

Grassland Benchmark Restoration at the Knife Creek Block

RP #07-14 Implementation Report



Prepared for:

Ecosystem Restoration Team, Cariboo-Chilcotin Range Branch, Ministry of Forests and Range



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Introduction

The Cariboo-Chilcotin Grassland Strategy established a “Grassland Benchmark” based on aerial photographs dated between 1962 and 1974. Areas mapped as open range during this first systematic forest inventory are considered benchmark and are to be managed, and in many cases restored, as native grassland (Cariboo-Chilcotin Grasslands Strategy Working Group, 2001).

The Knife Creek Block of the UBC Alex Fraser Research Forest (AFRF) contains 4.14 hectares of Grassland Benchmark. The polygon is centred at UTM coordinates 10U 576532 5767488 (NAD 83). Forest encroachment has been occurring since the early 1900s when permanent settlement in this region increased and the “cool” fires that occurred every 7-20 years were practically eliminated. Grassland restoration for this site was identified in the AFRF Management and Working Plan #3 (2007) pending financial feasibility. In October 2007, Harry Jennings, Team Leader for the Ecosystem Restoration Team, Cariboo-Chilcotin Range Branch, Ministry of Forests and Range approached AFRF about completing a tree removal phase in early 2008. A work plan and budget was approved and AFRF signed a grant agreement with the Ministry of Forests and Range (MOFR), Range Branch (titled UBC Research and Viewing Area for Demonstration of Restoration Methods and Monitoring of Ingrown Forest and Encroachment).

Being in the Very Dry Mild Subzone of the Interior Douglas Fir Zone (IDFxm) at 770 m above sea level, this site is considered an Upper Grassland. Such grasslands are transitional between a grassland dominated landscape at lower elevations and a forested landscape at higher elevations. Having a moister, cooler climate than grasslands in the Bunchgrass Biogeoclimatic Zone, they tend to undergo more forest encroachment (Cariboo-Chilcotin Grasslands Strategy Working Group, 2001).

This site still has several species of native grasses so it is important to protect them during the tree removal phase and encourage natural regeneration throughout the restoration area. They include: *Pseudoroegneria spicata* (*Agropyron spicatum*), *Festuca occidentalis*, *Stipa occidentalis*, *Stipa richardsonii*, *Trisetum spicatum*, *Elymus glaucus glaucus* and *Poa compressa* (naturalized in BC) and. Of great concern is the prevention of invasive plant introduction, especially since the site is adjacent to a well travelled road and is used for cattle grazing and loafing, both of which can introduce seeds to disturbed areas.

The objectives as listed in the Best Management Practice Guidelines for Harvesting Treatments on CCLUP Grassland Benchmark Sites (Cariboo-Chilcotin Grasslands Strategy Working Group, 2007) are to:

1. Manage density, distribution and species composition of trees to produce sparsely treed, open grassland conditions that more closely reflect grassland conditions prior to the introduction of fire control and cattle grazing.
2. Minimize long-term damage to grassland vegetation and soils resulting from harvesting treatments.
3. Maintain treated sites through time in open grassland, sparsely treed condition by regularly treating to kill newly established conifers.

This report summarizes the implementation of the tree removal work plan for the AFRF site.

Methods and Results

Planning

Using ArcView GIS 3.2, the Grassland Benchmark shapefile was superimposed over a 2006 orthomosaic of the Knife Creek Block and a map was created for field reconnaissance. A walk through the site ascertained biological boundaries based on the presence of residual grasses in the understory and the fairly even-aged nature of the encroachment trees. This new boundary was gpsd and a new polygon was created in ArcView GIS 3.2 (Fig. 1).

In order to accommodate the administrative side of harvest planning, conducting block referrals and intentionally planning for no reforestation, we made a major amendment to our UBC AFRF Stewardship Plan and created Stocking Standards for Grassland Restoration (Appendix 1). We then prepared a regular Site Plan and requested harvesting authority through the Ministry of Forests and Range under our Special Use Permit and Licence to Cut tenures. The Benchmark area is to be removed from the provincial forest inventory.

