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CONSUME Users Guide

Roger D. Ottmar, Mary F. Burns, Janet N. Hall,
and Aaron D. Hanson

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CONSUME Release version 1.0, January 1,1993

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Roger D. Ottmar, Mary F. Burns, Janet N. Hall, and
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Abstract

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CONSUME is a user-friendly computer program designed for resource managers with some working knowledge of IBM-PC applications. The software predicts the amount of fuel consumption on logged units based on weather data, the amount and fuel moisture of fuels, and a number of other factors. Using these predictions, the resource manager can accurately determine when and where to conduct a prescribed burn to achieve desired objectives, while reducing impacts on other resources. CONSUME can be used for most broadcast and underburns on forested lands in the western states if the woody fuels are relatively homogeneous and composed of Douglas fir, hemlock, alder, lodgepole pine, or mixed conifer species. The models within CONSUME have not been adequately evaluated for long-needled pine fuel types at this time.

Keywords: Prescribed burning, woody fuel consumption, duff consumption, fuel moisture.

Cooperative Acknowledgment

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About This Users Guide

Welcome to CONSUME. CONSUME is a user-friendly computer program that calculates woody fuel and duff consumption for resource managers who prescribe fire for management of forest resources and have some working knowledge of IBM-PC applications. This User Guide is divided into ten parts:

CONSUME Overview. Describes general features of CONSUME.

CONSUME Basics. Presents basic information you will need to know to use CONSUME, such as installing and getting help.

Recording and Managing Data. Provides information on data files.

Creating and Interpreting Reports. Describes the different kinds of reports generated and how to interpret them.

Quick Reference. Offers quick information about each screen and key that you can use in CONSUME.

References. Lists literature cited in this manual.

Appendix A: Tips and Cautions. Points out helpful tips and cautions that may save you time.

Appendix B: Troubleshooting. Describes error messages and helps diagnose problems.

Appendix C: Scientific Background. Provides scientific background for CONSUME, including documentation of major equations.

Glossary: Defines key words used in this manual and CONSUME.

Conventions

This manual uses the following conventions.

File and directory names are shown in ALL CAPS. For example, "Switch to the CONSUME directory."

Commands you type from the keyboard are shown in **bold text**. For example, "Type **y** to save the changes to the unit"

Key names are shown in SMALL CAPS. For example "Press the ESC key to exit CONSUME."

Key combinations are shown separated by a hyphen (-). For example, "press SHIFT-F1" means "hold down the SHIFT key and press F1."

Flowcharts

The following paragraphs describe the symbols used to depict the flow of the program.

All the charts flow from the top down. Side branches show the relative of order data used during the processing of the calculations.



INPUT DATA

Rectangles represent input data, including any measured or estimated value that is necessary for the calculations performed by CONSUME. Examples are fuel loadings, fuel moisture measurements, duff depth, and weather data.



Hexagons represent processes. These processes may contain any number of individual calculations. The result of the process is represented by the title of the process (for example, Percent Consumption). Examples are consumption calculations, fuel moisture estimates, and duff reduction.



The diamond shape represents a decision. CONSUME often must choose between different processes according to conditions present on a unit, in order to calculate various parameters properly. The diamond shape shows where a decision is made and the paths taken as a result of the decision.

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CONSUME Overview

Forest managers use prescribed fire on logged forest land to reduce obstacles to tree planting, expose mineral soil for natural regeneration, and reduce the hazard of wildfire

In the past, a fire that consumed most of the organic material on a logged forest site was thought to have met management objectives. As understanding of forest ecosystems has increased, forest managers have become more discriminating in their use of prescribed fire. Now prescribed fires are applied to satisfy forestry management objectives and benefit other forest ecosystems as a whole.

The CONSUME program is a decisionmaking tool, designed to assist you in your use of prescribed fire. CONSUME can help you achieve your prescribed burn objectives while minimizing the impact of prescribed fire on air quality, soil, water, wildlife, and other resources.

How Can CONSUME Help Me?

CONSUME predicts the amount of fuel consumption on a logged unit based on weather data, the amount and fuel moisture of fuels, and a number of other factors. Using these predictions, you can accurately determine when and where to conduct a prescribed burn to achieve desired objectives, while reducing impact on other resources.

For example, if a management objective was to retain an average duff depth of 2 inches on the unit, the manager could use CONSUME to determine the adjusted 1000-hour fuel moisture at which a burn could take place and meet the objective.

Another management objective might be to produce less than 750 tons of smoke particulates from a prescribed burn. CONSUME could be used to determine total fuels consumed for a particular adjusted 1000-hour fuel moisture content. By multiplying estimated fuel consumption by an average emission factor (for example, 28 pounds per ton of fuels consumed), the manager could determine whether the prescribed burn will meet the 750-ton objective.

CONSUME bases its predictions on the assumption that fuels will be broadcast burned, and that they have generally been subject to logging activity.

How Do I Use CONSUME?

To use CONSUME, follow these basic steps:

1. Identify units to be burned in the upcoming burn season.
2. Gather initial weather data for each weather zone and enter it into CONSUME. These zones should cover the entire area where the units are located. For information about the specific weather zone data to gather, see "Recording Weather Zone Data."
3. Collect daily weather observations from each weather zone and enter them into CONSUME. For more information about the specific daily weather data to gather, see "Recording Daily Weather Data."
4. Gather and enter data about each unit to be burned. You can do this before or after you gather weather data. For more information about the specific unit data to gather, see "Recording Unit Data."
5. Create CONSUME reports to find optimal dates for conducting prescribed burns or to determine the quantity of fuels that will be consumed on given dates or at given fuel moistures. For more information about the reports you can create, see "Creating and Interpreting Reports."

