Project Plan
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FPInnovations
Wildfire Operations Research
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Fire behaviour in harvest debris – West-central foothills

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Issue

The purpose of the MacLean Creek trials (2012) was to begin to understand how slash fuel loading affects fire behaviour and specifically to address the question of ' how much slash loading is too much' in terms of the hazard it poses to fire containment. This issue will continue to be investigated, this time in a harvest block west of Edson.

Background

In September 2012, experimental burns in harvest slash took place in the Southern Rockies Area at MacLean Creek. This set of trials documented fire behaviour in light, medium and heavy slash loads and documented initial attack firefighting crew (IAC) capabilities. We believe these were the first trials of this kind in in slash fuels in Alberta.

From these trials a number of suggestions for future work were brought forward.

These suggestions include:

- (We used a line ignition for all the study plots in these trials); however, a point-source ignition would help researchers determine fire growth rates and the consequent smoke production. Understanding this would assist agencies determine the appropriate resources to dispatch upon detection of a slash fire.
- (Conduct trials using lighter fuel loads, but with higher wind speeds.)
- Place study sites in areas created by normal harvesting operations, rather than using mechanically prepared plots.
- Do not limit a burn to a 30 m x 30 m plot. We could gain a more comprehensive understanding of fire behaviour in slash if we allowed the fire to reach its equilibrium growth rate and find its own path through the debris.
- Include measurements of fuel continuity (i.e., the reduction or absence of fuels) and how that affects fire intensity and rate of spread.

The proposed sites in Edson include a range in fuel loads and slash age resulting from two harvest treatments. The above recommendations from the MacLean Creek report can be addressed at the Edson sites.

Because the observed results from the MacLean Creek burns did not closely reflect FBP model predictions more burns are required to understand and eventually predict slash fire behaviour more accurately. Thus, we will continue to ignite 30 x 30 m research plots to collect fire behaviour data but will also propose to ignite fires that are free to grow for IA tests.

ESRD proposed burn tests to validate the 'Red Book' where slash fire danger increases when the BUI passes 20. Currently they are working with this value as the threshold where slash fires become problematic. They are interested in testing this threshold beginning following snowmelt to when fires become active in this fuel type. They are also interested in how ignition is influenced by the DMC. This would be a study on the potential of lightning starts in slash fuels and can be incorporated in the BUI study.

This site could be used for other research projects such as the effectiveness of long term retardant or gel on slash, the testing of heat flux sensors built at the University of Alberta and even UAV testing as the site is open for flight.

Objective

To add to the knowledge base of fire behaviour in slash fuels based on fuel loads (t/ha), species, slash age (percentage of fines present) and harvest method . Specifically to:

- Document fire behaviour in slash fuels of varying loads (t/ha)
- Document fire behaviour in slash of different ages.
- Determine initial attack crew fire containment capabilites in slash fires of various intensities (rates of spread and fuel loads).
- Validate the 'Red Book' where slash fire danger increases when the BUI increases.

Methods

Site Selection

FPInnovations along with ESRD and EdFor Cooperative Ltd. worked together to select a site where experimental burns in slash fuels can occur. Sites will be selected based on these criteria:

- Slash loading – all plots would have fuel loads < 100 t/ha.
- Age of slash ranges from 2-3 years (influences the amount of needle retention and thus fire rate-of-spread).
- Ignition methods (point source or line ignition).
- Natural and man-made fuel breaks for fire spread protection (ability to contain fire within the planned perimeters).

Nine 30 x 30 m plots were selected based on fuel loading, harvest treatment and the logistics of fire extinguishment. The sites can be seen in Appendix C.

Burn Matrix: the plots will be placed in the following matrix.

Harvest type	Fuel load	Slash Species
Block 5210532156 Stumpside 2011-12		
Block 5210532164 Buncher skidder 2012-13		

Plot Establishment

Plot establishment was done in conjunction with our study partners.

1. Located and established 30 x 30 m plots to be used for line ignition. Locate a number of point ignition spots for naturally growing fires. The number of plots will be based on size of area and Industry regulations. Plots set up in slash of varying ages and loadings.
2. Establish fuel breaks for fire control. (winter 2014)
3. Sample fuel loading in each plot. (spring 2014)
4. Describe each plot based on harvest method and age.
5. Develop and apply a fuel continuity descriptor for each slash plot.
6. Establish Initial Attack effectiveness plots. These will be point ignition plots and will be allowed to grow until an agreed upon size is reached.