The Knife Creek site was not uniform. Open conditions were still present in 0.64 ha (0.08 ha of which is permanent road). A 0.39 ha patch of mature trembling aspen, as well as a cold-air pooling site occupied by hybrid spruce, was set aside as a Wildlife Tree Patch (WTP). Being relatively rare on the Knife Creek Block, aspen clumps like these are tremendously valuable to cavity-nesting wildlife. While this clump has a Douglas-fir understory, it was decided that no slashing would be done as that work would require significant removal of danger trees among the aspen to a point where the value of the aspen would be lost. The remaining area was encroached predominantly by Douglas-fir with some aspen as well. Veteran Douglas-fir and recruitment vets were marked to keep (paint dots) so as to retain the open-forest nature that once occurred there. Recruitment trees have the clumped distribution typical to dry-belt Douglas-fir and several have branchy, gnarly form conducive to future wildlife use. Thirty veteran Douglas-fir, plus a total of about 100 Douglas-fir and aspen > 12.5 cm DBH were marked outside of the WTP. Individuals of those species having < 12.5 cm DBH were scheduled to be retained during the implementation process as well. Scattered individual aspen tree and veteran Douglas-fir and snags were wildlife tree/danger tree assessed and marked as 'safe' or 'dangerous'. One No Work Zone (NWZ) was established.

Existing coarse woody debris was to be retained intact so that it could continue to provide habitat and ecosystem functions. Logging debris, however, was to be removed to the landing for disposal by burning. From previous experience with a nearby commercial thinning and pre-commercial thinning project, we know that the needles from Douglas-fir slash left on the ground can accumulate to >20 cm depths and smother the groundcover. The volume of logging debris was expected to be considerable and therefore very likely to cause soil scorching if burned on site in spring. If the debris would be left on site over the summer, it would additionally present increased fuel-loading and risk of wildland interface fire. The idea of using a sloop on skids – a large pan in which debris is burned as it is created – was investigated, but none were available

locally in the time frame we had to complete the work. We chose not to use small burn piles on the restoration area as we wanted to avoid soil scorching and subsequent invasive plant invasion, plus maintain as much of this small grassland area as possible. We looked into chipping the slash and debris on-site but decided against it as the decay process uses up the soil nitrogen otherwise needed for new grass growth. We elected, therefore, to remove all the slash to an existing landing adjacent to the project area. Chipping at the landing for delivery to a co-generation plant is possible but was uneconomical at this phase of the restoration project. Chipping and cost

