FUEL MANAGEMENT PRESCRIPTION GUIDANCE

Provided by BC Wildfire Service

PURPOSE

The purpose of this document is to provide direction on fuel management components for stand level prescriptions that are being prepared for a wildfire risk reduction (WRR) objective (otherwise known as "fuel management prescriptions") that are funded by the Forest Enhancement Society of BC (FESBC), the Community Resiliency Investment (CRI) program or other government programs. This document assumes that all other approaches to, and components within, the prescription meet legal requirements and follow Association of BC Forest Professionals (ABCFP) published guidance, specifically around quality prescription development including, but not limited to: Standards of Professional Practice: Guidelines for Interpretation, Interim Guidelines –Fire and Fuel Management; Guidance for Professional Quality Field work, and Guidance for Professional Quality Rationales and Comments.

BC Wildfire Service (BCWS) has developed a suite of tools to support fuel management activities that are located on the BCWS Tools for Fuel Management webpage. These tools and other direct supporting information are hyperlinked in this document.

In addition, this document is not meant to cover all aspects of fuel management and fire behaviour and is directed towards experienced professionals working well within their scope of practice as outlined in the 2013 the ABCFP released Interim Guidelines – Fire and Fuel Management;

> *"Practicing in the field of fire and fuels management requires a specific education and training in subjects such as, but not limited to: fire ecology, fire effects, fire behaviour, fire regimes, conditions classes, fuel types, fuel moisture content, fire suppression, prescribed burning, fire behaviour modelling, and fire weather in addition to forestry subjects. ….Education provided at post-secondary school is insufficient and often additional expertise is obtained through experience fighting wildfires or working with a competent forest professional already practicing in the field…."*

PRINCIPLES

A fuel management prescription is a document that describes the recommended fuel management activities in an identified area that will reduce fire behaviour. It is expected that the post treatment

stand conditions will result in reduced fire behaviour such as a decrease in fire intensity and the potential for sustained ignition. Fuel management prescriptions must ensure a cost effective and measurable reduction in expected fire behaviour with the consideration and management of other values on the landscape. Prescriptions are consistent with the principles outlined below and meet government objectives for fuel management. Prescriptions need to consider the balance between potential fire behaviour implications and resource values and meet all legislative and non-statutory requirements.

A sound fuel management prescription follows three guiding principles: (1) it prescribes specific and measurable targets for fire behaviour reduction; (2) it contains site specific considerations tied to WRR objectives; and (3) it aligns with other legal, resource management and non-statutory objectives including First Nation consultation requirements.

Prescribes Specific and Measurable Targets for Fire Behaviour Reduction

- For each treatment unit, specific and measurable fuel targets are described so that post treatment outcomes can be measured.
- Prescribed fuel reduction targets should be sufficient to be effective to meet treatment objectives of reduced fire behaviour under 90th Percentile Fire Weather Index Conditions (FFMC, ISI, BUI) which are available from the BCWS weather network. If this data is not representative of the treatment unit, then analysis of local weather station data is an option.
- Fuel fragmentation targets declines in at least one of the fuel factors affecting fire behaviour where surface and ladder fuel changes are prioritized over canopy changes[1]:
    - Prescribed treatments focus on reducing the potential for sustained ignition and crown fire initiation by reducing surface fuel loading to achieve potential fire intensity levels below 2000 kilowatts per metre or below critical surface fire intensity thresholds[2] .
    - Increase the height to live crown through a reduction in ladder fuels (crown base height) to reduce potential for crown fire ignition.
    - Reduction in crown closure and canopy bulk density (volume/density (basal area/stems per hectare) as necessary to reduce crown fire spread rate and potential (e.g spotting).

[1] Martinson, Erik J.; Omi, Philip N. 2013. *Fuel treatments and fire severity: A metaanalysis*. Res. Pap. RMRS-RP-103WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 38 p.

[2] Surface fuel targets for fuel management are typically above and beyond those of hazard abatement requirements.

Contains Site Specific Considerations Tied to (WRR) Objectives

- Treatment targets utilize a zoned approach generally within 2 kilometers of the value; fuels are more intensively treated closest to the value of concern.
- Fuel treatment location design maximizes opportunities to anchor to non-fuel or low flammability areas such as water bodies, wetlands and roads and provides adequate breaks in continuous fuels (e.g wildlife tree patches, riparian reserves etc.).
- Prescription considers the unique variability that exists in each stand, including but not limited to: vertical fuel strata, horizontal fuel continuity, extent of the surrounding fuel, fire weather components, topography, and values at risk, and is stratified out if required.
- Treatments are appropriate for the given Biogeoclimatic (BGC) area (site series) and consider factors such as rate of decay for slash, shaded fuel breaks, controlling canopy density, and retaining suitable residual species that are resilient to the post treatment conditions, including but not limited to fire disturbance.

