Alaska Fuels Drying & Data Entry Instructions

The following process can be used for drying duff, foliar, woody, and herbaceous fuel moisture samples along with entering data and calculating moisture content and the CFFDRS Indices.

Recording Data

Record all data on the **Fuel Moisture Data Sheet**. Be sure to complete all of the header information.

PLEASE REFERENCE THE <u>EXAMPLE DATA SHEET</u> ON THE LAST PAGE.

Items of Note:

Sample #	Type	Fuel Code
1	Duff	LM
1	Duff	DM
1	Duff	UD
2	Duff	LM
2	Duff	DM
2	Duff	UD
3	Duff	LM
3	Duff	DM
3	Duff	UD

- The *Sample #* will remain the same for each duff layer (i.e., Live Moss (LM), Dead Moss (DM), Upper Duff (DM)) within the same plug (Figure 1).
- For each sample *type* (Duff, Woody (shrubs), Herbaceous (grass), or Foliar (spruce) number each sample 1, 2, 3 etc. This is needed for the data entry spreadsheet to work correctly (Fig. 2).
- The *Thickness (cm)* column only applies to duff samples.
- Record notes about the samples or phenology of the specific species in the *Comments* column. Please record the feathermoss species in the *Comments* column.

Figure 1. Example of *Sample #* column for 3 duff samples.

Fuels Drying

Weigh all fuel moisture samples with lid on jar and record this in the **Wet Weight** column of the **Fuel Moisture Data Sheet**. Next, take the lids off of the containers and place the containers (with the lids underneath) in the oven. Set the oven temperature to 100°C (or 212°F). Foliar, woody, and herbaceous samples should dry for 24 hours. Duff samples generally should remain in the oven for 48 hours to make sure they are dry. *Trick:* Occasionally check dry weights to see if the weights change to confirm that the samples are dry. If all moisture is removed, the dry weights should be the same between weight checks.

> **Note:** *If drying ONLY spruce needles (foliar) samples, set the oven temp to 80°C (176°F) to prevent the release of sticky resins in the sample containers.*

Remove the containers from the oven, put lids on, and weigh the samples to get the **Dry Weight**. Discard the fuel samples and weigh the empty containers (**with lids**) for the **Tare Weight**.

Data Entry

Data Entry Spreadsheet: FuelMoisture_DataEntry_Site_Year_Blank (v2014).xls Rename the file with the appropriate year and sampling site or site names.

Tab 1. Site Information

Open the spreadsheet and enter your sampling location information for the area you are sampling from in the Tab *1. SiteInfo*. This only needs to be done for each general sampling area, if you sample there multiple times this does not need to be updated. Be sure to add a latitude and longitude for the general sampling area.

Tab 2. Fuel Moisture Data Entry

This is where you will enter all the fuel moisture data for a site and for all the dates collected at that site. You can use the same excel spreadsheet for multiple sites if desired.   Enter data from the paper data sheet into the Tab *2. Fuel Moisture Data Entry*. The columns with red font (% Gravimetric, % Volumetric, and Bulk Density) are formulas, *do not type in these columns* or the formulas may get erased. In general, samples are collected using gravimetric techniques (where moisture content is calculated by weight opposed to volume) therefore the *% Volumetric Moisture* and *Bulk Density* fields **will not be used**.

> *Note:* The *% Volumetric Moisture* field will only be accurate if you do exact duff plug dimensions of 3" x 3" and record accurate thickness measurements. Gravimetric sampling is recommended when calculating bulk density is not needed.