6. Update and make changes to existing data as necessary. For more information about making changes to weather zone, unit, and daily weather data see "Recording Weather Zone Data," "Recording Unit Data," and "Recording Daily Weather Data."

What Data Do I Enter?

CONSUME makes its predictions based on three types of data:

Weather zone data is information about forest areas that have similar weather characteristics. This includes initial fuel moisture, relative humidity, latitude, temperature, and other factors. When you start using CONSUME, you create an initial set of weather zone data.

You can also enter **daily weather data** for each day thereafter, to reflect changing conditions.

Unit data is information about the specific units you will be burning. Unit data includes number of acres, wind, ignition time, slope, fuel loadings, and other prescription factors.

You enter this data into the CONSUME data base using data entry screens.

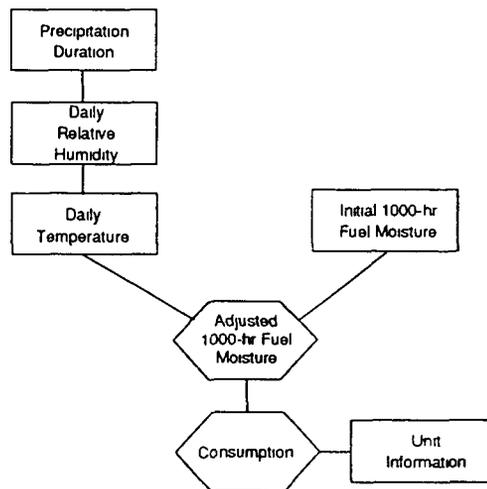
How Does CONSUME Analyze Data?

Once you have entered weather and unit data into the CONSUME data base, CONSUME can predict the quantity of fuels that would be consumed in a prescribed burn on a given date.

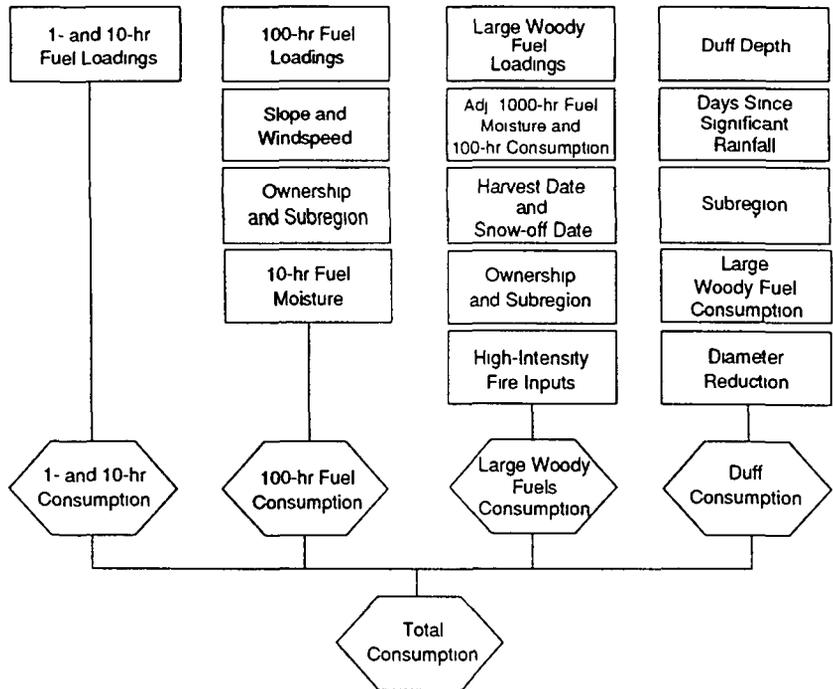
Fuel moisture of 1000-hour (3- to 9-inch-diameter) fuels is the most important factor in predicting fuel consumption. CONSUME uses an adjusted 1000-hour fuel moisture, which is an estimated fuel moisture (derived from temperature, relative humidity, and precipitation data) that represents the average unit fuel moisture of large woody fuels in the Pacific Northwest. Adjusted 1000-hour fuel moisture predicts the fuel moisture of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), hemlock (*Tsuga* sp.), mixed conifers, and lodgepole pine (*Pinus contorta* Dougl. ex Loud.). It has not been evaluated for predicting fuel moisture of long-needled pine. For the Pacific Northwest, adjusted 1000-hour fuel moisture is a more precise way to measure the moisture of large woody fuels than the National Fire Danger Rating System.

In addition to adjusted 1000-hour fuel moisture, a number of other factors are used to improve the accuracy of predictions.

The following charts show (in simplified form) how CONSUME makes predictions. Appendix C shows more detailed information about the CONSUME algorithms and the equations they use.



CONSUME uses weather data to calculate adjusted 1000-hour fuel moisture. This is the most important factor in determining fuel consumption.



CONSUME uses separate algorithms to predict consumption of 1- and 10-hour fuels, 100-hour fuels, large woody fuels, and duff.

What Results Do I Get?

In several types of reports, you can view the results of the predictions CONSUME makes:

- **Fuel Consumption by Date** reports show you the quantity of fuels that would be consumed in burns on different calendar dates.
- **Fuel Consumption by Adjusted 1000-Hour Fuel Moisture** reports show you the quantity of fuels that would be consumed in burns at different values of adjusted 1000-hour fuel moisture.
- **Target Adjusted 1000-Hour Fuel Moisture** reports show you when fuels will reach a target fuel moisture value.

CONSUME can also provide reports that summarize the data you entered:

- **Weather Information** reports show all or part of the weather data that has been entered into the CONSUME database.

Unit Information reports show all or part of the unit data that has been entered into the CONSUME database.

You can display reports on screen, print them on a printer, or use them as text files in other programs, such as a database management system, spreadsheet, or word processor.

You will find detailed information about reports in "Creating and Interpreting Reports."

