

How Much Fuel Is in That Pile or Windrow?

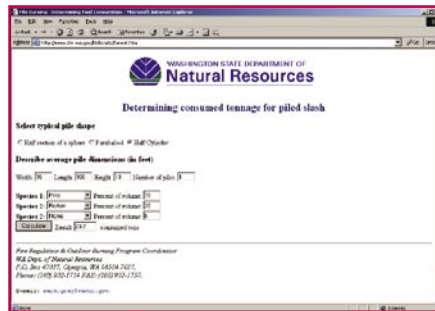
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I've often been asked by both fire managers and other fire researchers how to sample the fuel weight in woody debris piles and windrows. Certainly, the planar (Anderson 1978; Brown 1974; Brown and others 1982) or line intersect techniques (McRae and others 1979; Taylor 1997; Van Wagner 1982) are not very efficient methods for sampling in these kinds of fuel complexes. Other more practical techniques exist (e.g., Hardy 1996; Johansen 1981; Johnson 1984; McNab 1980; McNab and Saucier 1980; Mohler 1977).

In this brief article, I will list the relevant literature and highlight the existence of a simple, freely available computer program now available for calculating the fuel weights of woody debris piles and windrows.

The Washington Department of Natural Resources has developed a user-friendly, online calculator program for determining the fuel weights of debris piles and windrows (<<http://www.dnr.wa.gov/htdocs/rp/tonest.htm>>). The program is based on Hardy's (1996) publication. If you have a need to know preburn fuel weights of debris piles or windrows, this calculator offers a quick and easy approach.

Users are required to input one of three possible pile or windrow shapes—i.e., half section of a sphere, paraboloid, or a half-cylinder (Alexander 2006)—as well as the length, height, and width of the pile or windrow (either measured or estimated) and the number of piles or windrows with these attri-



Sample screen from the online fuel weight calculator for piled debris and windrows developed by the Washington State Department of Natural Resources.

butes. Finally, the user is required to specify the percent volume by tree species based on ocular estimates.

Sample Calculation

A sample screen capture from this program is presented here for the case of a single, half-cylinder shaped windrow 16 ft (4.8 m) in width, 100 ft (30.3 m) in length, and 10 ft (3 m) high. This windrow is comprised of (volume) 70 percent pine and 30 percent rotten wood. The final output is in tons of total fuel consumed (tons x 0.9 = tonnes), which is assumed to be equivalent to 85 percent of the total preburn fuel weight.

This follows Hardy's (1996) statement that: *"The percentage of wood mass consumed when piles are burned typically ranges between 75 and 95 percent"* (Gray 2005). Thus, for the sample screen of capture below of 23.7 tons, the total preburn fuel weight would be 27.9 tons (i.e., $(23.7 \times 100)/85 = 27.9$). This is equivalent in the International System (SI) of units to 25.1 tonnes (i.e., $27.9 \times 0.9 = 25.1$).

This calculator program is oriented toward tree species in the Pacific Northwest. Obviously, if sufficient interest and need existed, a similar program could be developed (including a SI unit option) for other tree species—based on wood density values found in published sources (e.g., Mullins and McKnight 1981) (if such precision was deemed necessary).

However, I believe that reasonable estimates can still be made with the current program by using Pacific Northwest tree species that are anatomically similar (e.g., use Sitka spruce for black spruce and white spruce; alder for trembling aspen).

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Table 2—Ozone exceedance days in 2005 in Atlanta, Augusta, and Macon GA; and Chattanooga, TN.

Location	Forecasted exceedance days	Forecasted exceedance days, yet did not occur	Exceedance days that occurred, but were not forecast	Actual exceedance days
Atlanta, GA	26	17	8	17
Augusta, GA	0	0	1	1
Chattanooga, TN	4	4	2	2
Macon, GA	38	37	1	2

the commission's method did capture 1 of the 2 high ozone days (table 2). Because the commission's ozone forecast method was designed to over forecast exceedance days in order to minimize the possibility of issuing permits on high ozone days, we considered the results acceptable. (If the 0.085 ppm standard had been used, the number of forecast high-ozone days would have been reduced to only 1 day.)

2. **Atlanta.** There were 26 days forecast to be high ozone days, with 17 days when this was forecast but did not occur. There were 8 days where an ozone exceedance occurred but was not forecast (table 2). Under

the reevaluated summer ban rules, prescribed burnings were allowed on 127 days during the ozone season in the 26 second-tier counties around Atlanta. If a total burn ban had been applied, there would have been no burning days during ozone season in these 26 counties.

3. **Augusta.** There were no days forecast to be in exceedance. All 153 days were therefore available for burning (table 2).

4. **Chattanooga.** Four days were forecast to be high ozone days, with two actually occurring (table 2). Therefore, 149 days were available for burning.

Today, during the burn ban period of May 1 through Sept. 30, prescribed burning is only allowed in the Atlanta area's 26 second-tier counties when the ozone potential is low. In addition, during low ozone potential days, both prescribed burning and slash burning are allowed in the newly added counties around Macon, Augusta, and Chattanooga.

As advances are made in ozone forecasting, the number of false alarms will likely decrease, further reducing lost burning days in the summer. By working together, the forestry community and the GAEPD have developed a method that protects air quality and preserves limited prescribed fire during the summer months.

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