browse vegetation (unpublished data). Between 2004 and 2009, approximately 158 ha of the 178 ha were re-cleared by ACA, while the remaining 20 ha was either re-cleared by lessees, not re-cleared due to logistical and financial constraints or have remained as open grass areas since the initial clearing.

A total of 26 enhancement blocks (63 ha) were mechanically cleared in 2004 (September 3-9), 15 blocks in 2005 (33 ha; August 25-30), eight blocks in 2006 (22 ha; August 22-25), nine blocks in 2007 (25 ha; October 6-12), and seven blocks in 2009 (16 ha; September 9-14) (Appendix 4). Mechanical clearing was not conducted in 2008 due to a lack of financial support.

All 16 priority-1 blocks (37 ha) were re-cleared between 2004 and 2009, including five blocks (9 ha) that were re-cleared by the lessee. Of the 60 priority-2 blocks, 56 were re-cleared, including one block (0.5 ha) which was re-cleared by the lessee, leaving only 4 blocks (8 ha) that were not re-cleared.

Mechanically clearing the re-growth with mulching machinery resulted in low ground disturbance as the Gyro-Trac is equipped with rubber tracks that only exert 3.5 pounds per square inch of ground pressure. The remaining mulch retains soil moisture, which is believed to accelerate natural decomposition, thereby re-fertilizing impoverished soil (Gyro-Trac 2004). There were no windrows or slash piles associated with this method, as all vegetation in the path of the Gyro-Trac becomes mulched. In 2004, the number of passes made by the Gyro-Trac machinery was limited to save on time and cost. This resulted in slightly larger residual pieces (larger than a finger) than anticipated; however, it was not expected to obstruct wildlife or cattle movement across the enhancement blocks. Within a few hours following re-clearing, it was not uncommon to observe various wildlife species or cattle browsing on mulched material within the re-

cleared area. Figure 3, shows a comparison of photographs taken before and after the re-clearing of an enhancement block.

Based on feedback from the grazing lessees, and their concerns with the size of the residual pieces left on the ground after the 2004 clearings, the mulching machinery travelled slower in 2005 and 2006 in order to minimize the abundance and size of debris left behind. In 2007, larger machinery (GT-25XP) was available which resolved some of the debris size and operating speed concerns. In 2009, the re-growth within the enhancement blocks was substantially larger than previous years. The larger machinery was required to operate at substantially slower speeds and make multiple passes to minimize the amount and size of debris left on the ground. This resulted in increased time and costs to complete the re-clearing.

Figure 3. Photos of Block 150 taken in 2004 to illustrate the vegetation structure before and after clearing, and in comparison with adjacent habitat.

4.1 Degree of re-growth within priority-1 blocks

Figures 4 to 11 document the degree of re-growth in priority-1 blocks that were re-cleared, using mechanical mulching, in 2004 or 2005. This does not include blocks identified as re-cleared by the lessee.

Figure 4. Block 45, re-cleared in 2004. Block 45 is 3.2 ha in size and characterized as an open grass community with limited aspen and willow re-growth. Photos A and B were taken in August 2010, 6 years after re-clearing. Photo A shows a moist, rich area within the block with limited aspen regrowth. Light browsing of re-growth was observed; however, browse intensity on shrubs within the surrounding forest appeared to be equal or greater, as evidenced by stem architecture. Photo B shows the degree of decomposition of mulched debris within the block.

Figure 5. Block 46, re-cleared in 2004. Block 46 is 2.4 ha in size with minor aspen re-growth in a patchy distribution. Photos A and B were taken in August 2010, 6 years after re-clearing. Photos A and B show regenerating aspen are still < 2 m in height and the block is largely characterized as an open grass community.

Figure 6. Block 34, re-cleared in 2005. Block 34 is 2.0 ha in size and is a valuable priority-1 block because of its location in relation to surrounding wetlands and willow stands. Photos A and B were taken in August 2010, 5 years after re-clearing. Photo A shows the block has little aspen re-growth, and willow height appears to be controlled by browsing, as evidenced by arrested-type stem development. Photo B shows the neighbouring wetland complex along the border of the block.

Figure 7. Block 35, re-cleared in 2005. Block 35 is 3.6 ha in size with moderate aspen re-growth in a patchy distribution. Photos A and B were taken in August 2010, 5 years after re-clearing. Photo A shows the patchy distribution of aspen re-growth, which is < 2 m in height, on the drier upper slope portion of the block. Photo B shows the lower portion of the block, which is largely characterized as open grass community, with small patches of dense aspen and willow regrowth where moist, nutrient rich soil conditions are present.

Figure 8. Block 28, re-cleared in 2004. Block 28 is 3.6 ha in size and is largely characterized by an open grass and sedge community. Photos A and B were taken in August 2010, 6 years after re-clearing. Photo A shows moderate willow re-growth with arrested-type stem development due to browsing. Photo B shows a relatively moist, low lying portion of the block, along the southeast boundary, characterized by a sedge and willow community.

Figure 9. Block 31, re-cleared in 2005. Block 31 is 1.2 ha in size with limited aspen and willow re-growth. Photos A and B were taken in August 2010, 5 years after re-clearing. Photos A and B show that the vegetation community of the block is dominated by grasses and forbs. The slash pile in the center of Photo A provides an indication of the level of decomposition of debris following the original clearing in 1985.