Aligns with Other Legal, Non Statutory and Resource Management Objectives

- Recognizes any overlapping legal objectives relevant to the tenure (e.g. Open Burning Smoke Control Regulation, mule deer winter range) in conjunction with fuel management objectives.
- Seeks to align with other forest stand improvement and collaborative management opportunities to maximize cost effectiveness.
- Considers retention of large size trees to increase resiliency to wildfire and forest health factors.
- Meets provincial and local land manager requirements for First Nations Consultation.
- Targets fibre utilization as a primary debris management strategy when consistent with objectives of the prescription. Where surface fuel reduction targets cannot be achieved through fibre utilization, additional activities are prescribed to manage material (e.g. broadcast or pile burning or mulching).
- Units are designed to consider the full lifespan of the treatment (e.g. logical burn units for maintenance burns and appropriate Fire Management Stocking Standards) and to avoid undesirable consequences such as:
    - increased risk to forest health concerns;

- significant reduction in fuel moisture content and susceptibility to wind in the understory;
- unacceptable windthrow levels;
- excessive overstory thinning, grass or shrub ingrowth and surface fuel loading (e.g. chipping); and,
- mortality along treatment unit edge exposed to wildfire from adjacent stands.

CONTENT REQUIREMENTS

The prescription must identify treatment unit objectives and measurables for the modification of fire behaviour (head fire intensity, crown fire initiation and spread, spotting, etc.) that will guide the development of fuel treatment targets consistent with the principles described above.

FUEL MANAGEMENT OBJECTIVES WITH RATIONALE

Fuel management objectives must be specified and will drive the rationale for treatment unit placement and treatment method selection. Fuel management objectives need to:

- Provide a rationale for the fuel treatment with specified objectives (e.g. improved suppression opportunities around communities by reducing the potential for crown fire initiation).
- Describe fuel management specific strategies that outline how the treatment units are designed to be anchored, accessible and defensible as well as designed according to expected fire spread and intensity.
- Provide clearly defined objectives and target conditions for fuel management that include fuel load reduction targets and measures for expected fire behaviour outcomes post treatment (e.g. reducing crown fire initiation potential by XX and rate of spread by XX from the adjacent stand by reducing surface fuel loading to XX and increasing height to live crown to XX).
- Relevant supporting details such as fire history, probability of ignition and spread, fuel type and continuity, weather trends (i.e. prevailing winds) that support the treatment as a priority to mitigate negative impacts to the identified values at risk will help build the rationale.
- Address legal objectives such as mule deer winter range, grassland benchmarks, visual quality and recreation; and describe the associated management considerations. Indicate how the prescription seeks to balances the objectives. For example, "*Increase sunlight to the forest floor to encourage grass and forage production, and reduce predator hide habitat*", or

"*targeting surface and ladder fuels as a priority for fuel reduction while maintaining visual quality objectives*".

Fuel Treatment Unit Summary

Each fuel treatment unit (FTU) is described by site characteristics, location, treatment unit, treatment type, and fuel type hazard distribution.

Site Characteristics

Generalized Site Characteristics

Describe the treatment area and its boundaries in the context of the local terrain including terrain characteristics (e.g. flat, rolling, etc.) or features, any landscape/topographic limitations to wildfire, and any other physical characteristics. For example: "The treatment unit (TU) is uniformly sloped with a few rocky outcrops that were excluded from the net treatment area. The TU is located between the Chapman Road and the lake, being bounded on the east by Deep Creek and on the west by the BC Hydro campground". Include a description on forest health factors that will influence fire behaviour.

Stand Description

This section describes the existing and desired characteristics of the forest stand within the treatment unit. This information is essential in ensuring the prescription is meeting the established objectives with measurable specifications. In all cases, the stand should be sampled to a level that provides sufficient and accurate data required to determine the desired treatment specifications, estimate fuel loading, and assist with harvest/treatment planning and valuation (if applicable).

Pre and post-treatment stand data should be collected in accordance with the principles outlined in the Silviculture Surveys Procedures Manual 2018.

Surface fuel data collection should be consistent with the general methodologies outlined in the documents located under the heading Inventorying Downed Woody Material.

Timber Type

Enter major tree species and percent species composition. For example, Fd7 Lw3 (Py) denotes a stand dominated by Douglas fir (70%) followed by Western larch (30%), with a minor component (<10% which is denoted in brackets) of Yellow pine.

Stand and Stock Table

The stand and stock table (SST) is required for all treatment methods other than clearcut, and should include both pre- and post-treatment density measures. An example SST is provided in the Fuel Management Prescription Specimen Document.

SPECIES AND DIAMETER CLASS: Fill in a separate line for each species by layer / diameter class. Use appropriate diameter classes to ensure adequate data for treatment specifications and for fire behaviour model inputs. Include total dead potential and total live.