Fuel Moisture_DataEntry_SITE_YEAR_BLANK (2013v3).xlsx

	A	B	C	D	E	F	G	H	I	J	K	L
1	Data Entry for Duff and Fuel Moisture Year:											
2	Site	Date	Sample #	Type	Fuel Code	Duff Thickness * (cm)	Bottle #	Wet Wt	Dry Wt	Tare Wt	% Gravimetric Moisture	% Volumetric Moisture
3	Example	5/29/2013	1	Duff	LM	3.5	911	58.9	58.2	52.6	12.5	0.19
4	Example	5/29/2013	1	Duff	DM	5.5	35	64.2	60.1	53.9	66.1	0.72
5	Example	5/29/2013	1	Duff	UD	16.0	121	169.1	127.7	108.4	214.5	2.51
6	Example	5/29/2013	2	Duff	LM	3.5	91	58.4	57.6	53.4	19.0	0.22
7	Example	5/29/2013	2	Duff	DM	4.5	58	69.0	61.1	53.3	101.3	1.70
8	Example	5/29/2013	2	Duff	UD	11.5	103	157.4	131.2	109.2	119.1	2.21
9	Example	5/29/2013	3	Duff	LM	3.5	31	60.3	59.3	53.0	15.9	0.28
10	Example	5/29/2013	3	Duff	DM	2.5	110	66.7	58.8	52.8	131.7	3.07
11	Example	5/29/2013	3	Duff	UD	13.5	101	172.6	141.1	108.0	95.2	2.27
12	Example	5/29/2013	1	Woody	LEPA		117	59.9	56.5	52.9	94.4	#DIV/0!
13	Example	5/29/2013	2	Woody	LEPA		37	61.7	57.7	53.4	93.0	#DIV/0!
14	Example	5/29/2013	3	Woody	LEPA		162	62.0	57.7	53.3	97.7	#DIV/0!
15	Example	5/29/2013	1	Foliar	PIMA		28	71.5	63.0	53.0	85.0	#DIV/0!
16	Example	5/29/2013	2	Foliar	PIMA		33	66.9	60.6	52.9	81.8	#DIV/0!
17	Example	5/29/2013	3	Foliar	PIMA		106	78.2	67.4	54.0	80.6	#DIV/0!
18	Example	5/29/2013	1	Woody	BEGL		124	60.3	56.7	53.6	116.1	#DIV/0!
19	Example	5/29/2013	2	Woody	BEGL		180	60.3	56.6	53.5	119.4	#DIV/0!

1. SiteInfo   2. Fuel Moisture Data Entry   3. Average Grav MC Pivot   4. Fuel Moisture Data Summary   Optional Duff CFFDRS Data Sum

Figure 2. Screen shot of the *2. Fuel Moisture Data Entry* tab where data is entered in from the information collected in the field and weights were recorded for the fuel moisture samples.

Tab 3. Calculating Average % Gravimetric Moisture Content

Click on the **3. Average Grav MC Pivot** tab. Right click inside the pivot table and select **Refresh** to update the data. **You must REFRESH** the table every time you add data in the **Moisture Data Entry** tab. The average gravimetric moisture content will be highlighted in the right hand column.

The pull down arrows next to the **Site, Date, Type**, and/or **Fuel Code** columns can be used to filter the summary table (Figure 3). The average gravimetric moisture content will need to be manually entered into the **Fuel Moisture Data Summary** tab.

> **Note:** the fuel codes are shown in alphabetical order for each fuel type. Therefore, unlike the data entry tab, DM comes before LM in the pivot table. Keep this in mind when transferring the data to other tabs in the spreadsheets or NFMD (see information below).

Figure 3. Screen shot of **3. Average Grav MC Pivot** tab. This sheet is a pivot table that will calculate the average gravimetric moisture content of the samples collected by type and fuel code for each date and site. Don't forget to refresh the data!

Tab 4. Fuel Moisture Data Summary

Fill out the table on the **4. Fuel Moisture Data Summary** tab with the site name and date (Figure 4). Record the average moisture content for each fuel type you collected. The average values to be entered are taken from the **3. Average Grav MC** tab. If you didn't sample a specific fuel type – leave it blank. If you sampled additional fuel types, use the extra columns provided.   You will have to scroll over to see all the columns.

> **Tip:** You can use the copy and paste function to transfer average values from these two tabs. When pasting the average %MC into the **Fuel Moisture Data Summary** tab, you must **right click** in the cell, select **paste special**, and then select **values**.

CFFDRS values for Duff Moisture Code and Drought Code are calculated from the dead moss and upper duff moisture content (respectively) based on published equations. The equations should auto-calculate once duff moisture is entered into the spreadsheet (don't type in the auto-calculate columns or the equations will be erased). There are two DC values based on different equations. There is also a draft equation for FFMC, but is only for comparison to the RAWS FFMC. If you are only collecting duff moisture, the data can be entered under the Optional Duff CFFDRS Data Sum tab (Fig. 5). The equations (and descriptions) are provided above the table for your reference in that tab or in the **CFFDRS Formulas** tab. The numbers for the equation do not refer to the published reference number.