Figure 10. Block 73, re-cleared in 2005. Block 73 is small in size at 0.7 ha. Photos A and B were taken in August 2010, 5 years after re-clearing. Photos A and B show that the vegetation community across this block is dominated by grass. There is considerable aspen re-growth, < 2 m in height, located primarily along the edges of the block.

Figure 11. Block 77, re-cleared in 2005. Block 77 is 3.9 ha in size. Photos A and B were taken in August 2010, 5 years after re-clearing. Photos A and B show aspen re-growth is considerable throughout this block, although re-growth height is < 2.5m. Browse intensity appears to be low, as evidenced by stem architecture.

4.2 Current moose population estimates in the Chain Lakes area

Since the early 1990s, moose population estimates have been determined using winter aerial surveys and a stratified habitat sampling technique. Density estimates in the Chain Lakes area between 1981 and 2009 range from 0.5 to 1.9 moose/km^2, with annual densities most commonly above 1 moose/km^2 (Appendix 5). This is high in comparison with density estimates for many other areas of Alberta, which are commonly well below this level. According to moose population estimates for Wildlife Management Units (WMU) 304 and 308, the Chain Lakes area moose population appears to be stable. Confidence intervals around the estimates are quite wide, therefore these population estimates should be considered approximate. The majority of the Chain Lakes study area falls within WMUs 304 and 308; however, a portion (Mt. Sentinel Ranch and the majority of Spruce Ranching Coop) is within WMU 310. The historic proposed moose population goal for WMU 310 is 400 individuals. The moose population in WMU 310 is currently close to half of this population goal, but these estimates are not robust as they are based on moose encountered incidentally during deer surveys (P. Young, ASRD, pers. comm.).

5.0 FUTURE RESTORATION CONSIDERATIONS

Small scale habitat enhancement and restoration projects can provide the necessary focus and flexibility to achieve meaningful and desirable ecological results within the social and economic constraints of the day; however, these projects must be well planned with measurable objectives, effective indicators, realistic targets and significant stakeholder input.

Based on the results of the Chain Lakes moose habitat enhancement project to date and the priority-1 block walkthroughs completed in 2010, we feel there is little value in continuing to maintain these small habitat enhancement blocks for moose browse. Overall, the aspen and willow re-growth in the priority-1 blocks is limited and unlikely to restrict wildlife or cattle movement as the blocks remain largely open.

Where suitable browse re-growth within the blocks was noted, browse utilization by wildlife and/or cattle appeared to be low. The majority of aspen terminal leaders are currently within, or have surpassed the browse zone, and largely show uninterrupted growth. If the aspen re-growth was being intensely browsed, we should have observed greater differences in stem heights, the development of stems from twig clusters, and arrested-type stem development (Keigley et al. 2003). Arrested stem development is caused by intense browsing, where the plants will typically grow < 35 cm in height and have a flat-top appearance due to browsing at snow-level (Keigley et al. 2003). Significant, arrested-type stem development was primarily observed on willow stems within Blocks 28 and 34. These blocks are relatively moist sites, and are in close proximity to wetlands and/or significant willow habitat that is attractive to wildlife.

We do recognize that vegetation re-growth is considerable on Blocks 73 and 77 (southern portion of the Spruce Ranching Coop), and could benefit from mechanical treatment in the future. However, the current state of the re-growth does not justify the time and cost associated with moving machinery into this location and re-clearing these blocks at this time.

As permitted by available funding, ACA attempted to re-clear as many of the priority-2 blocks as possible between 2004 and 2009, in accordance with the agreement schedules. However, due to the inherent lower value of the priority-2 blocks, the results of clearing

to date and the increasing costs associated with re-clearing, ACA decided to not re-clear four of the priority-2 blocks (Blocks 109-112). The cost-benefit of re-clearing these upland aspen stands, specifically for the maintenance of moose browse, was difficult to justify.

Notwithstanding the possibility of re-evaluating any perceived need for re-clearing efforts until 2016 (7 years after last re-clearing activities in 2009), our position is that ACA's responsibility for re-clearing tasks on any enhancement blocks will mature in 2016. If there is continued interest in re-clearing either the priority-1 or priority-2 blocks from grazing lease holders, for use by livestock, they are encouraged to apply to ASRD Public Lands Division to maintain these blocks as range improvement areas.

We believe that future habitat enhancement and restoration efforts in southwestern Alberta, whether mechanical or prescribed fire, would be better served by focusing on alternative areas within the region. For example, wildfire control and competing land use activities have had serious ecological implications for wildlife habitat in the southern Rocky Mountains of Alberta, through impacts on vegetation patterns and stand age. For most large mammals these changes have meant a loss of habitat quality (Pengelly and Rogeau 2001). Areas of high quality wildlife habitat, that were historically maintained through lightning and First Nations initiated fire, may no longer support historic biodiversity.