CROWN BASE HEIGHT: Record the conifer Crown Base Height (CBH). CBH is a measure from the ground to the live or dead crown in the veteran, dominant and co-dominant coniferous canopy layers. Dead crowns are only measured when they are of sufficient density to allow vertical wildfire spread. Individual dead limbs should not be considered. Full whorls of dead limbs, especially with needles and fine branches or volatile mosses or lichens should be considered as part of the live crown in this measurement.

TREE HEIGHT: Record the average tree height for each species within each diameter class.

STEMS AND VOLUME PER HECTARE: Existing, cut and leave number of stems per hectare (sph) are required. Where volume-based data is preferred, also populate the volume per hectare section.

Surface Fuel Loading

Provide the dry weight of combustible materials per unit area and describe the distribution (i.e. scattered, continuous, elevated, etc.). Recommended units are kilograms per square metre (kg/m2) and tonnes per hectare (tonnes/ha) (1.0 kg/m2 is equivalent to 10 tonnes/ha).

Describe the composition and the continuity of surface fuel including the duff depth, moisture type, vegetative material composition, and % cover of both fine and woody debris. Describe methods for determining this value at the pre- and post-treatment stages.

Crown Closure and Canopy Bulk Density

Describe the stand in terms of canopy bulk density through the vertical profile as well as crown closure. Removing overstory trees results in a reduction of canopy bulk density and subsequent crown fire behaviour. However, final outcomes are related to where in the canopy the reduction occurs. Estimate the percentage of the crown touching and effectively blocking sunlight from reaching the forest floor. If there is a deciduous component to the stand, provide percent of crown closure for the live and dead coniferous component as well as the crown closure for the deciduous component.

Fuel Treatment Description

Treatment Specification Rationale

Provide a summary as to how the treatment specifications and treatment unit widths were determined and how they will meet the prescription objectives. The rationale should describe the retention strategy and associated fire behaviour outcomes including a summary of adjacent fuel types and values at risk. Include considerations of site-specific fire behaviour components, fire history, and anchoring of treatment units. Targets further out from the value can consider a time objective linked to rate of decay for fine and coarse surface fuels. Also include specifics around determination of treatment targets (e.g. surface fuel loading, pruning height, and thinning density). Attach any supporting documentation (e.g. model runs, references, etc.).

Stand Modification Treatments

This section describes the treatment phases for each FTU including post treatment targets and associated fire behaviour outcomes (e.g critical surface fire flame length to avoid crown fire). Sufficient detail is required to ensure transparency with prescription objectives and the management of identified values and concerns. BCWS has developed a Fuel Treatment Design Wildfire Intensity Tool that can be used to support the determination of wildfire intensities for surface fuel components.

Treatment Specifications

BRUSHING: Provide details such as target species and size for removal, as well as desired post-treatment density.

PRUNING: Describe the target crown base height or fuel strata gap, and the live crown ratio that will result.

DEBRIS MANAGEMENT: Describe the target surface fuel outcomes.

PRESCRIBED BURNING: For treatment units where resource management open fire is prescribed, a burn plan must be completed on the BCWS Burn Plan Template. The prescription should include the objectives and desired effect(s) of the prescribed fire (i.e. desired amount of duff consumption; surface fuel reduction targets: type and size of material to be consumed, % coverage, crown fraction burned and crown base height targets; acceptable % leave tree mortality; % acceptable understory survival, etc.). Provide a specific, measurable, realistic, and time-bound range of outcomes for each of these objectives, so that burn objectives are achievable.

- FTU design should include logical burn units to incorporate natural, existing, or other control lines to be utilized during implementation. Development of these burn units should be

considered and carried out during the implementation of earlier phases of operational treatments to maximize efficiencies and help set up the treatment unit for subsequent burning.

Forest Health Considerations and Targets

Describe any forest health factors relevant to your treatment design including post treatment risks such as windthrow.

OTHER: Describe any treatment not specifically listed above or under prescribed burning; including the method, and the target results, and how debris will be disposed of. Explain how the treatment will meet the objectives of the prescription while addressing the identified values and issues.

Treatment Specifications Summary

TREE REMOVAL/RETENTION STRATEGY BY SIZE/SPECIES: For each treatment unit, summarize the tree removal/retention strategy by size/species specifications that are outlined throughout the stand and stock table. For example: “Retain all Yellow pine (25 sph), Western larch (30 sph), hardwoods (15 sph), and 50% of Douglas fir greater than 40 cm. (15 sph). Remove all Douglas fir below 40 cm dbh, 50% of Douglas fir greater than 40 cm dbh, and all Lodgepole pine. Target density = 85 sph, with an acceptable range of 60 – 110 sph.”