CONSUME Basics

This chapter introduces you to the basic information you need to use CONSUME, including-

- Installation, upgrading, and using the CONSUME sample database.
- How to start and exit CONSUME.
- An overview of the CONSUME screens and how to use them.
- Information about backing up and restoring files.

Installing and Setting Up

You can install CONSUME on a personal computer with the following system:

- IBM XT or better, or compatible.
- One megabyte of available disk space (500K for CONSUME program files, and approximately 500K for the CONSUME database—the actual size of the database depends on how much data you will enter).
- MS-DOS or IBM PC-DOS 3.0 or higher.
- Any IBM-compatible monitor.

Running the Install Program

The CONSUME disks include a program that will install CONSUME on your hard disk.

To install CONSUME on your computer:

1. With your computer turned on and the DOS prompt showing, insert the CONSUME floppy disk labeled Disk 1 into one of your computer's floppy disk drives
2. If the disk is in drive A, type **a:install** and press ENTER.

If the disk is in drive B, type **b:install** and press ENTER.

The install program screen appears, and suggests that you install CONSUME in a directory named CONSUME on drive C.
3. If you want to install CONSUME in the suggested directory, press a.

If you want to install CONSUME in a different directory, press c and then type the complete path (including drive letter) to the directory.
4. When the install program displays the name of the correct directory, press ENTER, and then press c.

The install program will display an error message if:

- The directory already contains files. You need to delete all the files from the directory, or specify a different directory.
 - The drive does not have enough space. Specify a different drive, or delete unneeded files from the drive. The CONSUME program files require about 500K of disk space.
 - The path is incorrect. Type a correct path. See your DOS documentation for more information about paths.
 - The DOS version is incompatible with CONSUME. You must have DOS version 3.0 or later.
5. When the install program prompts you to change disks, insert Disk 2 in the floppy disk drive.

The install program copies the following files to your hard disk,

CONGO.EXE
CONSUME.BAT
CONSUME.HLP
BSTOP.COM
UNIT0100.BTR
WTHR0100.BTR
BTRIEVE.EXE

Checking Your System Configuration

Before you start CONSUME, check your system configuration to make sure CONSUME will run properly.

To check your system configuration:

1. At the DOS prompt, enter the following to change to drive C:

c:

2. Enter the following to change to the root directory

**cd **

3. Enter the following to display the contents of the CONFIG.SYS file on your computer.

type config.sys

If you see the following lines on your screen, you do not need to make any changes to the CONFIG.SYS file.

FILES=20
(or any number higher than 20)

BUFFERS=20
(or any number higher than 20)

4. If you do not have these lines, you need to add them to the CONFIG.SYS file. You can edit the file using any text editor or word processor that can save files in text (ASCII) format. See your DOS manual for more information.

Using the Sample Data

When you first install CONSUME, it includes some sample weather and unit records. Before you use CONSUME to create your own database, you can use these sample records to try out CONSUME and see how it works.

For example, you can use the sample database to view and modify existing data and create reports.

When you are ready to start using CONSUME to enter your own data, you can delete the sample records. For more information about deleting records, see "Deleting Weather Zones" and "Deleting Unit Records."

Switching From Previous Versions of CONSUME

If you are currently using a prototype of CONSUME, and you want to use the weather or unit data you entered into it, leave the prototype and its data files on your system. Contact the USDA Forest Service, Pacific Northwest Research Station, Software Support, 4043 Roosevelt Way NE, Seattle, WA 98105 for more information about upgrading to the new version.

Starting CONSUME

You start CONSUME from the DOS prompt. If you are not in the directory with the CONSUME files, you may need to change directories before you start.

To start CONSUME:

1. Begin at the DOS prompt. Be sure you are in the directory that contains the CONSUME files

2. Type **consume** and press ENTER

The CONSUME title screen appears

3. Press any key

The Main Menu screen appears.

Exiting CONSUME

Because CONSUME saves all changes as you make them, you do not need to save changes when you exit.

To exit CONSUME:

1. Press the ESC key.

Depending on where you are in the program, you may need to press ESC several times.

Before you exit the program, it displays the message "Do you wish to exit from CONSUME? (Y/N)"

2. Press **y** to exit CONSUME, or press **n** to continue.

You can also exit CONSUME by pressing CTRL-SHIFT-F1 from any menu or data entry screen.

Getting Help

You can get help about any screen or field in CONSUME by pressing SHIFT-F1. CONSUME displays a Help screen with specific information about the screen or field that you are in. To exit Help, press ESC.

Some Help topics have several screens. You can move forward from one screen to the next by pressing F4 or PG DM, or move backward by pressing F3 or PG UP.

Page 1 of 1	HELP FOR THE HOURS OF RAINFALL FIELD	6/15/92 2:30 P
FIELD WOTE:	Hours of Rainfall	
FORMAT:	An Integer between the range of 0 to 24	
DEFINITION:	The hours of total rainfall within a 24-hour weather observation period. If more than a trace of rain fell, a minimum of 1 hour should be entered. If several hours of rainfall occurred, enter the cumulative total duration of all occurrences rounded to the next highest full hour. If It was raining at the time of the observation, enter the duration of rainfall up to that time and account for the remainder of the storm the following day IF THE TOTAL DURATION OF THE STORM FOR BOTH DAYS EXCEEDS 1 HOUR. This variable is used to estimate the adjusted 1000-hours fuel moisturc.	
EXAMPLE:	If rain fell for 5 hours during a 24-hour weathcr observation period, enter 5.	
ESC Exit from HELP		

Help screens like this one are available throughout CONSUME.