Enter the *RAWS* (Remote Automated Weather Station) *Name, RAWS FFMC, RAWS DMC*, and *RAWS DC* values from the nearest FWI (Fire Weather Index) reporting weather station to compare weather generated and moisture calculated CFFDRS Fuel Moisture Codes. All reporting stations can be found in the FWI Database on the AICC webpage (http://fire.ak.blm.gov) under Fuels/Fire Danger. Be sure to enter RAWS data for the date that samples were collected, **not** the date you are entering the data.

Figure 4. Data entry table to report the average moisture contents for each fuel type on the **4. Fuel Moisture Data Summary** tab.

Optional Duff CFFDRS Data Summary

This tab can be used to calculate the CFFDRS indices based on the duff moisture contents if only duff data is being collected at a site. These equations and calculations are the same as on the **4. Fuel Moisture Data Summary** tab. The only difference from Tab 4 is that it does not include columns for live fuel data. Open the **CFFDRS Data Summary** tab. The equation to calculate the DMC from % moisture content and two options to calculate the DC from % moisture content have been entered into the table for you and will also auto-calculate (Figure 5). The equations (and descriptions) are provided above the table for your reference.

CFFDRS Formulas

The equations used to calculate CFFDRS Fuel Moisture Codes can be referenced on the **CFFDRS Formulas** tab. You can also convert % moisture content to any of the FWI indices. The equations are written in an excel friendly format should you want to incorporate additional equations into the **Duff CFFDRS Data Summary** tab.

Figure 5. Screen shot of the *Optional Duff CFFDRS Data Summary* tab.

How to Share the Data for Others to Use

Keep copies of the fuel moisture data spreadsheets and data sheets at your local office. At the end of the season please try to send a copy of your original data or summary of data to one of the Fuel Moisture lead contacts for your agency. A google drive spread sheet has been setup in previous years to enter summary data into. Information about this should be available from one of the Alaska fuel moisture coordinators.

See the fuel moisture sampling site on Alaska Fire Science Consortium/ FRDAC website for contacting a coordinator. This information will be utilized for comparison across Alaska and potentially developing new equations for duff moisture and CFFDRS indices.

Fire behavior analysts working on fires in your area will be interested in current fuel moisture data. To make these data available, the Alaska Interagency Fire Community has been posting live fuel moisture and duff moisture data on the National Fuel Moisture Database (NFMD) since 2012. This data is online at this web page http://www.wfas.net/nfmd/public/index.php (Note: i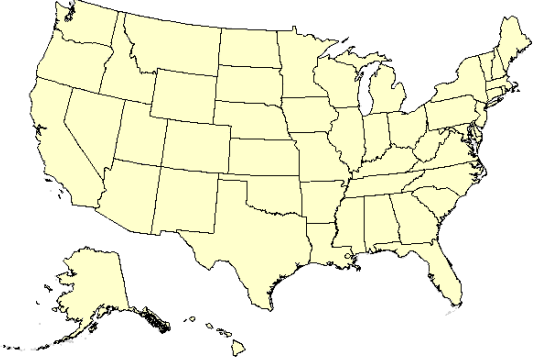f this link changes search for "NFMD fire" on the internet). Passwords are required to enter or edit data on this site. Currently, the BLM Alaska Fire Service, Fire Ecologist Eric Miller is the AK GACC coordinator for NFMD. Contact Eric for access and to set up a new sampling site. *NOTE: CFFDRS indices are not entered in this national database, only the actual fuel moisture of the duff layers.*

Helpful Hints with Excel: Expanding Tables with Formulas

The *Moisture Data Entry* and *Duff CFFDRS Data Summary* tabs contain formulas. If you need to add more rows to incorporate more data, you must highlight the cells with formulas and drag the formulas down. Make sure you "grab" and drag the corner of the highlighted cells with the "✚" mouse symbol showing (Figure 6).

DO NOT use the "Insert Row" function (by right clicking on the numbered rows on the far left of the spreadsheet and selecting "Insert"). The excel formulas will not work.

Upper Duff %MC	RAWS DC	Calc DC from UD Grv MC% (EQ 3)	Calc DC from UD Grv MC% (EQ 4)**	Du
95.52	151.3	919.9	437.2	
500.90		21.6	-6.8	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	
#N/A		#N/A	#N/A	

The pivot table on the *Summary Grav MC* tab is built to accommodate up to 9 samples of the same fuel code on a single date. For example, the pivot table will calculate the average % MC for up to 9 PIMA samples collected on 26-May-11, 9 PIMA samples on 23-June-11, as so forth.