Burn Methodology

Spring burns are planned for this project. Exact timing will depend on snow melt, spring precipitation and the fuel moisture characterisitics of the slash. Regional fire danger will also be included in the timing of the burns. Fire control will be handled by ESRD equipment and crews. Two types of burns will take place. The first is for the documentation of fire behaviour in slash of various ages and loads. The second type of burn will test the intial attack capabilities of a fire crew. There will be fewer of these burns and will be handled as wild fires.

Ignition Tests

Following snowmelt perform two-minute ignition tests in randomly selected sites in slash fuels. This can be performed on a weekly basis or longer depending on precipitation. The ignition tests will be compared to calculated BUI values based on daily fire weather data collected on site. ESRD will perform ignition tests following Shroeder 2002 and FPInnovations will write up results.

Fire Behaviour Plots

The following data will be collected during the burning of these plots:

- Headfire rate-of-spread (m/min). Total time from one end of plot to the other will be used.
- Flame length (m). Estimated using flame length poles placed within plots. The poles are placed 10 m away, in a direct line with video cameras perpendicular to direction of fire spread.
- Weather data: temperature, relative humidity (%), wind speed and if there is any precipitation. This data collected with a handheld Kestrel and compared to data from closest fire tower and on-site RAWS.

This data will be combined with fuel loads to calculate a fire intensity (kW/m). Video of the burns will be collected during all burns.

IA Effectiveness Plots

To help understand the potential fire hazard in slash fuels, FPInnovations initiated a related study that would evaluate the suppression capabilities of initial attack crews in slash fuels. In September 2012 we conducted two initial attack trials to evaluate a 'time and motion' data collection framework that we used to assess an initial attack crew's capability to successfully contain a wildfire in slash fuel types (Appendix A). These trials were structured to document an initial attack crew's movements and suppresson actions from time of smoke report to time of containment. This approach is valuable as a crew audit tool and can be used in future initial attack trials that will be conducted in the new harvest debris plots.

As described in the project update (Hvenegaard 2013) we would like to focus on capturing the data most essential to our research objective. For the purposes of the ongoing study, we would like to evaluate the success of containment in slash fuel as a function of fire size and fire intensity. A streamlined data collection process (Appendix B) to achieve this objective does not require a full 'time and motion' data capture. By using this modified approach, we can have the responding initial attack crew on site or nearby and allow the fire to grow to a size and intensity that we feel would challenge the crew and provide relevant data to the study. Logistically, this approach does not require that the crew is dispatched from their base and removes the requirement for helicopter travel time.

We can implement either the complete time and motion data collection process or use a streamlined version depending on the desired research goals for the project.

The same fire behaviour data will be collected from these burns as in the fire behaviour plots. We can use a point source ignition to evaluate the entire detection, IA response and suppression operations. Observing and documenting the growth of a point source ignitions has good value from a fire behaviour perspective. The downside of this approach is that an IA crew may arrive at the fire before the fire grows to a challenging size and intensity. In this case, we can hold the crew until the fire reaches an appropriate size and then allow the crew to continue suppression operatons. Alternately, once the fire has been reported and the crew is enroute, we can grow the fire to a challenging size and intensity that will provide useful data.

Roles and Responsibilities

ESRD Commitments:

1. Provide initial attack and overhead resources as required

2. Establish breaks in fuel load to ensure contained burning of test plots

   Plots have been designed to allow for minimal risk due to adjacent permanent oil and gas infrastructure and roads.

Individual plot sizes to be 30m by 30m to maintain control and limit resources needed.

Extra precautions to be taken based upon weather conditions and available resources at time of ignition.

Initial attack will be on site and "artificial delays" used to test effectiveness. Contingencies to prevent escape built in.