In 2009, ACA began evaluating the changes in vegetation communities in the South Porcupine Hills, located in the southern Rockies. Findings show that open grassland areas are disappearing and becoming increasingly fragmented due to shrub and tree encroachment (Didkowsky and Jones 2010). Didkowsky and Jones (2010) found that open grassland areas in the South Porcupine Hills decreased in area by 14% between 1949 and 2006. Associated with this decrease, fragmentation increased, evident in the doubling of the total number of land cover polygons (e.g. grassland, forest, shrub, crop etc) between 1949 (914 polygons) and 2006 (1,821 polygons) and the decrease in average polygon size by 50% (Didkowsky and Jones 2010). The largest intact grassland area in this region in 1949 was 971 ha in size, while the largest grassland area in 2006 was 224 ha (Didkowsky and Jones 2010). In addition to the changes in vegetation patterns, moose population estimates in this area (WMU 305) have declined to a level where ASRD no

longer allows a moose harvest (Appendix 6). ASRD will likely not re-open the season until they observe greater moose numbers (G. Hale, ASRD, pers. comm.).

In support of these findings, and in the interests of hunters, landowners, and the ASRD Fish and Wildlife Division, we believe future habitat enhancement and restoration activities will have the greatest benefit in the South Porcupine Hills, with efforts directed towards larger scale objectives rather than single species-specific objectives. Addressing the high degree of fragmentation and the loss of native grasslands in the montane and foothills fescue ecosystems in this area is expected to benefit a wide variety of wildlife species and their habitat needs at a broad scale. Boundaries of the proposed South Porcupine Hills study area and the Chain Lakes study area are shown in Figure 12.

Within its Restoring Natural Habitat for Wildlife project, ACA is proposing to develop a landscape level restoration plan for the South Porcupine Hills area, using an ecosystem management approach. This approach requires collaboration among private land managers, ACA, and multi-government agencies to develop hierarchical project objectives at four levels: landscape, ecosystem, species, and genetic diversity.

Landscape-level objectives will describe the proportion (acceptable range) of each ecosystem type (forest cover and age class distribution) that should be present within a planning unit. These proportions will be derived from our best understanding of the natural range of variability (NRV) that occurs as a result of natural disturbance. Ecosystem-level objectives will describe how restoration activities will emulate the effects of wildfire. Species-level objectives will ensure that restoration activities provide high quality habitat for wildlife species. Objectives for genetic diversity will ensure that restoration activities do not harm the genetic diversity of species at risk. The focus will be on the broader scale, landscape and ecosystem, objectives in order to benefit a larger suite of wildlife species and habitat needs.

In addition, performance measures for each hierarchical level will be presented in a manner compatible with ASRD's Alberta Forest Management Planning Manual. Under this framework, Values, Objectives, Indicators, and Targets (VOITs) are identified and monitored to evaluate restoration success and to facilitate adaptive management. Objectives consistent with the stated values are set and one or more indicators are selected to track progress at achieving the stated objective. These indicators become the

basis for a monitoring program. In addition, target values are proposed, which represent the benchmark to which indicator data are to be compared.

This planning process will ultimately capture the vision of a desired future state for the South Porcupine Hills, which can be used to inform discussions with partners and stakeholders with regards to specific actions. In addition, a multi-stakeholder coordinated plan such as this could be a valuable starting point for future revisions to the C5 Forest Management Plan (which includes the South Porcupine Hills), scheduled for April 2016 (Government of Alberta, 2010).