Using CONSUME Screens

You enter data and produce reports in CONSUME by using the following screens:

- Use the **Main Menu screen** to choose the task you want to perform.
- Use the **data entry screens** to enter weather and unit data into the CONSUME database
- Use the **Reports Menu screen** to choose a report to create

Main Menu Screen

When you start CONSUME, you see the Main Menu screen. You can choose an option from this screen to enter different types of data or create reports.

```
CONSUME                                     6/12/92 3:02 P
MENU 001

                                MAIN MENU
                                Version 01.00

--> 1. Create/Modify/View/Delete Weather Zones
    2. Create/Modify/View/Delete Units
    3. Add/Modify/View Daily Weather
    4. Produce/Print Reports

ENTEB CHOICE: 1

PRESS ESC to exit from CONSUME
PRESS SHIFT-F1 for HELP
```

The Main Menu screen appears when you start CONSUME. You can move easily between CONSUME screens by choosing menu options.

To choose an option from the Main Menu:

1. Type the number that corresponds to the option you want

Or use the UP ARROW or DOWN ARROW keys to move the arrow marker to the option you want.
2. Press ENTER.

Data Entry Screens

Use the CONSUME data entry screens to enter data into the CONSUME database. There are three screens: the Weather Zone Entry screen (for entering initial weather data for a weather zone), the Unit Entry screen (for entering unit data), and the Daily Weather Entry screen (for entering daily weather data).

You display a data entry screen by choosing the appropriate option from the Main Menu screen.

SCREEN 001	WEATHER ZONE ENTRY SCREEN	6/15/92 2:33 P
WEATHER_ZONE: ██████████	STARTING DATE: ██████	
INITIAL 1000-HR FUEL MOISTURE (%): █	LATITUDE (°): █	
MAXIMUM TEMPERATURE (°F): ██████	MINIMUM TEMPERATURE (°F): ██████	
MAXIMUM RELATIVE HUMIDITY (%): █	MINIMUM RELATIVE HUMIDITY (%): █	
DAYS SINCE SIGNIFICANT RAINFALL: █	HOURS OF RAINFALL: █	
TRANSACTION MENU		
Pick a transaction. (1. Create, 2. Modify, 3. View, 4. Delete)		
F1 Save Record	ESC Cancel Entries	CTRL-SHIFT-F2 main Mcnu
SHIFT-F1 HELP		

Use the Weather Zone Entry screen to enter initial weather zone data.

```

SCREEN 003                                9/02/92  2:52 P
                                UNIT ENTRY SCREEN

UNIT: ██████████ WEATHER ZONE: ██████████ ACRES TO TREAT: ██████
10-HR FTM(%):  █ TARGET ADJ 1000-HR FTM(%):  █ WIND (MPH):  █
IGNITION (MIN): █ DUFF DEPTH (IN):           █ SLOPE (%):  █
SNOW-OFF DATE:  █ HARVEST DATE: ██████ SUBREGION: █ OWNERSHIP:  █

                                FUEL LOADINGS (TONS PER ACRE)
0.0-0.25 IN:  █          0.26-1.0 IN:  █          1.1-3.0 IN:  █
3.1-9.0 IN:  █          9.1-20.0 IN:  █          20.1 PLUS IN:  █

                                TRANSACTION MENU
Pick a transaction: (1. Create, 2. Modify, 3. View, 4. Delete) 1

F1 Save      ESC Cancel  CTRL-SHIFT-F2 Main  SHIFT-F1 HELP
 Record     Entries    Menu                Menu

```

Use the Unit Entry screen to enter data about individual units.

```

SCREEN 005                                9/02/92  2:53 P
                                DAILY WEATHER ENTRY SCREEN

WEATHER ZONE: ██████████ DATE: ██████████
MAXIMUM TEMPERATURE (*F):  █ MINIMUM TEMPERATURE (*F):  █
MAXIMUM RELATIVE HUMIDITY (%):  █ MINIMUM RELATIVE HUMIDITY (%):  █
HOURS OF RAINFALL:  █ SIGNIFICANT RAINFALL? (Y/N):  █

                                TRANSACTION MENU
Pick a transaction: (1. Add, 2. Modify, 3. View)

F1 Save      ESC Cancel  CTRL-SHIFT-F2 Main  SHIFT-F1 HELP
 Record     Entries    Menu                Menu

```

Use the Daily Weather Entry screen to enter daily weather data.

As you can see, the three data entry screens are very similar. You use the same techniques to choose options, move around from one data field to another, and enter data.

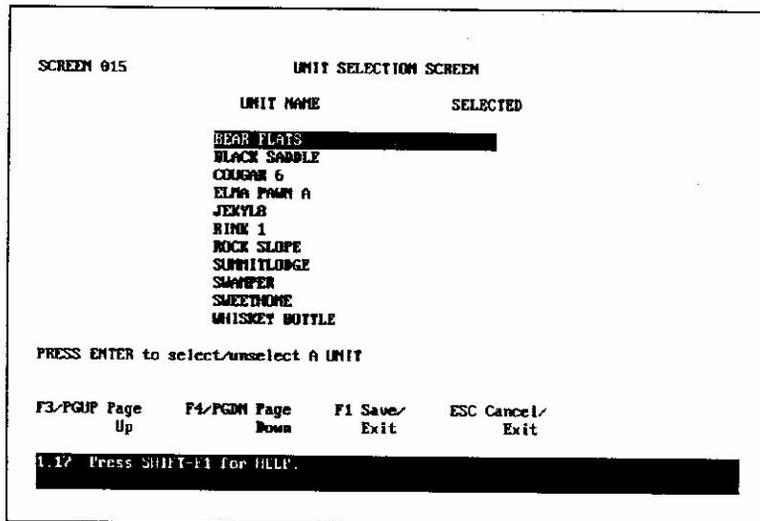
Choosing a transaction

At the bottom of each data entry screen is a Transaction Menu. When you first open a screen, the flashing cursor appears in the box next to the Transaction Menu. You choose to create, delete, modify, or view data by typing the number that corresponds to that task and pressing ENTER. When you make your choice the cursor moves to the first data field.

