SIFCo

SIFCo CFA K2R

Slocan Valley Strategic Landscape Level Wildfire Protection Plan Pilot Project

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1. Introduction

SIFCo has made management decisions since inception with climate change adaptation and wildfire behavior in mind and has been involved in planning and carrying out fuel management treatments on and adjacent to CFA K2R since 2009. To date, we have completed 220 ha of WUI treatments and 46 ha of fuel management harvesting.

The location of fuel management efforts has been heavily influenced by the funding parameters of the Strategic Wildfire Prevention Initiative (SWPI) program which is administered by the Union of BC Municipalities (UBCM). After an initial landscape level analysis done in 2009,, SIFCo decided, in 2014, that a landscape level strategy which considered fire movement paths, accessibility, and treatment feasibility was required to guide future fuel management work. The Strategic Fuel Management Plan was completed in 2016. This strategic plan identifies 5 to 7 years of treatment activities on the CFA landbase.

The Strategic Fuel Management Plan will be refined over time with additional field work and revised as necessary to reflect changes in fuel conditions from treatment, harvest or wildfires.

2. Planning Methods

2.1 Fire Behaviour Modelling

In 2014, SIFCo retained Bob Gray, Canadian fire researcher and fire behaviour expert, for professional advice on modelling fire behaviour and fuel types on the CFA landbase.

Gray suggested that we use the FlamMap 5 fire simulator, from the Joint Fire Sciences Program, Rocky Mountain Research Station, US Bureau of Land Management, to model fire behaviour.

FlamMap requires a set of input data prepared as ASCII grids. These are:

1. Elevation
2. Slope
3. Aspect
4. Stand Height
5. Canopy Cover (crown closure)
6. Fuel Model
7. Canopy Base Height
8. Canopy Bulk Density

The stock TRIM digital elevation model was used or interpreted to derive input data grids 1 through 3.

The provincial vegetation resource inventory (VRI) data set was used for input data grid 4 -Stand Height.

Input 5 - Crown Closure - is also based on VRI data. However, review showed that the VRI crown closure often did not reflect current stand crown closure, especially in upper elevation areas. Therefore crown closure was checked and, where required, revised in all VRI polygons using ortho photos and Google Earth.

Input 6 - Fuel Model- is created by assigning a predefined or customized fuel model to each vegetation cover polygon. The goal is to choose fuel models that result in alignment between real world and predicted fire behaviour in various forest and fuel types. Each fuel model contains an estimate of fine fuel load, surface area to volume ratio, a packing ratio, and a fire extinction moisture content. The model predicts rate of spread and flame length, relative to wind speed.

The fuel models were assigned by an algorithm based on VRI vegetation cover. Further adjustment of VRI species composition and stand age were carried out, again mainly in upper slopes, to improve the consistency of fuel model assignment.

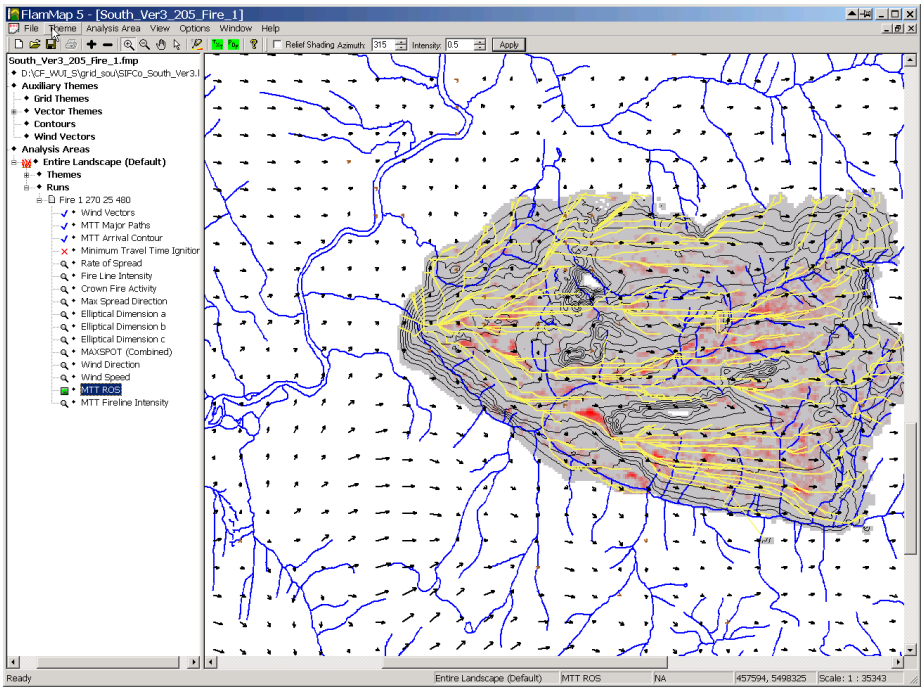
A custom fuel model with modified spread and flammability parameters was developed for closed canopy, low to mid elevation hemlock/cedar forests in the ICHmw subzone for greater modelling accuracy.