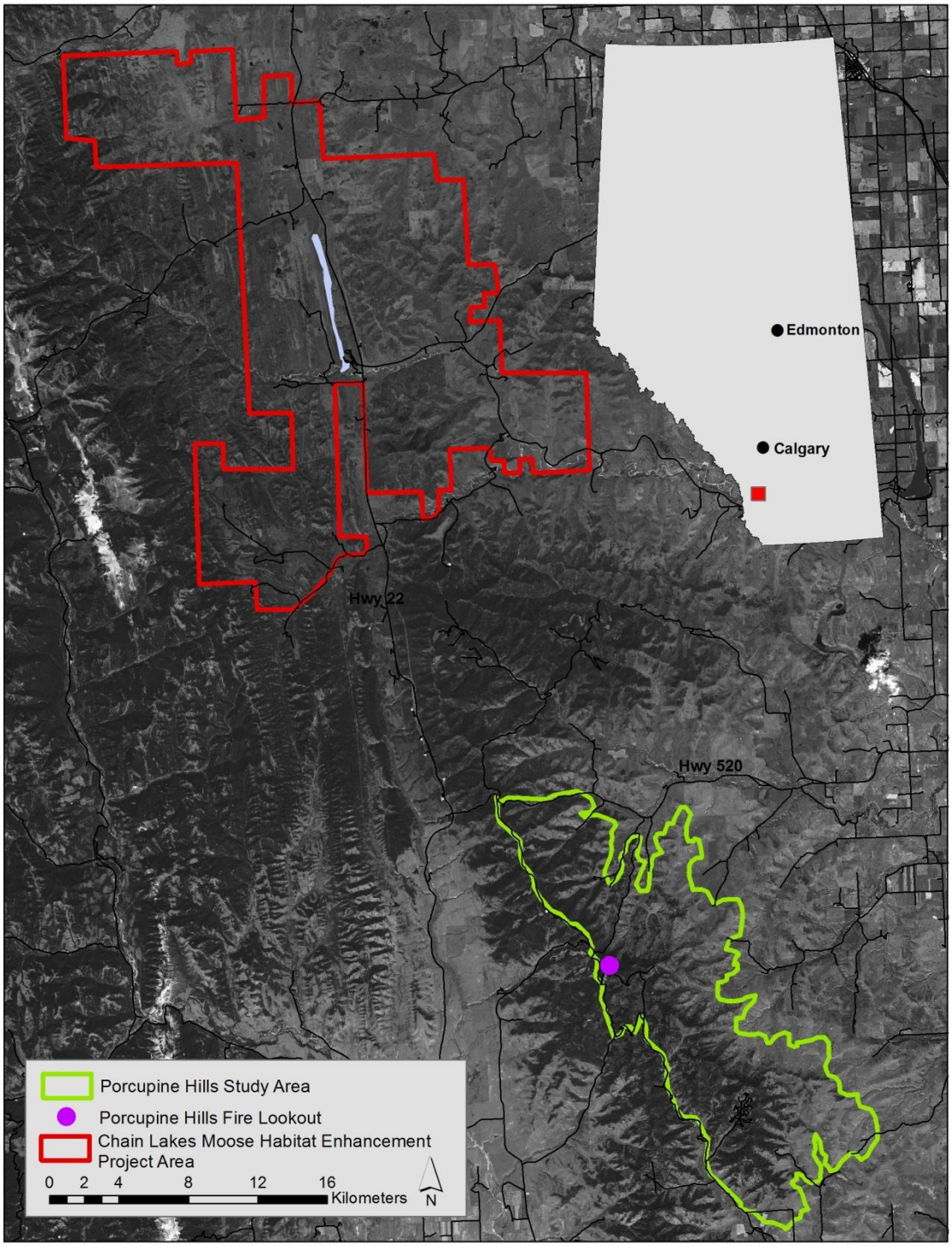

Figure 12. Geographic proximity of the proposed South Porcupine Hills study area to the Chain Lakes study area, Alberta, Canada.