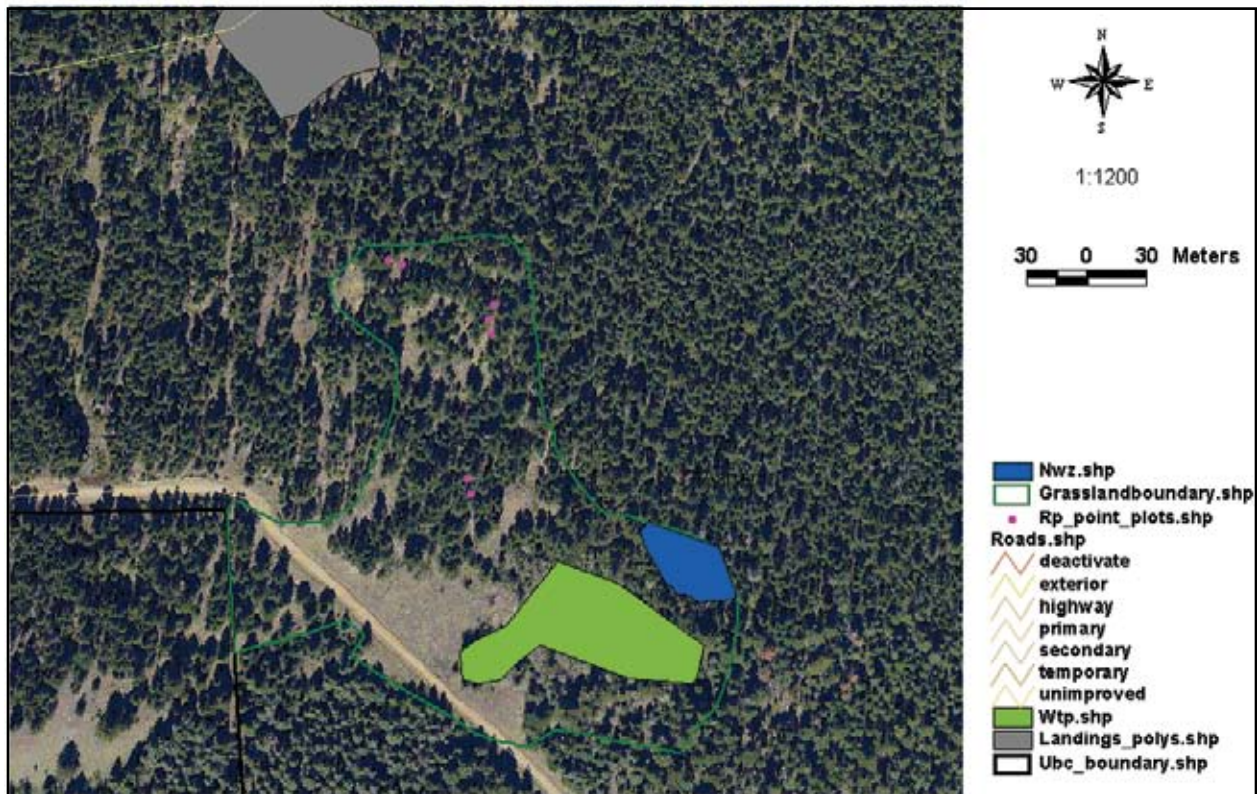


Figure 1: Biological perimeter of grassland restoration area showing WTP, NWZ, photopoints (pink) and landing.

evaluations will be pursued at a later phase.

The rancher whose range permit overlaps with the restoration site was contacted and the project discussed. He was supportive of the increased range opportunities it should lead to. The cattle will be kept to the east of the pipeline (to the east of site) until at least August 2008 so as to allow one full, undisturbed grass growing season.

All aspects of planning this project, including literature reviews, work planning and budgeting, field work, mapping, creation of stocking standards and administration took 5.3 person-days.

Effectiveness Monitoring

Permanent photo-points were established according to the methodology outlined in Hall (2002), although temporary metre-boards had to be used to make the best use of time. Four photopoints were installed and photographed using a FUJIFILM S 5100 digital camera with a 55 mm zoom lens (at its widest field of view) on November 13, 2007 (Fig.2). Photos should ideally be taken

before the end of the grass growing season, but in this instance we had to make due with the time available. Witness trees were painted with glo-pink and butter-soft aluminum tags with bearings and distances were stapled on the bases of the boles. Photopoint locations were gpsd (accuracy averaged around the 8 m mark). Steel railway spikes were pounded into the ground at both the photopoints and camera points (for relocation with metal detector if needed) and wooden stakes painted glo-pink were put up. While the likelihood of the stakes getting knocked over during logging was high, it was thought that their placement on the ground would help relocate the witness tree stumps and steel spikes following harvesting. Installation, photography, photo labelling and filing took 8 person-hours. Permanent photopoint metre-boards, as in Hall (2002) were constructed and installed in summer 2008 and post-treatment photos were taken on July 21, 2008. Photos should be taken annually in mid-July to early August using the same lens configuration, carefully labelled and filed.

Operations

Logging:

The pre-work meeting with Romar Contracting was done on-site on Feb. 11, 2008. Falling began on February 13 and continued through February 18, 2008. Trees were hand-felled (Fig. 2) and both a line- and grapple skidder were employed to move both merchantable (>12.5 cm dbh) and non-merchantable stems to the landing. An existing landing nearby to the site was used for processing and bucking as well as for piling debris. For the most part, stems were full-tree skidded to increase efficiency of debris collection. The existing open part of the restoration site was purposely restricted from landing-type activities to prevent soil disturbance.

Conditions for logging were excellent; the ground was well frozen and there were 50 cm of snow in open areas. Temperatures remained below freezing throughout the logging phase. For the most part, falling and slashing were done simultaneously. This process was



Figure 2: Day one of hand-falling, February, 13, 2008.

recommended as being most efficient following a fuel reduction research project (Mitchell, 2007). The slash and debris effectively armoured the ground and allowed skidder access to most areas in a manner that spread out activity and prevented soil disturbance. The skidder operators also placed poles across disturbance-prone knoll crests to prevent surface scraping (Fig. 3). They kept an eye out for soil exposure and ceased skidding over those areas once observed. Most skid trails retained an ice base which further prevented disturbance. This crew did an excellent job of preventing logging-induced soil disturbance. As requested, they also refrained from skidding over existing coarse woody debris (Fig. 4).



Figure 3: Skid trails armoured with slash with strategic pole placement in disturbance-prone sites (arrow).