Inputs 7 and 8 - Canopy Base Height and Canopy Bulk Density - were assigned by an algorithm based on guidance from the fire modelling professional.

FlamMap also requires information on the weather conditions (temperature, wind speed and direction, cloud cover) for a series of days before the fire and on the day of fire. Weather conditions conducive to extreme fire behaviour but within the range of historical weather conditions were selected.

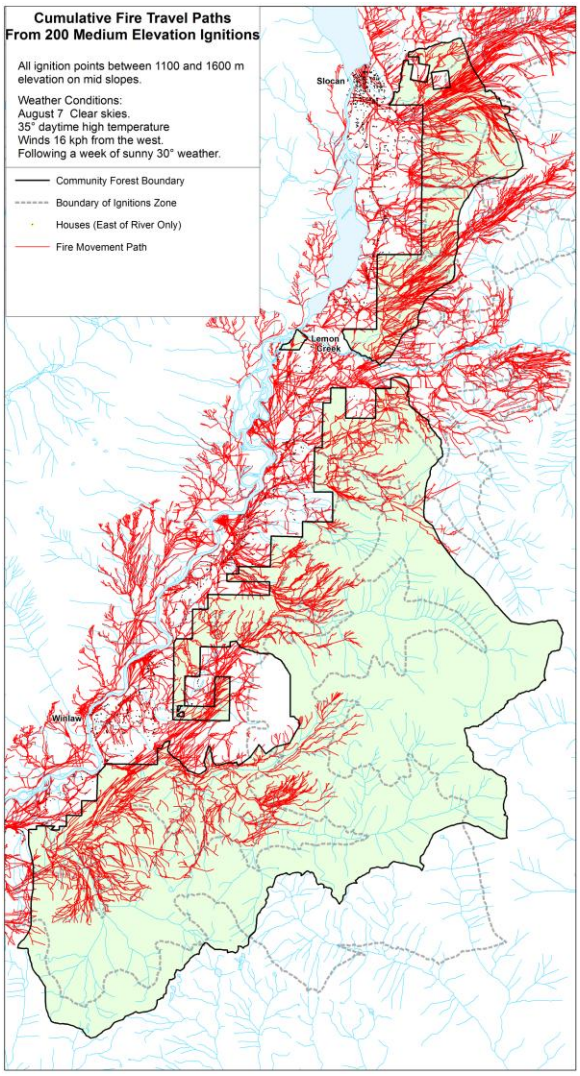
The WindNinja software module is housed inside FlamMap. WindNinja calculates wind patterns using fluid dynamics modelling to reflect the influence of topography and air temperature on wind direction and speed, which are significant in mountainous terrain. These localized wind patterns are used by FlamMap when modelling fire movement.

When all the data sets are prepared, the user can “light a fire” in the virtual landscape and see what happens.