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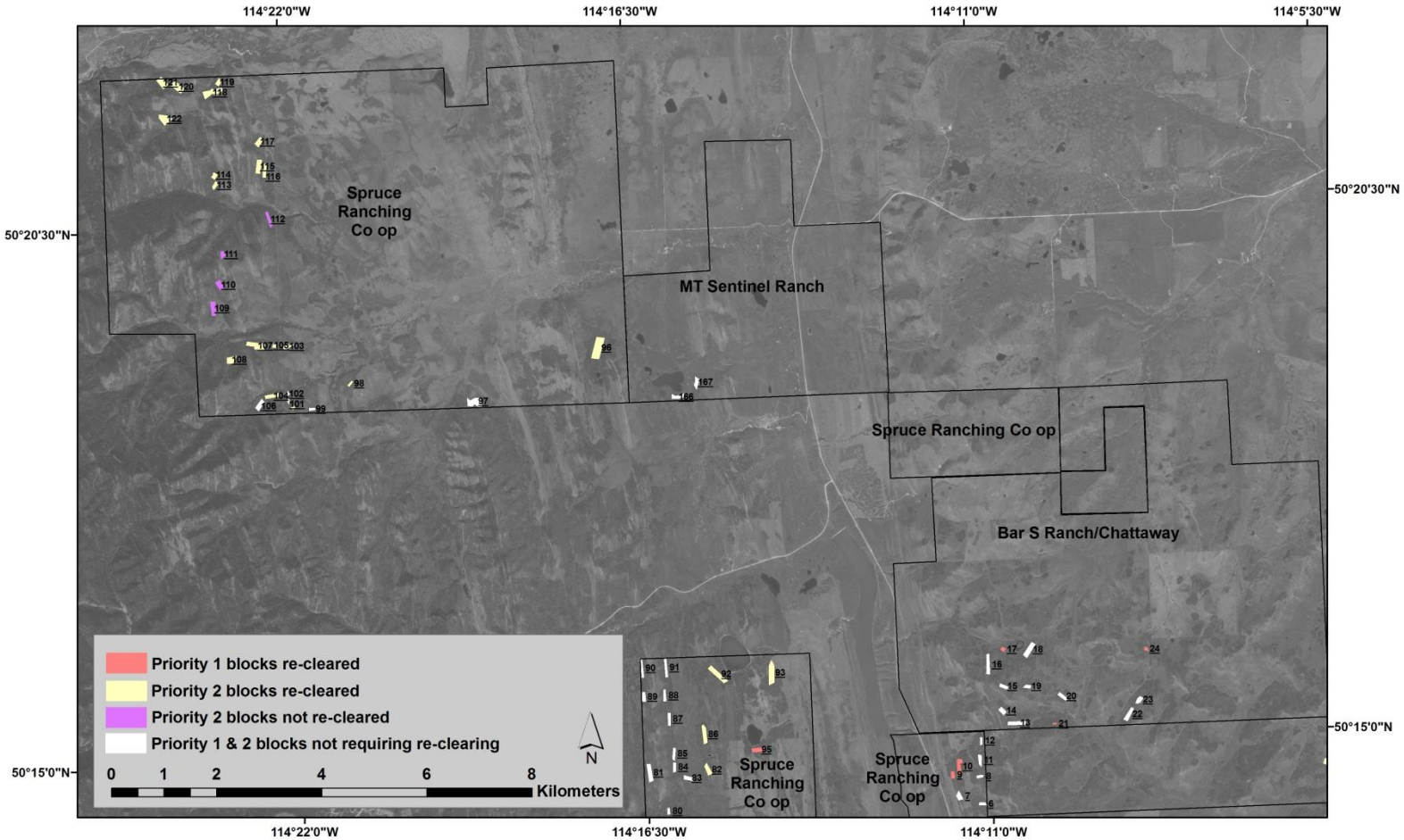
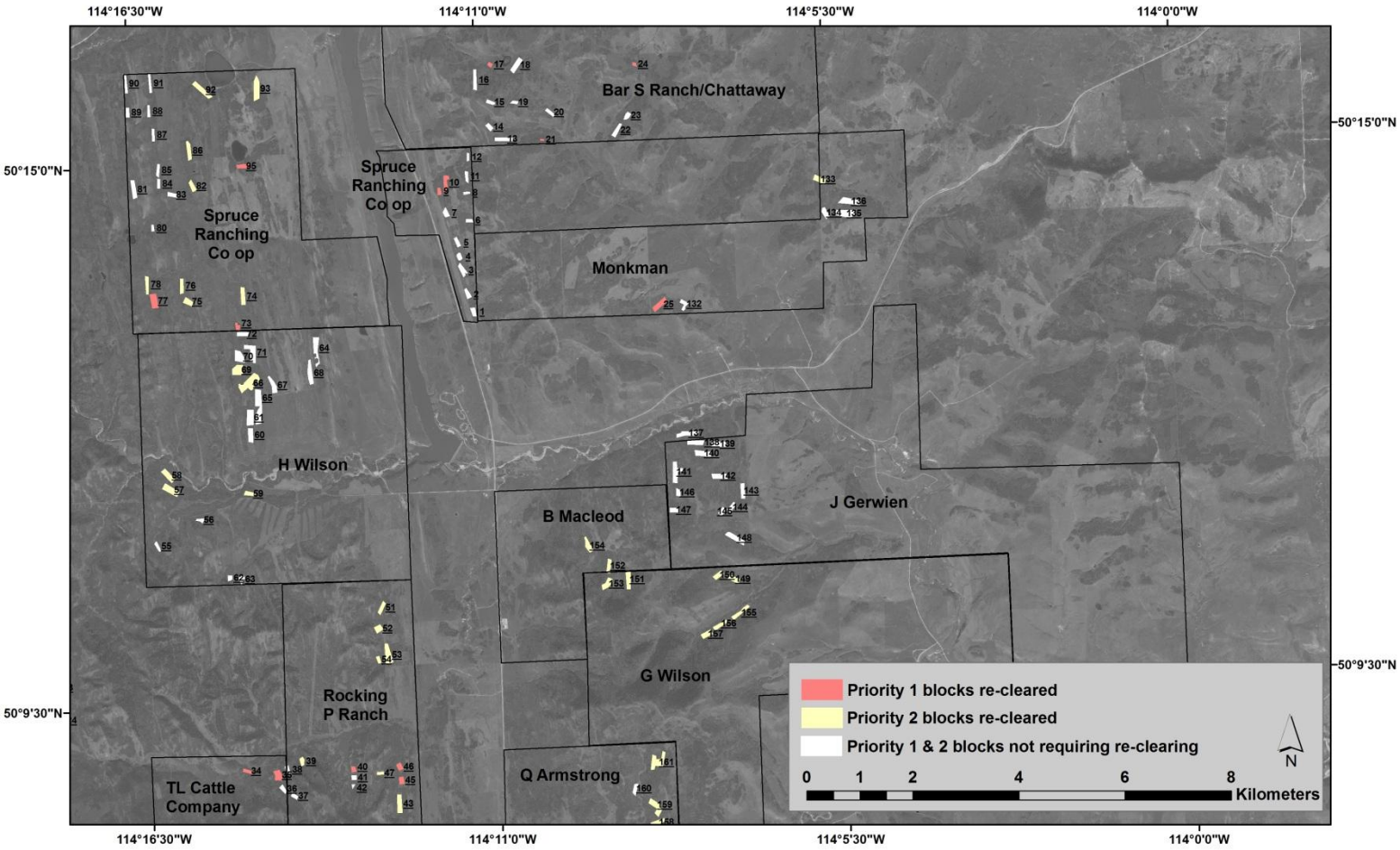
7.0 APPENDICES