Figure 6. You must highlight and drag the formulas down with the "✚" mouse symbol to expand tables on the F*uel Moisture Data Entry, Fuel Moisture Data Summary and Duff CFFDRS Data Summary* tabs.

To expand the pivot table, *Insert* a column between the last sample in the table and the *Average* column (Figure 7). Repeat until you have enough columns to accommodate all of your samples. Generally, additional columns are not needed.

Figure 7. *Insert* a column between the edge of the pivot table (or last sample) and the *Average* column to accommodate more than 9 samples of a single fuel code on a single day.

EXAMPLE - Fuel Moisture Data Sheet

Site Name: My Sampling Site   **Recorders:** John Smith & Jane Jones   **Date:** 5/16/2013

Unit: 12-2   **Fuel Type Sampling (Veg Community):** Black Spruce/Feathermoss   **Phenology:** Pre-greenup   **Time:** 1500

Latitude (DD): N 64.856708   **Longitude (DD): W** 147.888583   **Datum:** NAD83

Avg Slope: 2 %   **Elevation :** 450 (ft/m)   **Aspect:** 186°   **Nearest RAWS:** FBK

Sample #	Type	Fuel Code	Thickness (cm)	Bottle #	Wet Wt	Dry Wt	Tare Wt	Comments
1	Duff	LM	3	23	75.3	58.7	52.9	HYSP
1	Duff	DM	2	22	80.5	58.7	52.9	
1	Duff	UD	8	13	73.4	57.2	52.8	
2	Duff	LM	2	52	75.3	58.7	52.9	PLSC
2	Duff	DM	2	89	80.5	58.7	52.9	
2	Duff	UD	5	36	73.4	57.2	52.8	
3	Duff	LM	4	102	75.3	58.7	52.9	HYSP
3	Duff	DM	3	77	80.5	58.7	52.9	
3	Duff	UD	10	7	73.4	57.2	52.8	
4	Duff	LM	2	34	75.3	58.7	52.9	HYSP
4	Duff	DM	4	25	80.5	58.7	52.9	
4	Duff	UD	6	21	73.4	57.2	52.8	
1	Foliar	PIMA	-	153	79.8	67.8	52.8	
2	Foliar	PIMA	-	121	78.0	66.9	53.0	
3	Foliar	PIMA	-	158	79.8	67.8	52.8	
4	Foliar	PIMA	-	129	78.0	66.9	53.0	

Type: Duff, Woody (shrubs), Herb (grass or forbs), Foliar (spruce)

Fuel Codes: Duff: LM =live moss, DM = dead moss, UD = upper duff, LD = lower duff

PIMA = black spruce, PIGL = white spruce, BEGL = shrub birch, LEPA = Labrador tea, VAVI = cranberry, VAUL = blue berry, CACA = blue joint grass, ERVA = Tussock cotton grass, CAREX = Carex sedge

Comments: Include feathermoss species (HYSP = *Hylocomium splendens*, PLSC = *Pleurozium schreberi*)

Site Name: My Sampling Site   **Recorders:** John Smith & Jane Jones   **Date:** 5/16/2013

Sample #	Type	Fuel Code	Thickness (cm)	Bottle #	Wet Wt	Dry Wt	Tare Wt	Comments
1	Woody	LEPA	-	113	74.8	73.6	52.9	
2	Woody	LEPA	-	115	74.4	73.2	52.8	
3	Woody	LEPA	-	114	74.6	73.3	52.8	
4	Woody	LEPA	-	118	74.1	73.4	52.9	
1	Woody	VAVI	-	35	74.8	73.6	52.8	
2	Woody	VAVI	-	42	74.4	73.2	53.0	
3	Woody	VAVI	-	48	74.6	73.3	52.8	
4	Woody	VAVI	-	32	74.1	73.4	53.0	
1	Herb	CACA	-	65	74.8	73.6	52.8	
2	Herb	CACA	-	66	74.4	73.2	53.0	
3	Herb	CACA	-	70	74.6	73.3	52.8	
4	Herb	CACA	-	72	74.1	73.4	53.0	