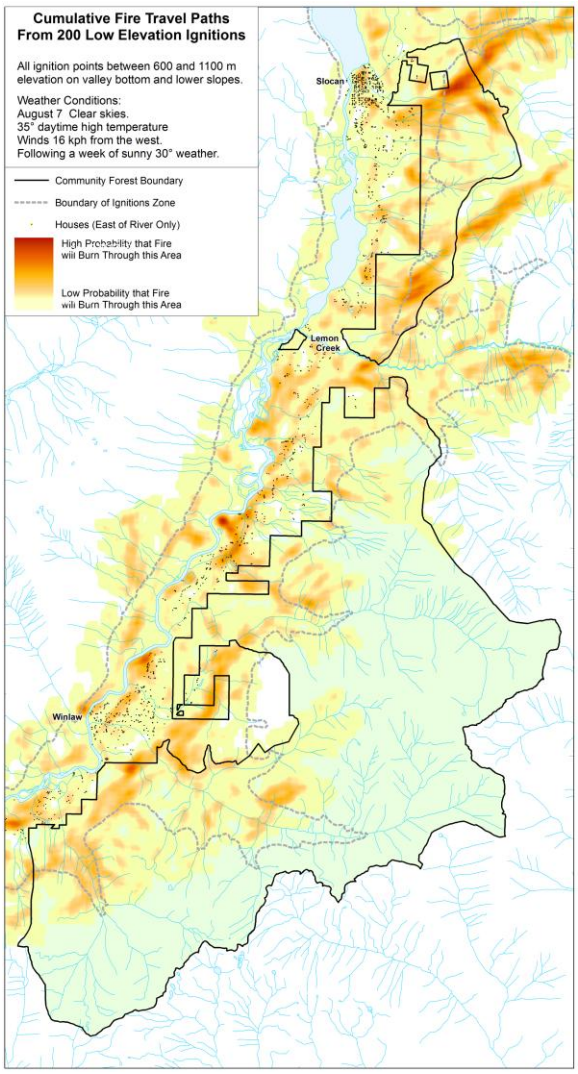


The model produces a visual output of major paths (yellow lines), time of arrival contours, rate of spread, fireline intensity, etc. All outputs can be saved to an ArcMap friendly data format.

The power of FlamMap for strategic planning support lies in bulk processing. Lighting many fires at dispersed locations, potentially under varying wind directions, and accumulating the outcomes reveals landscape scale fire movement patterns that are based on topography and fuel type. Areas within a fire movement path are the highest priority for location of strategic fuel breaks.



Outcome of 200 random ignitions, as major fire movement paths.



Outcome of 200 random ignitions, as probability surface of fire occurring within a 5 m raster grid.

The main fire movement paths identified by the FlamMap modelling analysis are represented by path vectors on the Strategic Fuel Management Plan maps.

2.2 <u>Strategic Fuel Management Plan</u>

The Strategic Fuel Management Plan identifies locations where is it feasible to create a strategic fire break.

The development of the Strategic Fuel Management Plan considered:

- Major fire path locations
- Vegetation and fuel types
- Terrain and slope
- Access (potential and existing)
- Forestry staff local knowledge
- Land ownership

Guiding principles for choosing strategic fire break locations were:

- Strategic fire breaks should be located to interrupt identified fire movement paths.
- Strategic fire breaks should reduce the chances of (a) fires moving from crown to private land, and (b) fires transitioning from local to landscape level disturbance events.
- Strategic fire breaks should be at least 200m wide and preferably wider.
- Strategic fire breaks should be as continuous as possible, to minimize potential fire pathways through the fire break.
- Strategic fire breaks should break the landscape into subunits, with the goal of providing suppression options to prevent the growth of local fires into landscape scale fires.
- Fuel management treatments are only feasible on slopes < 60%. (Minor inclusions of steeper slopes are acceptable.)
- Harvesting for fuel management is only feasible on slopes < 45%. (Minor inclusions of steeper slopes are acceptable.)
- Treatment areas must be accessible.
- Strategic fire breaks should expand from existing fuel treatments and natural low fuel areas wherever possible.
- Strategic fire breaks consider ecosystem restoration needs in ecosystems adapted to frequent fire intervals (NDT 4 ecosystems).

These principles were used to identify the strategic fire breaks shown on the Strategic Fuel Management Plan maps. SIFCo planning staff identified contiguous operable and accessible strategic fire breaks throughout the CFA. Areas with slopes <45% with some commercial harvest potential were classed as Harvesting for Fuel Management. Other areas were classed as WUI Fuel Treatment Areas.

2.3 Crown Land and Private Land

SIFCo has been involved in planning and carrying out fuel management treatment on and adjacent to our CFA since 2009. Funding has only been available for fuel management work on crown land throughout this time. The 220 ha of WUI treated area on crown land are significant and valuable, and will reduce wildfire intensity and rate of spread and risks to infrastructure from wildfires.