Selecting a zone or unit

From the first data field, you select the weather zone or unit you want to work with by:

- Typing the name of the zone or unit.
- Pressing F3 or PG up to scroll backward through an index of names, or F4 or PG DN to scroll forward.
- Pressing sHirr-F2 to display the complete list of existing names.



Use the Unit or Weather Zone Selection screens to find a unit or weather zone record quickly.

To select a zone or unit from a list of existing names:

1. Use the ARROW keys to move the highlight to the name you want.
2. Press ENTER.
3. A check mark appears next to the name.
4. Press F1 to return to the data entry screen.

Moving around

The fields available to you in a data entry screen depend on the task you are doing.

- When you create a new zone, unit, or daily weather record, you must enter data in all fields in the order presented
- When you modify an existing zone, unit, or daily weather record, you can move to any of the fields and make changes to data.
- When you delete or view a zone, unit, or daily weather record, you can only specify the name of the record you want to delete.

To move from one field to the next when you create or modify data, press ENTER or DOWN ARROW. To move backward through the fields, press UP ARROW.

To create a new record, type data in each empty field before moving to the next one. If you type the data in a field incorrectly, CONSUME prompts you with a message at the bottom of the data entry screen.

Executing a transaction

Depending on the data entry screen you are using, you can execute a transaction (such as saving or deleting the record you are working with) by pressing F1.

Typing data You can use the following keys as you type data in the fields of a data entry screen:

RIGHT ARROW	Move one space to the right
LEFT ARROW	Move one space to the left
HOME	Move to the beginning of the field
END	Delete characters to the end of the field
BACKSPACE	Delete one character to the left of the cursor
DEL	Delete one character at the cursor

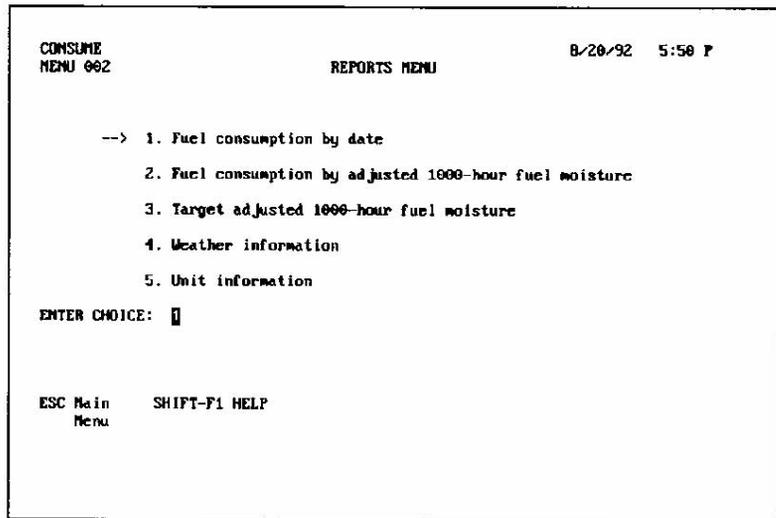
Canceling data You can clear the fields in a data entry screen without saving by pressing ESC.

Returning to the Main Menu If you want to return to the Main Menu screen and select another task, press ESC. Depending on the task you are doing, you may need to press ESC more than once.

Note: For a complete list of keys and their functions in CONSUME, see the Quick Reference section.

Reports Menu Screen

In the Reports Menu screen, you can choose one of several types of reports to create. You display the Reports Menu screen by choosing option 4 (Produce/Print Reports) from the Main Menu screen.



Use the Reports Menu screen to choose a report type to create.

To choose an option from the Reports Menu:

1. Type the number that corresponds to the option you want.

Or use the UP ARROW or DOWN ARROW keys to move the selection arrow to the option you want.

2. Press ENTER.

You will find detailed information about each type of report in "Creating and Interpreting Reports."

Backing Up and Restoring Database and Report Files

The information in the CONSUME database is stored in two files, UNIT0100.BTR and WTHR0100.BTR. Reports are stored in files with the extension .REP. To protect your data from accidental deletion or disk failure, you should make regular backup copies of all these files.

You can make backup copies in several ways. You can use the DOS **copy** command to copy the files to floppy disks. There are also many backup programs available that compress files so they require less storage space. Whatever method you use, be sure to back up your files regularly (whenever you make significant changes to them).

If you need to restore the database (.BTR) files because a database error occurred, simply replace the existing CONSUME database files with the backup copies. See appendix B, "Troubleshooting," for more information.

Recording and Managing Data

To create the reports that will assist you in managing prescribed burns, CONSUME requires three types of data:

- **Weather zone data** describes the weather characteristics of an area.
- **Unit data** describes the characteristics of a unit of land for which you want a fuel consumption prediction.
- **Daily weather data** records the observed weather that occurs in a weather zone. CONSUME requires you to enter daily weather data for each day after the initial day of the weather zone.

You use the data entry screens in CONSUME to create, modify, delete, and view these three types of data.

You can also view weather and unit data by creating reports. For more information, see "Creating and Interpreting Reports."

Recording Weather Zone Data

A weather zone is a geographic area in which weather data is collected daily. A weather zone should be located so that it offers representative weather data for logged units that are to be treated with prescribed fire.

For example, if a group of logged units is in a geographic area represented by a single manual weather station or a remote automatic weather station (RAWS), that area would be a suitable weather zone.

You can use CONSUME to:

- Create new weather zones.
- Base new weather zones on existing zones.

- Modify existing weather zones.
- View existing weather zones.
- Delete weather zones.

How Many Weather Zones?