3. Support resources as required by conditions. Heavy Equipment, support crews, aerial support.

4. Communication with involved stakeholders:

   Notification of burnings ETC

   Adjacent resource industry clients

5. Post burn assistance related to reforestation obligations.

6. RAWS weather station to record actual onsite conditions.

7. Put together Fire Plan for project.

FPInnovations Commitments:

1. Layout

2. Fuel loading calculation

3. Fire Behaviour recording

4. Technical write up

5. Support ESRD staff with burn implementation

Post Burn implications:

1. Reforestation liability to be address through negotiations with EDFOR Co-operative Ltd.

2. Change of ARIS records for the affected treatment areas within the harvested cutblocks to ensure reporting of reforestation timelines is correct.

Timeline

Determine Plots sites	Fall 2013

Finalise Methodologies	Winter 2013/14
Collect Fuel load data	Spring 2014
Burn Plots	Spring 2014
Report Findings	Fall 2014

Budget

Site Selection	2 days x 2 people
Fuel Loading	2 days x 3 people
Burn tests	2 days x 3 people
Data analysis	3 days x 1 person
Report	5 days x 2 people
Edits	4 days x 1 person

Deliverables

Case Study including:

- fire behaviour
- IA capabilities
- ignition test results
  Data will be entered into the ESRD fire behaviour data base.

Participating Members/Collaborators

ESRD

Edfor Cooperative Ltd.

FPInnovations

Safety

FPInnovations will adhere to ESRD Safety Standards and practices while burning and to FPInnovations SMS Manual otherwise. A tailgate Safety briefing will occur before ignition.

References

Baxter, G. Hvenegaard, S and R. Campbell. Fire behaviour in harvest debris. 2103. http://wildfire.fpinnovations.ca/

Hvenegaard, S. 2013. Containing fires in harvest debris: what the limits of initial-attack crews? http://wildfire.fpinnovations.ca/142/ProjectUpdate_IACrewsInSlash_v4.pdf

Schroeder, D. 2006. Advantage Report Vol. 7 No. 12 June 2006. Modelling ignition probability of thinned lodgepole pine stands.