However, we are also aware of the potential fire travel paths on adjacent private land. Our fire simulation modelling and feedback from fire experts shows that fires will find and burn rapidly through untreated fuels adjacent to treated areas. The untreated fuels on private land create fire movement paths that can carry fires past the flanks of our fuel managed areas on crown land, and thus directly threaten dwellings and infrastructure.

Recognizing this inherent limitation of our activities to date, we propose treatments on private land in this Strategic Fire Management Plan. Our first step was to identify locations on crown land where terrain features and predicted fire movement paths combine to create an opportunity to create a strategic fire break on crown land. Then,

where necessary, WUI treatments on adjacent private land are proposed to complete the fire break.

SIFCo will be delivering an outreach and education program for fall 2016 for landowners to demonstrate practical approaches to fuel management in hands-on workshops. The project plan is to host meetings on 5 to 10 properties to discuss safety, fuel treatment goals, and fuel treatment methods. Fuel management work will be carried out so that interested landowners understand what needs to be done, how to do it, and how much area can be treated in a day of work. The core message of the program will be that while treatment needs are large, a lot can be accomplished by an individual over several days of work.

Fuel management activity can not be required of a private landowner. We believe that some individuals will take action to reduce fuel loads on their properties independently, to directly protect their dwellings and infrastructure. However, the scope of the work required on larger properties exceeds individual resources. We believe that, where the landowner is willing, public funds should be invested in fuel management on private land to increase the efficacy of strategic fire breaks.

This departure from previous policy is a logical conclusion when the landscape is viewed as a whole unit. Fire breaks are only reliable if they are continuous. Leaving fire pathways with high fuel loads on private land in locations where they can transport fire through or around strategic fire breaks on crown land reduces the effectiveness of the crown land investment.

3. Climate Change Adaptation

SIFCo participated in the West Kootenay Resilience and Climate Change research project from 2010 to 2012. The results and conclusion from this research project lead us to include the following concepts in our strategic vision:

1. Climate change will result in dramatic shifts in species composition and vegetation density within our CFA in the next 60 years.
2. Species currently at the edge of their ecological/climate niche (e.g. red cedar in much of the southern CFA) will no longer establish and grow. Mature individuals may survive for many years, however.
3. Drought tolerant and fire resistant species currently barely present on much of the landbase (e.g. ponderosa pine) will become the most ecologically suitable species on many low elevation sites, and should be introduced as quickly as possible.
4. Current forest density in the ICH subzones will not be supportable under coming moisture and temperature regimes. Forest density will be reduced by management (harvesting, thinning, fuel management) or by wildfire. As temperatures rise and summer moisture inputs decrease, wildfires will be more likely to be catastrophic events that degrade soil and water resources and negatively impact forest structure, composition and function.
5. Retaining established large trees of fire resistant species in a reduced forest density/ fuel load environment is the key to building ecosystem resiliency. These

trees will have the best chance of surviving the coming drought stress and fire events, and will maintain forest ecosystem values over time.

We are also familiar with the current work of the Climate Leadership Team and the Southern Region Research Ecologist.

We believe that this Strategic Fuel Management Plan fits within current thinking on management for climate change adaptation.

4. Regulatory Regime

SIFCo holds Community Forest Agreement K2R, an area based tenure over the crown forests within the defined CFA boundaries.

SIFCo operates with the legal framework of the Forest and Range Practices Act (FRPA), the Forest Planning and Practices Regulation (FPPR), the CFA Licence Agreement, and our Forest Stewardship Plan (FSP). The K2R FSP was recently extended for a period ending in 2019.

5. Stocking Standards

During preparation of our FSP in 2008, SIFCo proposed and received approval for Wildland Urban Interface stocking standards for areas adjacent to settlement and infrastructure. The WUI standards have a target stocking standard of 400 stems/hectare, elevate deciduous tree species (which have limited flammability) to preferred, and contain ponderosa pine as a preferred or acceptable species in all but the ICH subzone wettest sites. The standards are intended to facilitate development of open forests of fire resistant and low flammability species, with limited coniferous regeneration and significant deciduous tree and shrub components. In practice, much of the post harvest stocking target will be met by retained large trees.