Overall, the log quality was quite good and much better than anticipated (Fig. 5). While there certainly were limby stems there were also some excellent sawlogs, some even of peeler quality. As the timing of this operation occurred at the tail end of when the mills in our sales agreement were accepting logs, our only option was to ship sawlogs. The logging phase, including falling, most slashing, skidding, bucking and loading the logging trucks took 18 person days among 4 people. The grapple skidder did move some unmerchantable logs along with the merchantable stems in this phase, but the amount was not quantified. A total of 221.2 cubic metres of sawlogs were shipped. Trucking, brokerage and stumpage were additional costs (Table 1).

Debris Removal:

Due to the timing of this operation, we had the opportunity to take advantage of some machinery additional to those listed in the work plan. Nilsson Select Contracting Ltd. just finished a job on



Figure 4: Line skidder avoiding existing coarse woody debris.



Figure 5: Douglas-fir sawlogs from removal of grassland encroachment.

the Research Forest and was available to bring a forwarder to the site to collect more debris (Fig. 6). On February 25, the owner-operator began collecting debris using the machine's grapple. It took from one to 1.5 hours to fill the bed and bring it to the landing. He decided to employ his log loader as well, as its grapple is more hand-like and could more quickly collect and pile debris that the forwarder could then pick up (Fig. 7). This decreased the forwarder cycle time to

the landing to about 30 minutes. The forwarder worked three five-hour days, predominantly in morning hours on frozen ground. The loader was employed for about 12 hours. About 22 partial forwarder loads of 5-7 cubic metres each (total ~132 cubic metres) were delivered to the landing. Generally, poles lined the bottom of the bed and smaller debris was loaded on top.

In the interim between the logging phase and the debris collection phase, significant snow melt



Figure 6: Forwarder transporting non-merchantable stems and debris to landing.



Figure 7: Loader with multi-pronged grapple “raking” and piling debris for forwarder to pick up.

occurred, especially on south-facing aspects. Five instances of soil disturbance (max. 3 m x 3 m) from the tracked machines were found. One knoll-crest was ribboned off to restrict further activity. The fact that melting accelerated once tree cover was removed added extra challenge to the prevention of soil disturbance by the grapples and crawler tracks. For the most part, this debris collection process was very effective at moving large quantities of debris with the fewest number of machine passes. It was advantageous to take this opportunity to advance the project towards completion while there was still frost in and snow on the ground. All that remained of the debris collection phase for Romar Contracting was to slash and remove a small amount of poles, regeneration and fine debris (accumulations of branches >15 cm deep). This was restricted to 5 early mornings. A Ford New Holland 30 HP tractor with winch, grapple, loader and roll-over bar/canopy with a hydraulic trailer were used to collect and deliver debris to the landing. Smaller debris was roughly hand-piled with a hay rake and picked up by the loader. The ATV and arch, as listed in the workplan, were not necessary following the loader/forwarding debris removal. We do know, however, that this combination is effective at removing larger debris (Mitchell, 2007), especially when there is sufficient snow and frost to protect the soil surface from the multiple skids. It was estimated that for every cubic metre of merchantable wood there were 9 cubic metres of waste generated in this operation.

Though not an option for this project, future grassland restoration projects could also consider utilizing a processor/forwarder/loader team for the entire operations phase. It was suggested that a processor could cut, sort and pile non-merchantable stems during the first pass in a manner that would facilitate pick-up by the forwarder and ultimately reduce the number of machine passes required to clear the restoration area.

Table 1: Costs per hectare for grassland restoration operations over net 3.75 ha at Knife Creek

Operation	Cost Per Hectare
Planning, Layout, Admin and Supervision	\$1012*
Logging, Skidding, Bucking, Loading	\$3120
Debris Removal: Loader/Forwarder	\$1008
Debris Removal: Tractor/Trailer/Manual	\$616
Trucking, Stumpage, Brokerage	\$538
Debris Burning (to be done in next phase)	N/A
Controlled Burn of Site (not incl. Unit Crew)	\$1331
<i>Subtotal Operational Costs per Hectare</i>	<i>\$7625</i>
Log Revenues	-\$2772
<i>Total Operational Costs per Hectare</i>	<i>\$4853</i>

*These costs are proportionately high due to the small area of the block. These are fixed planning costs that would average out much lower per hectare on a larger sized block.

