Protecting log yards from fire—best practices guide

Abstract

Forest companies in Canada frequently store large quantities of logs in permanent or temporary yards. Protecting these logs from fire is important because they represent a significant financial investment and are critical inventory for mills. The best practices contained within this report emerged from FPInnovations’ ongoing efforts to find solutions for protecting stored logs from fire.

Keywords:

Introduction

In response to the industry’s need to improve fire-protection practices, FPInnovations has been addressing log yard protection by conducting site tours, a workshop, and case studies of water-enhancing gels. From these efforts emerged a set of best practices for protecting log yards from fire, and these are summarized in this report.

Prevention is the priority in log deck protection because once a fire becomes entrenched in a log deck, it is very difficult to extinguish. For the purpose of this report, prevention includes addressing fire encroachment from outside the log yard, as well as ignition from embers or other sources within the log yard. However, if a fire ignites within a log yard, then suppression obviously becomes important too. Water additives are discussed separately in a third section because they are useful for both fire prevention and suppression.

Prevention

Log deck location, layout, and design

The location and design of the log yard and the layout of the log decks influence the effectiveness of prevention and suppression efforts. Log decks and protection systems need to be arranged with potential ignition sources in mind, especially in storage areas adjacent to industrial facilities which can be a source of embers.

Surrounding area

Managing forest fuel in the area surrounding a log yard can help prevent a fire from burning into the yard, and may reduce fire intensity so that fire crews or sprinkler suppression can be effective in stopping the fire. Performing the following will be effective:

• Locate the log yard in an aspen forest (Figure 1).
Convert surrounding conifer stands to aspen.

Create a modified fuel buffer around the entire log yard (Figure 2) by thinning adjacent conifer stands using FireSmart standards (Partners in Protection 2003). Remove surface fuel within the modified fuel buffer, regardless of stand type. The treatment width should be at least 40 m.

Construct a fuel break around the log yard (Figure 2). Neither forest conversion nor fuel removal alone would stop a surface fire. At the very least, a log yard should be surrounded by a buffer of exposed mineral soil in order to stop progress of a ground fire and to provide access for fire crews. This area should contain few fine fuels and it should be kept free of woody debris. Figure 1 shows a log yard with no buffer, and Figures 2 and 3 show buffered log yards.

Note: Although 40 m is the recommended minimum, a wider buffer would be better, as indicated by the results of two recent crown fire tests. In a crown fire test that burned from a conifer stand into an aspen stand, the fire changed from a crown to a surface fire within 40 m of entering the aspen stand, and ember transport was likely considerably further (Alexander and Lanoville 2004). In a second test, a crown fire burned into a thinned conifer stand and changed into a surface fire within 23 m, although the wind was not very strong (<15 km/h). Aerial embers were transported over 100 m from the boundary between untreated and treated stands (Schroeder 2006a).
Roads and log decks

As much space as possible should be allotted to roads, while still ensuring adequate space for log storage. Good access means that individual decks can be broken up to limit fire spread. Large decks may maximize use of space, but they concentrate fuel, and limit both access and the ability of equipment operators to separate unburned logs from those on fire (compare Figure 4 to Figure 1). Suppressing a fire in a log yard with large log decks and poor inter-deck access would be difficult (Figure 4).

Roads within the log yard—i.e., roads between the log decks—should be kept free of debris.

Water source

Log decks should be located close to a water source to reduce the amount of firefighting equipment required and the equipment set-up time. Layout of the yard and placement of decks should enable easy and quick placement of water hoses. For example, it is easier to lay hose with log decks oriented parallel to a water source rather than perpendicular (Figure 5).
Sprinklers

Where abundant water is available and insect damage is an issue, some log yards have installed permanent sprinkler systems to help protect the logs from insects by keeping the logs moist. One forest company recently analyzed some protection systems and found that installing a permanent sprinkler in one of its large satellite log yards for the sole purpose of fire protection was not economically feasible. Some arguments against proceeding with the installation included the initial cost to purchase and install a system, as well as maintenance and water supply issues.

Site maintenance

A regular site-maintenance program should be in place to remove ignition points in and around log decks. The removal of flammable material from the base of a log deck will reduce the chance of ignition or continued encroachment by a ground fire. If woody litter/residue is fairly deep, then wetting the surface or applying water additives (see below) may fail because the fire could burn underneath the treated surface. A maintenance program should also include periodic removal of surface and ladder fuels in the forest surrounding the log storage yard.