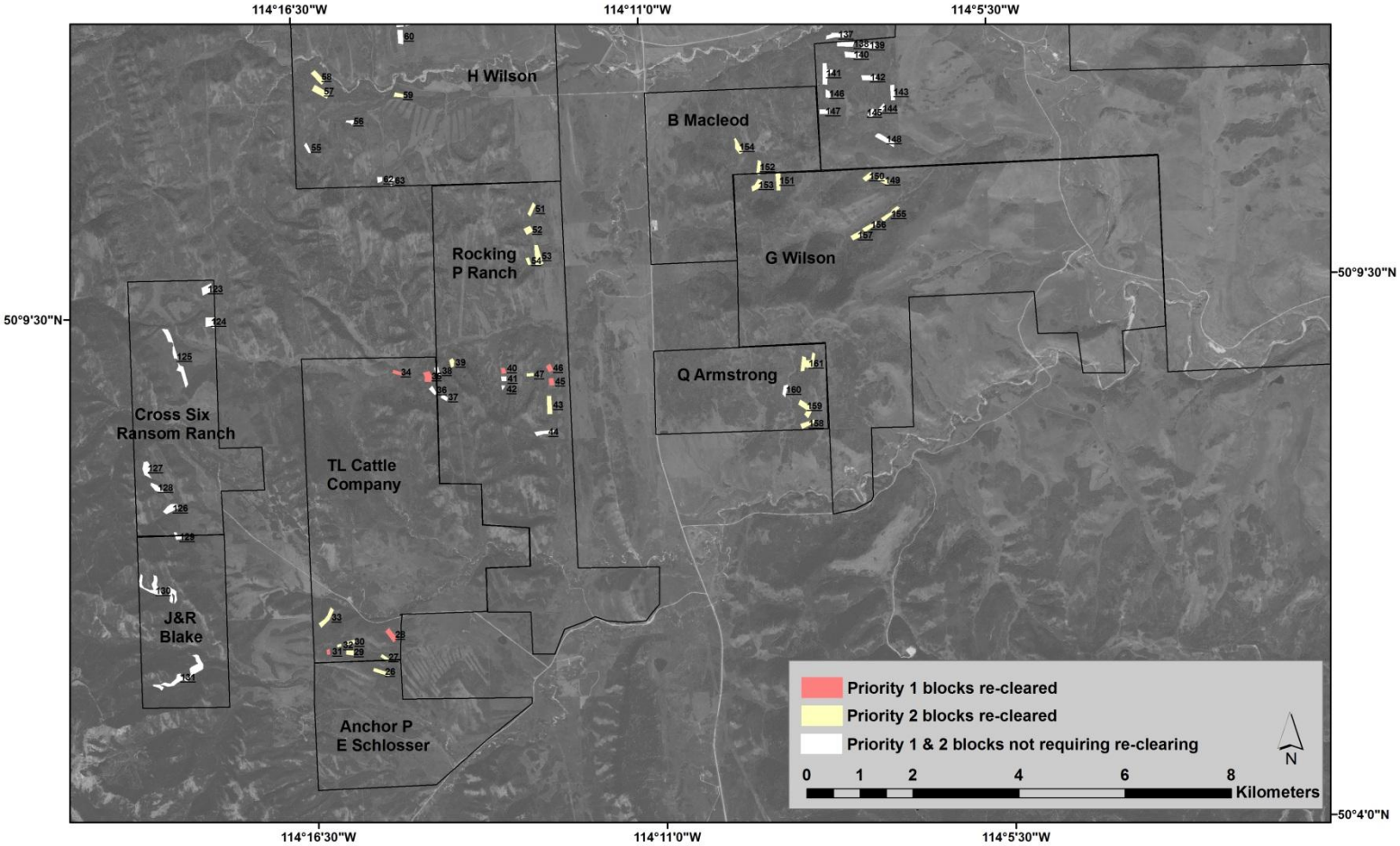
Appendix 1. Moose habitat enhancement project area with lessee boundaries and treatment block locations.



Appendix 1. Continued.



Appendix 1. Continued.



Appendix 2. Browse survey form, 2000 - 2001.

DATE: _____

SITE NUMBER: _____

PLANT SPECIES: _____

% OF SPECIES: _____

#	HEIGHT OF STEM (M)	TOTAL # OF LEADERS ON STEMS	NUMBER OF LEADERS BROWSED	PLANT CONDITION (EVIDENCE OF PAST BROWSING)			
				NOT HEDGED	LIGHTLY HEDGED	MODERATELY HEDGED	SEVERELY HEDGED
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
TOTAL							

Appendix 3. Pellet group survey form, 2000 - 2001.

PELLET GROUP SURVEY

		NUMBER OF PELLET GROUPS	TOTAL
TRANSECT #1	MOOSE		
	ELK		
	DEER		
	GROUSE		
	CATTLE		

		NUMBER OF PELLET GROUPS	TOTAL
TRANSECT #2	MOOSE		
	ELK		
	DEER		
	GROUSE		
	CATTLE		

NOTES:

GENERAL MAP OF SITE

N

Appendix 4. Lessee, block number, location, priority rating and year re-cleared.