6. Unconventional Fibre Utilization

SIFCo has initiated discussions with Mike Lynn, the Assistant Fibre Manager at Mercer International's Zellstoff Celgar pulp mill in Castlegar, BC, on utilizing small diameter and dead wood fibre from WUI harvest operations as feedstock. Celgar works with Arbor Sentinel, another Mercer owned company, to acquire and ship unconventional fibre. Their goals are to improve utilization, decrease waste, and address mid-term timber supply issues following the mountain pine beetle. Their minimum log size is 12 feet long to a 1 inch top. Their focus to date has been on the small and dead wood component of conventional harvesting, but the same material will be generated by fuel management harvesting, and is a natural fit with their program. Arbor Sentinel owns a variety of truck configurations, and as Mike puts it. "Can truck anything." The WUI treatment landbase on the SIFCo CFA landbase is within a feasible 3.5 to 4.5 hour hauling cycle time of the Celgar mill. We expect to reach an arrangement that works for both parties to utilize the recoverable unconventional fibre from WUI harvesting in the pulp mill, rather than disposing of it by burning.

7. Treatment Methods

The Strategic Fuel Management Plan proposes five general treatment regimes.

The specific operations in each treatment unit will be negotiated with funding agencies, if any, and will be documented in professionally prepared operational plan. The requirements of the regulatory regime will be met.

7.1 Wildland Urban Interface Management (Type 1)

This treatment method addresses the non-merchantable material in a forest area, or is carried out in forests with no merchantable timber. The following treatment regime is usually followed:

- Understory conifers < 17.5 cm in diameter are thinned to approximately 500 stems/ha (density depends on prescription)
- Overstory stems > 17.5 cm are retained, but pruned to a height of 2.5 to 3 m to remove ladder fuels.
- Accumulations of surface fuels are abated.
- Sufficient coarse woody debris > 25 cm in diameter is retained for ecological values.
- Cut stems, prunings and other fuels are disposed of by chipping or by piling and burning.
- Riparian reserves, steep slopes and small patches of retained understory provide habitat diversity.
- Machine piling of fuels can be used in locations suitable for machine travel to reduce costs.
- Because no revenue is associated with this treatment method, budget reflects all costs associated with treatment.

Before and after pictures from a Wildland Urban Interface Fuel Management area, showing impact of treatment on fuel load.

7.2 Post-Harvest Fuel Management (Type 2)

This treatment method combines harvesting, fuel management and climate change adaptation. The treatment goal is to create an open forest of established large trees of fire resistant species in a reduced forest density / fuel load environment, per the SIFCo WUI stocking standards. Marginal and beetle damaged stands are part of the potential harvesting for fuel management landbase.