Snow caching

Covering log decks with a layer of snow—or snow caching—is a technique shown to have a positive return on investment. The moisture content of the wood remains high, thereby keeping processing (pulping or sawmilling) costs from increasing (Nader 2003, 2005). This technique could also be useful in preventing a log deck from burning. However, the technique includes capping the snow with an insulating layer of sawdust or bark mulch. If this top layer dries, it could become an ignition point. However, it is unlikely that the log deck below the capping would be threatened except in extreme circumstances.

Suppression

A fire entrenched in a log deck is difficult to put out. The accepted technique is to use machinery to break the deck apart to save as many logs as possible, and then let the fire in the afflicted logs continue to burn out. The equipment operators must be able to work safely in the log yard and not be overrun by the fire. A proper suppression strategy should be in place to ensure safe and efficient operations.

Incident command system and preparedness planning

Provincial firefighting agencies, along with other fire and emergency services (nationally and internationally), have adopted the incident command system to manage fires. This system uses a standardized command hierarchy to manage emergencies. Any provincial agency responding to a fire in a log yard uses this system and forest industry personnel need to work with it as well.

A fire-management plan should be developed for each site. The plan would include, for example, a contact list and a site map, and the locations of water sources and equipment. The plan must identify safety zones and escape routes, and specify protocols for breaking up log decks and carrying out suppression. Signage at log yards should provide information about the fire reporting procedure.

It would also be valuable for companies to implement a preparedness system based on fire hazard. For example, when the fire...
hazard begins to climb, Alberta-Pacific Forest Industries Inc. alerts its staff and contractors. Beyond certain thresholds, the company will hire emergency response contractors to be on stand-by.  

**Equipment and water supply**

A large volume of water is needed to contain and suppress a fire in a log deck once it becomes entrenched. The water source should be big enough to supply the equipment. For example, a 3785 L/min (1000 US gallons/min) delivery system will use 1.8 million L (480 000 US gallons) over an 8-h period. An entrenched fire may require several days to extinguish, i.e., significant amounts of water would be required. In a recent deck fire, over 12 million L (3 million US gallons) were used. As well, personnel need to be able to get water to all parts of the log yard and apply it at some distance from the heat—some monitors can shoot water up to 100 m.

Equipment requirements will depend on the need for initial attack and extended suppression operations. The equipment criteria for initial attack of a fire in a log yard are:

- Firefighting equipment should be on-site to facilitate rapid access and response.
- Firefighting equipment should be mobile.
- It should be possible to operate the firefighting equipment with minimal staff.
- The equipment should be capable of meeting potential need, e.g., in terms of water delivery volume and range.

The fastest response will come from an on-site, water-tank-equipped vehicle. See Ault (2006) for examples of off-road, tank-equipped vehicles and Schroeder (2005a) for examples of other types of equipment useful in log yards. Gel or other water-enhancing products can be applied using backpack kits supported by a water-tank-equipped vehicle or by another water source. A backpack kit usually consists of a 20-L (53 US gallons) container, plus a proportioning nozzle (Figure 6) for liquid gels. Powdered gels also require a mixing tank and can be pre-mixed or mixed in line (Figure 7).

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In extended suppression operations, gel can be applied with a variety of hose/nozzle and monitor combinations. An inline proportioning valve is needed to mix the gel to the desired ratio. The benefit of this type of valve over a proportioning nozzle is that it allows an infinite range of mix ratio settings. This could be important if water hardness is an issue. With hard water, a larger volume gel container (e.g., large drum) would be useful to supply suppressant.

A hydro-seeder may be used to apply powdered or liquid gels over a larger surface such as a log deck as it is designed to spray a thickened solution such as gel.\(^4\)

Tank/sprayer combinations range in size from 1100 to 11 000 L (300 to 3000 US gallons). Larger hydro-seeder units have monitors or similar spray guns that allow application from a range of distances. This flexibility would be useful in the case of tall log decks and for fire suppression. Equipment for extended suppression can be costly—up to $100 000 for a monitor. The equipment could be supplied by contractors, or the purchase cost could be shared by an industry co-operative.

### Water additives

Water additives are discussed separately because they are used for both prevention and suppression. In wildland firefighting the most common water additives are retardant, foam, and water-enhancing gel. Additives can be applied from the air or on the ground.

A retardant is a salt-based chemical compound (essentially fertilizer) that is effective after the water has evaporated. It is used mainly in aerial applications but it would be useful in preventing the encroachment of a fire into a log yard if it is applied around the perimeter.