Controlled Burn of Site

The implementation of a controlled burn immediately following the tree removal phase was investigated and debated in depth. While considerable effort was invested into debris removal from the site, much fine woody debris still remained across the ground surface, especially on

major skid trails. A reintroduction of a low intensity, low severity fire would rapidly process much of the material and release nutrients to the soil. It was unknown, however, if the removal of logging debris was sufficient to prevent soil scorching if fire were to be introduced. The AFRF site had been under the influence of tree cover for almost a century, judging from tree growth rings. Conifer needle accumulation and moss growth would have acidified the soil (Brown and Kapler, 2000). It is hoped that the existing grass community will remain and expand to reoccupy formerly treed spaces. Combustion of needles and moss would increase soil and litter pH for a few years (Feller, pers. comm., May 13, 2008) and as grassland soils are typically more alkaline than forest soils (Grassland Conservation Council of BC, 2003), this could assist with vegetation community conversion. We do not know, however, if there is enough of a seed bank and rootstock present for open grassland plants to immediately occupy the site before wind-borne invasive plant seeds get established in a fire-enhanced seed bed. Other unknowns include whether or not burning would denature tree seeds or enhance their germination, or whether pinegrass (*Calamagrostis rubescens*) might become dominant over grassland species as it has at Churn Creek (Cheyne, 2007).

If the woody debris were to be left to decay without burning, that process would take many years (decades). Some space on the site where debris accumulations remain thick (skid trails) would not revert to grassland very quickly. The majority, though, would have vegetation cover fairly quickly as growth was evident by the end of April when burning was considered. While there are presumably thousands of tree seeds present, the fact that logging created almost no soil disturbance suggests that tree germination would be minimal. Holding off on burning would allow for the existing vegetation community to be assessed and for native grass seeding in patches that are bare (the latter would need to happen in mid-July after seed collection from the Knife Creek Mule Deer Grassland nearby). By minimizing disturbance, the establishment of invasive plants would also be minimized. The vegetation response could be monitored for a growing season to watch for initial treatment response to that point and the introduction of fire could be evaluated at a later date.

The offer from the MOFR Cariboo Fire Centre to provide a unit crew to help fireguard the site as part of their staff training was accepted so on Apr. 29, 2008 fine fuels were raked back from the boles of residual trees and large woody debris, as well as the WTP and transition to the adjacent forest. Larger debris was spaced or cut into smaller pieces. Fire weather was assessed daily at the end of April and on May 2 conditions were suitable to commence blacklining around the perimeter, as well as around retention features. As conditions continued to be suitable for burning on May 3, the Research Forest Manager decided to proceed with the full burn. It was managed by three people and was completed by May 4. Mop-up was provided by the Fire Centre on May 5 (crew, tanker truck, temporary water container). The site was checked daily throughout the ensuing week for smokes and those found extinguished with hand-tank pumps.

Surface fuels were effectively burned, aside from the skid trails where snow underneath prevented combustion. Unfortunately, the two large woody debris logs so well preserved by the loggers were partially consumed. It would have been best to douse these with water before the burn in addition to raking back the surrounding fine fuels. The burning crew were generally delighted with the fire response to their drip-torch ignition patterns ("It worked just like it was

supposed to!”).

Douglas-fir Bark Beetle Management

The MOFR Forest Science Program provided experimental use of 230 MCH bubble-paks – containing an antiaggregation pheromone for Douglas-fir beetle – that were stapled to the residual Douglas-fir in May 2008 so as to discourage infestation by bark beetles.

Extension

An interpretive sign (60 by 40 inches) was designed and printed describing the significance of grassland restoration in the Cariboo-Chilcotin to visitors to the Research Forest. It was installed at the pull-out along the Big Meadow Rd. at the west end of the opening. An additional “Permanent Photo Point” sign (18 x 12 inches) was placed a little further along the road that shows a “before” photo from that spot. This is the sixth in a series already on the Research Forest (Appendix 3). The project was also presented at the 2008 Southern Interior Silviculture Committee’s Winter Workshop, March 31-April 2, in Penticton, BC.

The Future

Now that the grassland has been reopened, it will be an ongoing effort to ensure that tree encroachment is held at bay. The fall of 2007 was an incredible cone production year for Douglas-fir and spruce across the region. According to the Cariboo-Chilcotin Grasslands Strategy Working Group (2001) the rate of tree encroachment in the region has not been constant but rather in phases where there is a high rate of establishment followed by periods with relatively low rates of establishment. In light of the prodigious quantity of seeds on the ground at the same time that the tree removal operation occurred, we might expect considerable tree seed germination to follow.