Fuel consumption estimates rely heavily on estimates of large woody fuel moisture. You can increase the accuracy of large woody fuel moisture predictions by creating as many weather zones as needed. This will ensure that the daily weather events occurring in each unit will be represented as precisely as possible. You should create a weather zone for each weather station.

About Weather Zone Data

Weather zone data is based on a 24-hour observation period. For example, the observation period could be from 1400 hours to 1400 hours the following day. Weather zone data includes the following information:

<i>Weather zone name</i>	A unique name of 20 characters or less (including spaces). This name will appear in reports, and you will use it when you work with units and daily weather. Assign a name to the weather zone that is easy for you and others to remember and identify.
<i>Starting date</i>	The date of the initial weather reading for the weather zone. The date must be within the last twelve months. To enter a date, type six digits in MMDDYY format. For example, to enter "March 5, 1992," you type 030592.

Caution: You must have valid, accurate weather data for the starting date, and for every day thereafter. Because you cannot change the starting date, be sure you can obtain reliable weather data for that date and for all subsequent dates.

Initial 1000-hour fuel moisture

The moisture content of cured, woody 1000-hour (3- to 9-inch-diameter) fuels on the weather zone's starting date. Fuel moisture is expressed as a percent of the oven-dry weight of the fuels. The value for initial 1000-hour fuel moisture must be an integer between 1 and 99.

Note; Adjusted 1000-hour fuel moisture is a crucial factor in predicting large woody fuel consumption. To get accurate results, the value you enter in the *Initial 1000-hour fuel moisture* field must accurately reflect the actual fuel moisture of the large woody fuels on the units in the weather zone.

You can determine initial 1000-hour fuel moisture in several ways. The methods are listed below in order of accuracy:

Measure the fuel moisture by oven-drying 20 cross sections of 1000-hour fuels collected from units in the weather zone. This is the most accurate method.

Use the adjusted 1000-hour fuel moisture estimated by an earlier prototype of CONSUME, or fuel moisture nomograms (Ottmar and Sandberg, 1985). This method will be accurate only if weather data has been continuously maintained.

Assume that fuel moisture will be 45 percent in April and May, 35-40 percent in summer months, and 50 percent or more in winter months. Use this method only if you cannot use the methods above.

CONSUME requires initial fuel moisture to determine adjusted 1000-hour fuel moisture.

Latitude

A measurement of the distance of a site from the equator. Each degree of latitude runs in an east-west direction parallel to the equator. There are 180 degrees of latitude from pole to pole. All weather zones in the northern hemisphere will have a latitude between 0 °N and 90 °N, so the *Latitude* field must contain a number between 0 and 90.

CONSUME uses latitude to determine the length of the drying day, which is one of the factors used to calculate adjusted 1000-hour fuel moisture.

Maximum and minimum temperature

The highest and lowest air temperature, in degrees Fahrenheit (°F), during the 24-hour observation period for the starting date. For example, if the temperature on the starting date ranged from 50 °F to 75 °F, you would enter 50 in the minimum temperature field and 75 in the maximum temperature field.

Maximum and minimum relative humidity

The highest and lowest relative humidity, during the 24-hour observation period for the starting date. For example, if the reported relative humidity on the starting date ranged from 35 to 85 percent, you would enter 35 in the minimum relative humidity field and 85 in the maximum relative humidity field.

CONSUME uses temperature and humidity data to determine adjusted 1000-hour fuel moisture.

Days since significant rainfall

The number of days since a significant amount of rain fell in a 48-hour period. A significant amount of rainfall is one-half inch on sites west of the Cascades/Sierra Nevada and one-quarter inch on sites east of the Cascades/Sierra Nevada.

For example, suppose the starting date was Wednesday, July 14. If an inch of rain fell on the previous Saturday and Sunday (July 10 and 11), with no rainfall since, you would enter 2 in the *Days since significant rainfall* field.

CONSUME uses the data in this field to predict duff consumption.

Hours of rainfall

The hours of total rainfall in the 24-hour observation period of the starting date.

If a trace of rain fell, enter 1. If rain fell for several hours, enter the cumulative total duration of all occurrences, rounded up to the next full hour.

If it was raining at the time of the observation, enter the duration of rainfall up to that time. Account for the remainder of the rainfall in the first daily weather record (if the total duration of the rainfall for both days exceeds 1 hour).

CONSUME uses the data in this field to estimate adjusted 1000-hour fuel moisture.

Creating Weather Zones

To obtain accurate predictions, you should create as many weather zones as your weather station network will allow.

To create a weather zone:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 1, and press ENTER.

The Weather Zone Entry screen appears.

2. Type 1 and press ENTER to select Create from the Transaction Menu.
3. In the *Weather zone* field, type the name of the new weather zone.
4. Press DOWN ARROW or ENTER to move to the next field.
5. Type data in each field of the Weather Zone Entry screen.

Use DOWN ARROW or ENTER to move from one field to the next.

A prompt at the bottom of the screen explains the contents of each field. For more information, press SHIFT-M, or see the descriptions at the beginning of this section.

When you finish entering data in all the fields, CONSUME displays the prompt "Execute? (Y/N)."

6. After you have checked all the data, type **y** and press ENTER to create the new weather zone.

Or type **n** and press ENTER to edit any of the data you entered.

Or press ESC to clear all the fields in the screen and return to the Transaction Menu.

Basing a New Zone on an Existing One

You can use an existing zone as the basis for a new one. This allows you to create new zones for similar areas without creating them all from scratch. To base a new zone on an existing zone, you first display the data for the existing zone. Then you type a new name and make any modifications to the data.

To base a new zone on an existing zone:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 1, and press ENTER.

The Weather Zone Entry screen appears.