A foam is a hydro-carbon-based surfactant (detergent). It must be agitated with the water during application. Foam is said to double water’s effectiveness for suppression (Goodson and Adams 1998) and it can also extend water’s usefulness for prevention. Foam application for prevention can be expected to be effective for approximately 1 h after application.

Water-enhancing gel is essentially a super-absorbent polymer—similar to the material used in disposable diapers—that can hold many times its weight in water. Gel is useful in preventing a fire in a log deck (e.g., by flying embers) or in suppressing a fire.

Because gel is a fairly new product, FPInnovations has investigated its use under a variety of conditions, and found that gel can extend water’s effectiveness in preventing ignition by flying embers (Gibos and Schroeder 2006) and in preventing fire encroachment (Schroeder 2006a and b). Gel was also found to be effective at slowing the spread of fire after a log deck had been ignited (Schroeder 2005b).

FPInnovations conducted a case study in 2006 to examine the effectiveness of gel for suppressing fire (Figure 6). When 3785 L (1000 US gallons) of water mixed with 1% Thermo-Gel® 200L\(^5\) was applied to a test fire in a small pile of logging debris, the fire was not extinguished. However, the gel did act as an insulator, which could allow a fire crew or equipment to get close to the deck to break it up and extinguish the fire.

For fire prevention, the suggested technique is to first cover the area with a lower mix ratio of gel and water to achieve better penetration into the fuels, and then increase the ratio and apply a second, thicker layer.

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5. Thermo Technologies, LLC.
Gel can be applied with standard wildfire water-delivery equipment. It needs to be mixed if it is a powder, or it is mixed in line if it is a liquid, usually with a specialized nozzle. Consultation and training with a gel supplier are recommended in order to ensure the product is used to its greatest potential.

Following are some guidelines for applying Thermo-Gel. A 20-L gel application using a 77-L/min (20 US gallons/min) nozzle will cover 800 m² at a 1% mix ratio, and 350 m² at a 2% mix ratio (by volume). This equates to 42 m²/L at 1% and 18.5 m²/L at 2%. However, water hardness affects gel applications. In general, hard water will require more gel to achieve the same effectiveness as softer water. Water hardness should be tested prior to the occurrence of a fire, as part of the prevention program.

Gel longevity after application varies with the mix ratio. A 2% ratio should be effective for 1 to 4 h depending on weather conditions. A 1 to 1.5% ratio will be effective for 30 to 60 minutes and could be capped with a second application using a higher mix ratio. Gel can be re-hydrated by applying a water mist (not a water stream), but it will lose 30% of its effectiveness each time it is re-hydrated.

Other gels such as Phos-Chek® AquaGel-K® are also effective. Phos-Chek is supplied in a powder form, which is good for long-term storage, but mix ratios and application equipment may differ from liquid gels. The manufacturer should be consulted about mix ratios and application equipment.

Gel can be applied through sprinklers but this technique is not recommended. High pressure is required to pump gel through hose lines and sprinklers, and the gel tends to aggregate into pools, resulting in more gel being applied than needed.

Operational, environmental, and clean-up issues must be considered when using water additives. All additives, but especially foam and gel, can make surfaces slippery. Products used by Canadian wildfire agencies have been tested for environmental toxicity and corrosivity. These additives are on a qualified products list that is managed by the Canadian Interagency Forest Fire Centre (http://www.ciffc.ca/). Approved products are deemed to have low toxicity but applying them in and around water bodies should be avoided.

Early gel products were difficult to remove after being applied and this gave the products a bad reputation. Today’s products can be washed off with a water stream. Gel also degrades with ultraviolet exposure. The speed of degradation depends on the mix ratio and application thickness, but in general it should not take more than 3 or 4 weeks.

**Conclusions and implementation**

This report has separated the protection of log yards from fire into prevention and suppression activities. However, the two components should be linked as part of a log-yard protection plan that can be followed by individual companies or an industry co-operative. Specific details such as personnel safety, water supply, water additives, and equipment need to be addressed within each plan. A protection plan should include the following:

- Managing forest fuels surrounding the log yard, including periodic maintenance.
- Removing fine fuels and debris within the log yard.

6. Astaris Canada Ltd. And ICL Performance Products LP.
• Managing the arrangement of log decks.
• Adopting the incident command system.
• Establishing a preparedness system based on fire hazard, including stand-by alerts for staff and contractors during times of high fire hazard.
• Developing a plan for the use of water-enhancing gels.
• Making equipment available, and developing a list of contractors that can supply additional or specialized equipment.
• Implementing a program for maintenance of suppression equipment.
• Ensuring an adequate supply of water is readily available.

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References