A controlled burn could again be pursued in future to kill seedlings and further encourage native grass establishment and growth. Now that much of the woody debris has been removed, such a fire would have to rely on enough grass biomass to carry the flames. It might take a few years before the grass community on this site is sufficient to do so. Alternatively, future encroachment can be similarly treated by manual brushing. Annual inspections over the next 2-5 years should actively look for signs of encroachment, keep note of grass establishment and monitor for invasive plants.

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APPENDIX 1

Stocking Standards for Grassland Restoration (from Day, 2007 B) (RESULTS Standards ID: UBC GRASS)

Application: Upper Grassland and Open Range Stocking Standards apply to permanent grassland benchmark areas identified by the Cariboo-Chilcotin Grasslands Strategy Working Group (2001) in the KC FDU that are prescribed to undergo restoration.

Definition of Upper Grassland and Open Range Stocking Standards: For stands that are managed to reduce forest in-growth and encroachment onto former open range, post-harvest stand structure will be prescribed according to the interpreted historical stand structure of the sites. These stands generally occur above 900 m in elevation and border with historically forest-dominated sites in the Interior Douglas Fir Biogeoclimatic Zone. Excess immature, understory and co-dominant trees will be targeted for removal so as to regain conditions reflective of fire-maintained ecosystems that existed prior to the reduction of fire frequency over the past century. Grasslands are defined as having <10% tree cover, while the term ‘open range’ typically refers to areas having <15% tree cover, some of which may be aggregated in small, localized stands (Cariboo Chilcotin Grasslands Strategy, 2001). According to the Rocky Mountain Trench Ecosystem Restoration Committee (2000), open range is dominated by grasslands with scattered trees (less than 75/ha) while open forest has from 76-400 trees/ha. Significant forest encroachment and in-growth has occurred in these areas over the past century in the absence of regular (7-20 year interval), low-intensity fires.

For moderately to very closed stands of older encroachment and in-growth on benchmark areas, the Cariboo Chilcotin Grasslands Strategy (2001) recommends retention of 90% or more of large veteran trees (>140 years old) and maintenance of a small number of trees to become future veterans. Non-veteran trees >12.5 cm dbh will be retained in a scattered distribution, preferably in clumps. The Strategy recommends a retention rate of 3-4 times the number of retained veterans, however, experience in the Churn Creek Protected Area in 2005 found that a rate of 2-3 times veteran density was better suited to grassland restoration and fire hazard reduction. Localized stands <0.5 ha in size, such as aspen groves, can be retained if they reflect the original nature of the particular open range or open forest. Trees <12.5 cm dbh should be retained at a rate of about 10 times the number of kept veterans, preferably in clumps. Some retention trees can have poor form as this is often conducive to wildlife use, but care should be taken to ensure recruitment trees have sufficient vigour to likely endure to veteran status.

Species preference for residual trees is as follows: Preferred species are Douglas-fir or trembling aspen; Acceptable species are white birch, hybrid spruce, lodgepole pine.

Free Growing density: Veterans: Minimum = 0 stems/ha; Target = 90% of pre-harvest number
Layer 1: Minimum = 0 stems/ha; Target = 25 stems/ha preferred and acceptable. Layer 2,3,4:
Minimum = 0 stems/ha; Target = 100 stems/ha preferred and acceptable.

Minimum Free Growing Age: Free growing may be declared after at least one year post-treatment.

Distribution: Veterans will be distributed according to the nature of the current stand. Layer 1, 2, 3, and 4 trees will be left singly or in groups of up to 0.5 ha in area.

This stocking standard does not infer a financial responsibility for future maintenance of the grassland condition upon the Alex Fraser Research Forest. However, the use of prescribed fire or cutting to restrict subsequent forest encroachment of regenerating trees should be employed periodically over time to maintain the restored grassland and open range conditions. This supports the Williams Lake SRMP objectives of managing benchmark areas as grassland, as well as maintaining or enhancing grassland ecosystems.

Ammended Content December 6, 2007

APPENDIX 2

Permanent Photo Points - “Before” images from November 13, 2007

Note close-ups to right and left of each “1 metre board” were also taken. Red line is at 1 metre.





3.



4.