2. Type **1** and press ENTER to select Create from the Transaction Menu.
3. With the cursor in the *Weather zone* field, press SHIFT-F2 to choose an existing zone from the list of weather zones. Use the ARROW keys to highlight a zone, press ENTER to select it, and press F1 to return to the Weather Zone Entry screen.

Or press F4 or PG DN to display the data for the next zone, or press F3 or PG UP to display the data for the previous zone.

4. When you see the data for the zone you want to use as the basis of a new zone, type a name for the new zone in the *Weather Zone field*, and press ENTER.

5. Use ENTER or UP or DOWN ARROW to move between fields and make any changes for the new zone.

A prompt at the bottom of the screen explains the contents of each field. For more information, press SHIFT-F1, or see the descriptions at the beginning of this section.

6. When you finish modifying data, press F1 to save the new weather zone.

Or press ESC to clear all the fields in the screen and return to the Transaction Menu.

Modifying Weather Zones

If a weather zone contains incorrect data, you can make changes to it.

Caution: You cannot change the name or starting date of a zone. If you want a zone to have a different name or starting date, you can delete the zone and create a new one. If you do decide to delete a zone, all the daily weather data you have entered for the zone will be lost. You can also create a new zone based on initial day of the existing one.

To modify a weather zone:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 1, and press ENTER.

The Weather Zone Entry screen appears.

2. Type 2 and press ENTER to select Modify from the Transaction Menu.

The cursor moves to the first data entry field, *Weather zone*.

3. Type the name of an existing weather zone.

Or press SHIFT-F2 to choose from a list of weather zones. Use the arrow keys to highlight a zone, press ENTER to select the zone, and press n to return to the Weather Zone Entry screen. To deselect a weather zone, press ENTER.

Or press F4 or PG DN to display the data for the next zone, or press F3 or PG UP to display the data for the previous zone.

4. When the name of the zone you want to modify is entered in the *Weather zone* field, press ENTER to make changes to the data for the zone.
5. Use ENTER or UP or DOWN ARROW to move between fields and make any changes.

A prompt at the bottom of the screen explains the contents of each field. For more information, press SHIFT-F1, or see the descriptions at the beginning of this section.

6. When you finish modifying data, press FI to save the changes to the weather zone.

Or press ESC to clear all the fields in the screen and return to the Transaction Menu.

Viewing Weather Zones

You can use the Weather Zone Entry screen to view the data in any weather zone after they have been created. This gives you a quick way to see weather zone data as you create, modify, or delete zones.

If you want a printed or onscreen listing of the data for several zones, you can create a Weather Information report. See "Creating Reports" for more information.

To view a weather zone:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 1, and press ENTER.

The Weather Zone Entry screen appears.

2. Type 3 and press ENTER to select View from the Transaction Menu.
3. In the *Weather zone* field, type the name of a weather zone and press ENTER.

Or press SHIFT-F2 to choose from a list of weather zones. Use the arrow keys to highlight a zone, press ENTER to select it, and press F1 to return to the Weather Zone Entry screen. To deselect a zone, press ENTER.

Or press F4 or PG DN to display the data for the next zone, or press F3 or PG up to display the data for the previous zone.

4. When you finish viewing weather zone data, press ESC to return to the Transaction Menu.

Deleting Weather Zones

If you need to remove weather zones from the database, you can do so from the Weather Zone Entry screen.

Caution: When you delete a weather zone, CONSUME also deletes all the daily weather data for that zone.

To delete a weather zone:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 1, and press ENTER.

The Weather Zone Entry screen appears.

2. Type 4 and press ENTER to select Delete from the Transaction Menu.
3. In the *Weather zone* field, type the name of an existing weather zone.

Or press SHIFT-F2 to choose from a list of weather zones. Use the arrow keys to highlight a zone, press ENTER to select it, and press F1 to return to the Weather Zone Entry screen. To deselect a zone, press ENTER.

Or press F4 or PG DN to display the data for the next zone, or press F3 or PG UP to display the data for the previous zone.

4. When the name of the zone you want to delete appears in the *Weather zone* field, press ENTER.

CONSUME displays the message "Execute? (Y/N)"

5. Type y and press ENTER to delete the weather zone (and all the daily weather records associated with it), or type n and press ENTER to return to the Transaction Menu.

Recording Unit Data

You must record data for each unit you plan to treat with a prescribed burn. Because weather data are an important factor in determining the adjusted 1000-hour fuel moisture, you must assign each unit to a zone that accurately represents the weather in the unit.

You can use CONSUME to:

- Create new unit records.
- Base new unit records on existing records-
- Modify existing unit records.
- View existing unit records.
- Delete unit records.

About Unit Data

Each unit record includes the following data:

Unit name A unique name of 14 characters or less, including spaces. This name will appear in reports. If several units have the same timber sale name, include the timber sale unit number in the unit name.

For example, suppose there are several units in the Happy Creek timber sale. If all the units will be treated with prescribed fire, create unique names by combining the timber sale name with the timber unit number: Happy Creek 01, Happy Creek 02, and so on.

Weather zone An existing weather zone, or a weather zone you will create later.

If you want, you can specify a weather zone that is not recorded in the CONSUME database. You can create some reports (such as Consumption by Adjusted 1000-Hour Fuel Moisture reports) without having any weather information. You also can enter weather information into the database later on (for example, after a RAWS weather station has been set up).

CONSUME uses weather zone data to determine the adjusted 1000-hour fuel moisture of the unit.

Acres to treat The number of acres in the unit that will be treated with prescribed fire. For example, if 10 acres of a 35-acre unit will be treated, enter 10.

CONSUME uses the number of acres treated to calculate total consumption for all types of fuels.

10-hour fuel moisture The moisture content of 10-hour fuels (0.26- to 1 -inch-diameter roundwood fuels). CONSUME expresses 10-hour fuel moisture as a percentage of the oven-dry weight of the fuels.