Appendix A: Time and Motion data-capture sheet for initial attack trials

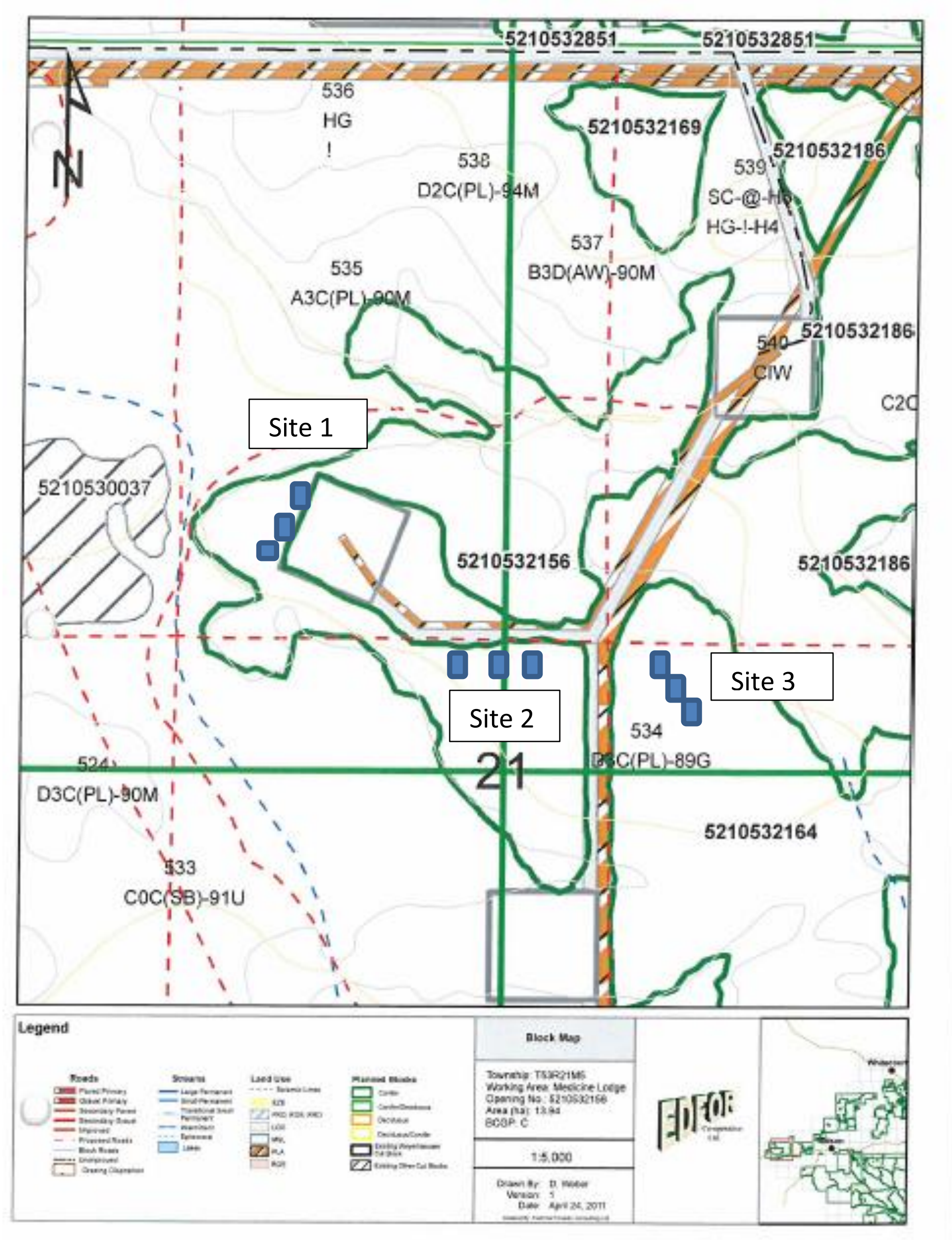
<table>
<tr><th colspan="5">Time and Motion Documentation of Helitack Suppression Operations</th></tr>
<tr><td>Date</td><td colspan="2"></td><td>Location</td><td></td></tr>
<tr><td>Crew</td><td colspan="2"></td><td>Evaluator</td><td></td></tr>
<tr><th colspan="2">Event</th><th>Time</th><th colspan="2">Comments</th></tr>
<tr><td colspan="2">Smoke Report called</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">IA crew dispatch</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Helicopter lift off or wheels rolling</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Departure message from IA leader</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Communications en route</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Report of first sighting of smoke</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Onsite quick assessment</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Full fire assessment</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Land at fire – R/W</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Arrive at fire – truck attack</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Crew proceeds to fire</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Crew arrives at fire</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Discussion of suppression strategy and tailgate safety plan</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Crew commences firefighting</td><td></td><td colspan="2">Specify activities:
• Pump setup
• WaJax bag operation
• Hand-line construction</td></tr>
<tr><td colspan="2">First bucket drop</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Second bucket drop</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">IA crew reports that fire is BEING HELD (subject to evaluator discretion)</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">IA crew reports that fire is UNDER CONTROL (subject to evaluator discretion)</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="5">Notes</td></tr>
</table>

Appendix B: Revised data-capture sheet for initial attack trials

<table>
<tr><th colspan="5">Initial Attack Crew Suppression Operations</th></tr>
<tr><td>Date</td><td colspan="2"></td><td>Location</td><td></td></tr>
<tr><td>Crew</td><td colspan="2"></td><td>Evaluator</td><td></td></tr>
<tr><td colspan="2">Event</td><td>Time</td><td colspan="2">Comments</td></tr>
<tr><td colspan="2">Commencement of firefighting operations</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Fire status = BEING HELD</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Fire status = UNDER CONTROL</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="5">Notes:</td></tr>
<tr><td colspan="5">Additional suppression:</td></tr>
<tr><td colspan="5">Fire behaviour characteristics:</td></tr>
</table>

	Flame Length (m)	Fire Size (m x m)	Comments
Ignition (0 min)			
5 min			
10 min			
15 min			
20 min			
25 min			
30 min			
35 min			
40 min			
45 min			
50 min			
55 min			
60 min			

Appendix C. Site map.



Burn Plot sites (blue shaded boxes).

Site 1: Heavy fuels. Stumpside processing. West wind to burn.

Site 2: Moderate fuels. Stumpside processing. South or SE wind to burn.

Site 3: Light fuels. Haul to landing processing. SE winds.