Permanent Photo Points - “After” images from July 21, 2008



1.



2.



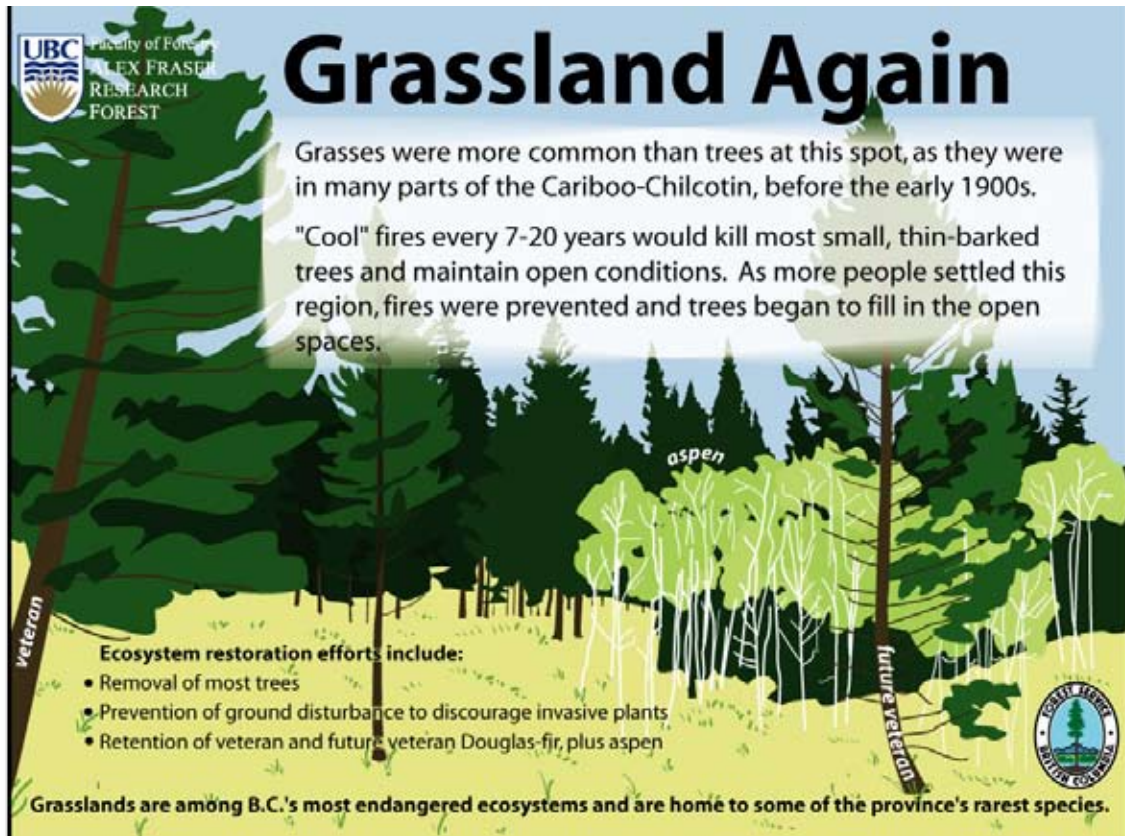
3.



4.

APPENDIX 3

Extension Sign Content



The sign features a stylized illustration of a forest landscape. On the left, a large green tree is labeled 'veteran'. In the center, a smaller tree is labeled 'aspen'. On the right, a tree is labeled 'future veteran'. The background shows a mix of evergreen and deciduous trees. The UBC logo is in the top left, and a smaller circular logo is in the bottom right.

Grassland Again

Grasses were more common than trees at this spot, as they were in many parts of the Cariboo-Chilcotin, before the early 1900s.

"Cool" fires every 7-20 years would kill most small, thin-barked trees and maintain open conditions. As more people settled this region, fires were prevented and trees began to fill in the open spaces.

Ecosystem restoration efforts include:

- Removal of most trees
- Prevention of ground disturbance to discourage invasive plants
- Retention of veteran and future veteran Douglas-fir, plus aspen

Grasslands are among B.C.'s most endangered ecosystems and are home to some of the province's rarest species.

Permanent Photo Point #6

Watch how this view changes over time as this area is restored back to grassland.



Photo taken February 2008

Site History

Status	Year
Open Range	1960
Tree Encroachment	~1920 - 2007
Restoration Initiated	2008