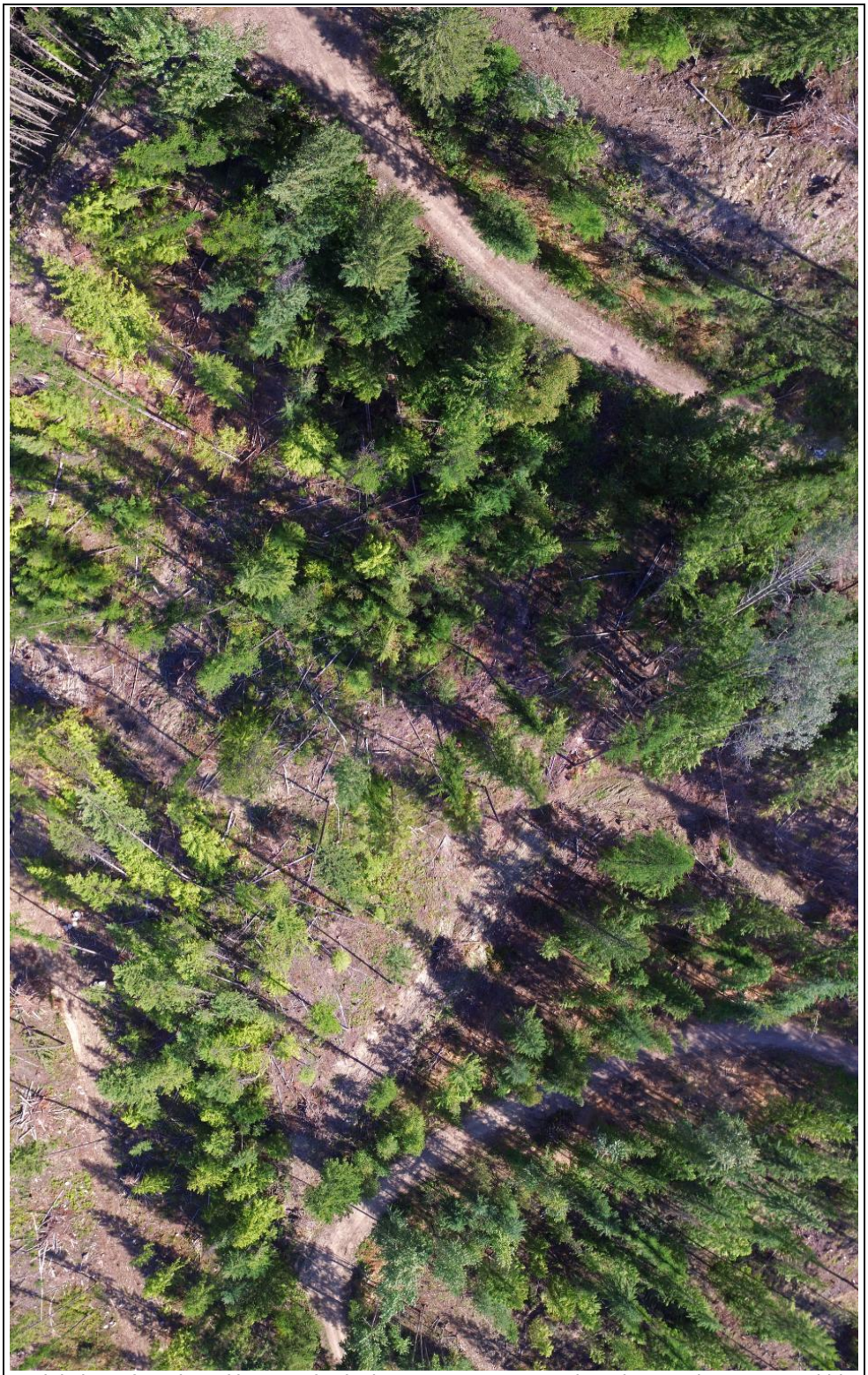
The following treatment regime is usually followed:

- Merchantable timber is cut and sold.

  200 to 250 stems/ha of Layer 1, 2 and 3 stems are retained, if that number of suitable leave trees exist. Suitable leave trees are healthy individuals of fire resistant, long lived species (Fd, Lw, Py, Pw), deciduous stems, and minor other conifers for diversity. Leave trees should have a low height to diameter ratio to resist snow press.
- Unconventional fibre is cut and sold to the extent possible, as determined by cost of production and shipping versus product value, with consideration of the costs to abate the fuels by other means (chipping, burning).
- Machine piling of remaining dispersed fuels in the treatment unit is carried out where possible.
- Following harvest and machine piling, the hand treatment crew goes thought the harvest unit to address remnant dense understory patches, pruning, and carry out additional general fuel cleanup
- Sufficient coarse woody debris > 25 cm in diameter is retained for ecological values.
- Riparian reserves, steep slopes and small patches of retained understory provide habitat diversity.
- Budget reflects all costs that are <u>over and above</u> the costs that conventional harvesting of this same area would be without the WUI component.

Fuel load reduced by harvesting and machine cleanup.

Retained young forest /biodiversity patch in harvest for fuel management area, fuel load reduced by hand treatment.



Aerial view of portion of harvest for fuel management area. (Previous 2 pictures are within this aerial view)

7.3 Machine Based Interface Cleanup (Type 3)

This treatment method is similar to Post-Harvest Fuel Management, but will be carried out in interface areas where combinations of insect attack, root disease, blowdown and past high-grading have depleted the stock of merchantable timber to the point where no harvest volume remains. The treatment regime combines fuel management and climate change adaptation. The treatment goal is to reduce the often extreme fuel loads on these sites, while retaining a very open overstory of established large trees of fire resistant species. The density of retained large trees will be limited by the stocking on site, and may be very low. The SIFCo WUI stocking standards will generally be met by natural regeneration.