Lessee	Block #	UTM (Zone 11U) Easting	Northing	Legal land description	Priority rating	Acres	Hectares	Cleared	Re-cleared	Notes
Q. Armstrong	158	704073	5557639	SE 1-14-2-W5	2	3.1	1.3	1987-88	2005	
	159	704073	5557639	SE 1-14-2-W5	2	4.8	1.7	1987-88	2005	
	161	704059	5558775	NE 1-14-2-W5	2	5.0	2.0	1987-88	2005	
M. Blades	39	697456	5558828	NE 5-14-2-W5	2	5.0	2.0	1985-86	not done	open grass
	43	699315	5558057	SE 4-14-2-W5	2	11.0	4.5	1985-86	2004	
	45	699351	5558418	NE 4-14-2-W5	1	8.0	3.2	1985-86	2004	
	46	699340	5558731	NE 4-14-2-W5	1	6.0	2.4	1985-86	2004	
	47	698934	5558588	NE 4-14-2-W5	2	6.0	2.4	1985-86	2004	
	51	699009	5561794	NE 16-14-2-W5	2	7.0	2.8	1985-86	2004	
	52	698943	5561328	E½ 16-14-2-W5	2	6.0	2.4	1985-86	2004	
	53	699170	5560766	SE 16-14-2-W5	2	14.0	5.7	1985-86	2004	
	54	698938	5560720	SE 16-14-2-W5	2	3.0	1.2	1985-86	2004	
R. Blades	27	696299	5553131	NE 19-13-2-W5	2	4.0	1.6	1985-86	2004	
	28	696527	5553483	NE 19-13-2-W5	1	9.0	3.6	1985-86	2004	
	29	695636	5553169	NW 19-13-2-W5	2	5.0	2.0	1985-86	2005	
	30	695564	5553350	NW 19-13-2-W5	2	4.0	1.6	1985-86	2004	
	31	695218	5553143	NW 19-13-2-W5	1	3.0	1.2	1985-86	2005	
	32	695459	5553322	NW 19-13-2-W5	2	4.0	1.6	1985-86	2005	
	33	695141	5553769	NW19 + SW30-13-2-W5	2	8.0	3.2	1985-86	2005	
	34	696469	5558622	NW 5-14-2-W5	1	5.0	2.0	1985-86	2005	
	35	697090	5558468	NW 5-14-2-W5	1	9.0	3.6	1985-86	2005	

Appendix 4. Continued.

Lessee	Block #	UTM (Zone 11U) Easting	Northing	Legal land description	Priority rating	Acres	Hectares	Cleared	Re-cleared	Notes
B. Macleod	152	703272	5562519	SW 24-14-2-W5	2	3.1	1.3	1987-88	2004	
	154	702787	5562946	SW 24-14-2-W5	2	2.6	1.1	1987-88	2004	
B. Monkman	25	704184	5567381	SW 6-15-1-W5	1	5.0	2.0	1987-88	1996/?	re-cleared own
	133 (part)	707143	5569768	W1/2 9-15-1-W5	2	1.3	0.5	1987-88	1996/?	re-cleared own
E. & C. Schlosser	26	696521	5552876	SE 19-13-2-W5	2	9.0	3.6	1985-86	2004	
G. Wilson	149	705706	5562260	NE 18-14-1-W5	2	2.0	0.8	1987-88	2004	
	150	705079	5562347	NE 18-14-1-W5	2	4.4	1.8	1987-88	2004	
	151	703640	5562270	N1/2 13-14-2-W5	2	5.0	2.0	1987-88	2004	
	153	703235	5562167	NW 13-14-2-W5	2	2.0	0.8	1987-88	2004	
	155	705697	5561578	E1/2 18-14-1-W5	2	4.5	1.8	1987-88	2004	
	156	705415	5561382	S1/2 18-14-1-W5	2	3.3	1.3	1987-88	2004	
	157	706103	5561205	S1/2 18-14-1-W5	2	2.0	0.8	1987-88	2004	
H. Wilson	57	695066	5563810	SW 30-14-2-W5	2	6.5	2.6	1990	2004	
	58	695095	5564022	SW 30-14-2-W5	2	6.5	2.6	1990	2004	
	59	696457	5563635	SW 29-14-2-W5	2	3.2	1.3	1990	2004	
	66	696486	5565851	SW 32-14-2-W5	2	16.6	6.7	1990	2004	
	69	696214	5566206	W1/2 32-14-2-W5	2	7.7	3.1	1990	2004	
C. Chattaway	17	701029	5571932	NW 14-15-2-W5	1	6.0	2.4	1985-86	?	re-cleared own
	21	702009	5570531	SE 14-15-2-W5	1	3.0	1.2	1985-86	?	re-cleared own
	24	703742	5571943	NE 13-15-2-W5	1	5.0	2.0	1985-86	?	re-cleared own
M. Blades	40	698425	5558633	NW 4-14-2-W5	1	3.0	1.2	1985-86	?	re-cleared own

Appendix 4. Continued.

Lessee	Block #	UTM (Zone 11) Easting	Northing	Legal land description	Priority rating	Acres	Hectares	Cleared	Re-cleared	Notes
Spruce	9	700075	5569549	E1/2 10-15-2-W5	1	3.7	1.5	1984-85	2009	
Ranching	10	700187	5569701	NE 10-15-2-W5	1	11.0	4.5	1984-85	2009	
Co-op	73	696295	5566992	SW 5-15-2-W5	1	1.7	0.7	1984-85	2005	
	74	696402	5567549	SW 5-15-2-W5	2	8.8	3.6	1984-85	2005	
	75	695280	5567486	SE 6-15-2-W5	2	5.0	2.0	1984-85	2005	
	76	695258	5567808	E1/2 6-15-2-W5	2	4.1	1.7	1984-85	2005	
	77	694211	5567414	SW 6-15-2-W5	1	9.7	3.9	1984-85	2005	
	78	694536	5567904	W1/2 6-15-2-W5	2	5.1	2.0	1984-85	2005	
	82	695491	5569667	NE 7-15-2-W5	2	4.3	1.7	1984-85	2009	
	86	695378	5570193	NE7 + SE18-15-2-W5	2	7.2	2.9	1984-85	2009	
	92	695583	5571500	NW17 + NE18-15-2-W5	2	5.8	2.3	1984-85	2009	
	93	696566	5571565	NE 17-15-2-W5	2	4.2	1.7	1984-85	2009	
	95	696343	5570045	NW 8-15-2-W5	1	3.1	1.3	1984-85	2009	
	96	693291	5577627	NE 1-16-3-W5	2	16.0	6.5	1985-86	2006	
	98	688643	5577001	SE 4-16-3-W5	2	3.0	1.2	1985-86	2006	
	100	687447	5576481	SW 4-16-3-W5	2	2.0	0.8	1985-86	2006	
	103	687418	5577673	NW 4-16-3-W5	2	5.0	2.0	1985-86	2006	
	104	687217	5576781	SE 5-16-3-W5	2	6.0	2.4	1985-86	2006	
	105	687150	5577669	NE 5-16-3-W5	2	2.0	0.8	1985-86	2006	
	107	686699	5577781	NE 5-16-3-W5	2	10.0	4.0	1985-86	2006	
	108	686302	5577399	NW 5-16-3-W5	2	10.0	4.0	1985-86	2006	