Post Treatment

This section addresses silviculture obligations and the effects of the proposed treatments over time.

Maintenance

EXPECTED VEGETATION RESPONSE: Describe the amount and type of vegetation expected to occupy the site because of the treatment(s).

MAINTENANCE PLAN: Include a maintenance plan based on the length of time the treatment will be effective, including re-treatment triggers such as increased fuel load (kg/m2) or a reduction in inter tree spacing. Treatments should be monitored and re-treated at the most economical time frame. For example, it may be more economical to use prescribed fire to maintain forest encroachment while the regen is small enough to kill with understory fire. Once regeneration is too advanced, a mechanical treatment will have to be conducted, which may be more expensive. This can be said for hand/mechanical treatments where an increased amount or larger debris is more expensive to treat and remove.

Silviculture Obligations

In prescriptions where silvicultural obligations exist, develop the appropriate Fire Management Stocking Standards and request approval by the Natural Resource District Manager if required. Provide details around silviculture obligations (e.g. planting, stand tending, free to grow) if applicable. See the Appendix Two of the Fire Management Stocking Standards Guidance document for information on the fire resistance/resilience characteristics of common tree species used for reforestation in BC. Think about:

- Regenerating with deciduous species or mixed wood that have higher moisture content foliage and live stems and are less flammable and have reduced fire intensity and crowning potential at most times of the year.
- Regenerating with fire resilient conifers (eg. Larch, Douglas fir, Ponderosa pine) at low densities. Widely spaced trees reduce both the crown bulk density and the continuity of crown fuels, making crown fires unlikely.

PLANTING: Provide specific planting specifications not found in the stocking standards table. Any ribboning required should also be stated in the "Outstanding Works" section if not completed at the time of the prescription.

Post Treatment Report

Post treatment surface fuel loading is critical to measure due to the potential for additional debris accumulation from the treatments activities themselves. Ensure that a post treatment report is completed for after initial treatment is done.

Outstanding Works

Describe any outstanding work required prior to treatment (e.g. assessments, ribboning, authorization and tenure acquisition, sowing request, etc.). It is expected that the majority of work required for the prescribed treatment(s) will be completed at the prescription stage. If this is not possible it is expected that the local government and the Fuels Management Specialist are informed and that details are provided in this section.

Attachments

Indicate which documents are attached by checking the appropriate box. If a professional assessment was completed, indicate the date the report was completed and the professional who completed the work.

OTHER CONSIDERATIONS

Prescribing Foresters are encouraged to work with the Fire Centre WPO for technical input to ensure that the prescription outcomes are consistent with government objectives for fuel management.

MAPPING STANDARDS

Include the following georeferenced map(s):

- Overview: General overview map of the project boundary in relation to communities and other major features and base data should be to geo-located.
- Fuel Treatment Prescription Map

Prescription map should include:

- Treatment unit boundaries
- Reserves (including wildlife tree retention areas, riparian reserve zones, etc.)
- Streams, Wetlands, Lakes including the class and identification number/name
- Existing and proposed roads and skid trails (labeled)
- Existing or proposed stream crossing structures (culverts, bridges)
- Any other values or features that should be mapped (i.e. Goshawk nests, bear den, range fencing, power lines, a licensed waterworks that is within 100 m of proposed treatment, etc.)
- Natural range barriers that may be affected by treatment
- Any areas of safety concern (i.e. steep slopes, utility lines, etc.)

Note: *If features or areas discussed above are not labeled, they should be included in the legend. A separate harvesting, road building, or planting map may be required depending on the treatment.*

APPENDIX A

KEY DEFINITIONS:

Resource management open fire - means an open fire that

(a) burns unpiled slash over an area of any size, or

(b) is not a campfire or a category 2 or 3 open fire and is lit, fueled or used for silviculture treatment, forest health management, wildlife habitat enhancement, fire hazard abatement, ecological restoration or range improvement (BC Wildfire Act & Regulation).

Fire Effect(s) - Any change(s) on an area attributable to a fire, whether immediate or long-term, and on-site or off-site. May be detrimental, beneficial, or benign from the standpoint of forest management and other land use objectives (CIFFC 2003).

Fire Effects – The physical, biological, and ecological impacts of fire on the environment. (NWCG, 2012)

First Order Fire Effects – The effects that concern the direct or immediate consequences of fire, such as biomass consumption, crown scorch, bole damage, and smoke production. First order effects form and important basis for predicting secondary effects such as tree regeneration, plant succession, and changes in site productivity, but these involve interaction with many other non-fire variables (NWCG, 20102).

Second Order Fire Effects – The secondary effects of fire such as tree regeneration, plant succession, and changes in site productivity. Although second order fire effects are dependent, in part, on first order fire effects, they also involve interaction with many other non-fire variables. (NWCG, 2012)