The following treatment regime is usually followed:

- Where present, leave trees of fire resistant, long lived conifer species (Fd, Lw, Py, Pw), deciduous stems, and minor other conifers are retained. Leave trees should have a low height to diameter ratio to resist snow press.
- Unconventional fibre will be cut and sold to the extent possible, as determined by cost of production and shipping versus product value, with consideration of the costs to abate the fuels by other means (chipping, burning).
- Machine piling of remaining dispersed fuels in the treatment unit is carried out where possible.
- Following harvest and machine piling, the hand treatment crew goes thought the harvest unit to address remnant dense understory patches, pruning, and carry out additional general fuel cleanup
- Sufficient coarse woody debris > 25 cm in diameter is retained for ecological values.
- Riparian reserves, steep slopes and small patches of retained understory provide habitat diversity.
- Budget reflects all cost associated with this treatment method minus an estimated small revenue generated by sale of unconventional fiber.

7.4 Fuel Management for Habitat Restoration and Ecosystem Resiliency (Type 4)

The southern portion of the CFA contains several areas of isolated dry site NDT 4 ecosystems on steep south and south west facing slopes.

These areas have unusual plant communities more commonly associated with the dry Interior Douglas Fir biogeoclimatic zone. Large ponderosa pine are common, and open pine forests with a fire adapted shrub/herb understory is the desired future condition. These areas are not part of or are marginally productive parts of the timber harvesting landbase.

From a climate change adaptation perspective, these units contain outposts of the biota that should thrive in the surrounding areas as the climate warms. However, these areas are being reduced and degraded by coniferous ingress. Further, if/when these areas burn under current conditions, the fire is highly likely to be intense, fast moving, and

uncontrollable due to combinations of steep slopes, frequent valley winds, high fine fuel loads, and generally hot and dry conditions. This will create significant risks of a fire that quickly transforms from local to landscape scale. A fire under current conditions will also kill many of the locally rare and ecologically valuable species on the site, which are adapted to frequent low intensity fires, not extreme fire events.

Treatments in these areas will be designed to facilitate the return of fire to the ecosystem. The treatment regime will include:

- Commercial harvest of species other than Py, where potential harvest volume and terrain conditions make this feasible.
- Machine piling of fuels and debris, where terrain conditions are suitable.
- Hand treatment as required to reduce fuel loads adjacent to the stems and above the rooting area of Py leave trees, to greatly reduce fire intensity and soil and bark heating.
- Hand treatment to reduce the fuel loads in dense regeneration thickets, to moderate fire intensity.
- Establishment of fire breaks.
- Development of a professional burn plan.
- Reintroduction of fire.
- Post fire surveys and documentation.

The ecosystem and strategic fire management benefits of managing these areas with low intensity, frequent fires are significant, but achieving the social licence to reintroduce fire to these ecosystems may take time.

We hope to involve the South East Fire Center fully in the planning and execution of the restoration program.

Budget reflects all costs associated with this treatment method since no revenue will be generated.

Ecosystem restoration area during harvest phase. The ponderosa pine stems are the retained forest canopy.

Oblique aerial view of ecosystem restoration area following harvest. Note greatly reduced fuel load.

7.5 Wildland-Urban Interface Re-treatment on Crown and Municipal Land (Type 5)

WUI fuel management reduces potential fire intensity and potential rate of spread by reducing the fuel load in the lower forest canopy. The rate at which post-treatment coniferous regeneration increases fuel loads is moderated by overstory retention to provide shade, retention of deciduous shrub vegetation, and seeding disturbed areas with ground cover mixtures. However, some restocking by conifers is inevitable in a forest ecosystem. Maintenance re-treatment is required to retain the efficacy of the initial fuel management work.

Experience indicates that a re-treatment 7 to 10 years after the initial WUI fuel management is highly cost effective. Coniferous regeneration is small and easily cut with brush saws. Post treatment cut fuel loads are light, and can be safely disposed of by lop and scatter.

Re-treatment on a shorter time frame is not required. Re-treatment on a longer time frame allows regeneration to grow to large size, resulting in rapidly increasing per hectare fuel management costs.

Budget reflects all costs associated with this treatment method since no revenue is generated.

8. Conclusion

Because landscape-size forest fires are more likely to happen now than they have in the past, planning for a resistant ecosystem is becoming increasingly important. SIFCo believes that the future of forestry in the Interior of British-Columbia and in many other areas of North-America will include a growing focus on adaption to climate change. The planning outlined in this report is a step in the right direction. The challenge ahead is to make this type of planning and its implementation financially feasible, socially acceptable and ecologically sustainable.