Appendix 4. Continued.

Lessee	Block #	UTM (Zone 11) Easting	Northing	Legal land description	Priority rating	Acres	Hectares	Cleared	Re-cleared	Notes
Spruce	109	686051	5578335	SW 8-16-3-W5	2	5.0	2.0	1985-86	-	not cleared
Ranching	110	686133	5578921	W1/2 8-16-3-W5	2	5.0	2.0	1985-86	-	not cleared
Co-op	111	686202	5579408	NW 8-16-3-W5	2	2.0	0.8	1985-86	-	not cleared
	112	687084	5580100	SE 17-16-3-W5	2	8.0	3.2	1985-86	-	not cleared
	113	686043	5580740	NW 17-16-3-W5	2	5.0	2.0	1985-86	2007	
	114	686043	5580740	NW 17-16-3-W5	2	2.0	0.8	1985-86	2007	
	115	687033	5581079	NE 17-16-3-W5	2	7.0	2.8	1985-86	2007	
	116	687033	5581079	NE 17-16-3-W5	2	5.0	2.0	1985-86	2007	
	117	686894	5531593	SE 20-16-3-W5	2	5.0	2.0	1985-86	2007	
	118	685996	5582509	NW 20-16-3-W5	2	8.0	3.2	1985-86	2007	
	119	686141	5532716	NW 20-16-3-W5	2	3.0	1.2	1985-87	2007	
	120* + 121	685314*	5532597*	NE 19-16-3-W5	2	16.0	6.5	1985-88	2007	
	122	685163	5531925	SE 19-16-3-W5	2	10.0	4.0	1985-89	2007	

Appendix 5. Moose population estimates for WMUs 304 and 308.

WMU and year	Moose density per square km of range	Estimated moose population	Moose population structure	
			Bulls/100 cows	Calves/100 cows
WMU 304				
1981-82	1.1	no estimate	19	70
1983-84	1.3	no estimate	17	66
1985-86	0.7	no estimate	17	40
1988-89	0.5	no estimate	16	40
1990-91	0.8	268	13	40
1993-94	1.3	434	19	71
1995-96	not available	550	30	37
1998	not available	567	25	37
2002	1.8	598	34	41
2009	1.6	535	41	28
WMU 308				
1981-82	1.8	no estimate	33	50
1983-84	1.1	no estimate	9	51
1985-86	0.6	no estimate	15	27
1988-89	0.9	no estimate	16	44
1990-91	1.1	271	41	61
1993-94	1.9	468	25	52
1995-96	1.6	411	44	44
1998	not available	478	40	27
2002	0.8	285	29	43
2009	1.3	385	42	12

Appendix 6. Moose population estimates for WMU 305.

Year	Moose density per square km of range	Estimated moose population	Moose population structure	
			Bulls/100 cows	Calves/100 cows
1977-78	0.4	I/S	I/S	I/S
1979-80	0.5	I/S	I/S	I/S
1981-82	0.2	I/S	I/S	I/S
1983-84	0.2	I/S	I/S	I/S
1985-86	Not surveyed	Not surveyed	Not surveyed	Not surveyed
1988-89	0.1	I/S	I/S	I/S
1990-91	Not surveyed	Not surveyed	Not surveyed	Not surveyed
1993-94	0.1	38	20	40
1995-96	Not available	103	27	36
1998	Not available	49	13	25
2002	0.1	I/S	I/S	I/S
2009	0.2	I/S	I/S	I/S

I/S – Insufficient Sample

These results are based on flying pre-determined areas within WMU 305 (habitat stratified as high, medium and low moose density blocks) which are then used to estimate the moose population density for the entire WMU. However, counts have been too low to calculate a robust estimate of moose density or population size since the early 1990s. During a mule deer survey of WMU 305 in January 2010, the entire WMU was rapidly surveyed for moose during stratification flights. A total of 21 moose were observed, and while this is a coarse measure, this low number suggests the moose population is still below population estimates from the 1990s.

Alberta Conservation Association acknowledges the following partners for their generous support of this project:

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Government of Alberta

TALISMAN ENERGY

Alberta Conservation Association

Conserving Alberta's Wild Side