When you first enter unit data, you may want to use the 10-hour fuel moisture listed in the prescribed burn plan. To obtain accurate consumption values as the unit's ignition date approaches, you must check this initial entry, and make modifications if necessary.

You can determine 10-hour fuel moisture from moisture samples, moisture meters, or fuel sticks. It is recommended that 15 moisture samples or 15 moisture meter measurements be collected vertically across the fuel bed to represent a unit average 10-hour fuel moisture. If you use fuel sticks, place the sticks in the fuel bed and multiply the measurement by 1.4 to better represent a unit average 10-hour fuel moisture.

CONSUME uses 10-hour fuel moisture as a factor in predicting 100-hour (1- to 3-inch-diameter) fuel consumption.

Target adjusted 1000-hour fuel moisture The adjusted 1000-hour fuel moisture prescribed by the burn plan to meet the specific resource objectives of the burn.

Adjusted 1000-hour fuel moisture is an estimated fuel moisture (derived from temperature, relative humidity, and precipitation data) that represents the average unit fuel moisture of large woody fuels in the Pacific Northwest more precisely than the National Fire Danger Rating System. Adjusted 1000-hour fuel moisture predicts the fuel moisture of Douglas-fir, hemlock, mixed conifers, and lodgepole pine. It has not been evaluated for predicting fuel moisture of long-needled pine.

CONSUME can produce a report showing the number of days the unit requires to reach the target adjusted 1000-hour fuel moisture. This report is based on default weather data. You will find detailed information about this report in "Creating and Interpreting Reports."

- Wind* The prescribed midflame wind speed, in miles per hour, during the burn. The maximum wind speed is 35 miles per hour.
- When you enter initial unit data, you may want to use the wind speed value specified in the prescribed burn plan. To obtain accurate consumption values as the unit's ignition date approaches, you must check this initial entry and make modifications if necessary.
- CONSUME uses wind speed as a factor in predicting 100-hour (1- to 3-inch-diameter) fuel consumption.
- Ignition* The amount of time, in minutes, that it will take to ignite the area to be burned. For example, if it will take 3 hours to complete ignition of the area, enter 180.
- When you enter initial unit data, you may want to use the ignition time value listed in the prescribed burn plan. To obtain accurate consumption values as the unit's ignition date approaches, you must check this initial entry and make modifications if necessary.
- CONSUME uses ignition time to determine if the fire will be of high intensity. The intensity of a fire affects the diameter reduction of large woody fuels.
- Duff depth* The average preburn depth of duff in the unit. Duff is the layer of partially and fully decomposed organic materials lying below the litter (freshly fallen leaves, needles, twigs, stems, bark, and fruit) and immediately above the mineral soil.
- Note:** Litter is not considered part of the duff layer. Litter loading should be included in the 1-hour fuel loading.
- You can enter a duff depth to the nearest tenth of an inch between 0.0 and 9.9.
- CONSUME uses duff depth to predict duff consumption.

Slope The average vertical change (rise) in the unit's ground surface over a given horizontal distance (run). Slope is expressed as a percentage (%).

CONSUME uses slope to predict consumption of 100-hour fuels.

Snow-off date The month that snow melted from the unit. For example, if snow melted from a unit on March 1, type 03. If snow melted from a unit on May 31, type 05. If no snow accumulated on the unit, type 00.

CONSUME uses the snow-off date to determine the drying days for large woody fuels.

Harvest date The month and year that the timber on the unit was cut. If the timber was cut over an extended period of time, enter the month and year when 70 percent of the timber was cut.

Type dates as four-digit numbers in MMY format. For example, enter July 1990 as 0790. The harvest date must be before today's date.

If the unit contains natural fuels, enter 9999.

CONSUME uses the harvest date to determine if large woody fuels are cured.

Subregion The geographical subregion in which the unit is located. In Oregon and Washington, the subregions lie west or east of the Cascade Range. In California, the subregions lie west or east of the Cascade Range or Sierra Nevada.

The codes for subregions are:

Subregion	Code
Western Oregon	WO
Eastern Oregon	EO
Western Washington	WW
Eastern Washington	EW
Western California	WC
Eastern California	EC

Ownership The type of landowner for the unit.

The codes for landowners are:

<u>Owner</u>	<u>Code</u>
Forest Service	nothing (leave blank)
Other Federal agencies	F
State agencies	S
Private	P

CONSUME uses the subregion and ownership to determine default values for small and large woody fuel consumption.

Fuels The preburn loading of sound and rotten fuels in the unit. Use the planar intersect method or a photo series to estimate fuel loadings.

Litter should be included in the 1-hour fuel loading.

<u>Diameter</u>	<u>Timelag</u>	<u>Maximum value</u>
<i>Inches</i>	<i>Hours</i>	<i>Tons/acre</i>
0 0-0.25	1	25
0.26-1.0	10	25
1.1-3	100	50
3.1-9	1000	100
9.1-20	10000	150
20.1+	10000P ¹	200

¹ Fuels 20.1 inches or more in diameter have a timelag greater than 10,000 hours.

Creating Unit Records

At the beginning of each burn season, you need to record unit data for the units that will be treated with prescribed burns.

To create a unit record:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 2, and press ENTER.

The Unit Entry screen appears.

2. Type 1 and press ENTER to select Create from the Transaction Menu.
3. In the *Unit* field, type the name of the new unit.
4. Press DOWN ARROW or ENTER to move to the next field.
5. Type data in each field of the Unit Entry screen.

Use DOWN ARROW or ENTER to move from one field to the next.

A prompt at the bottom of the screen explains the contents of each field. For more information, press SHIFT-F1, or see the descriptions at the beginning of this section.

In the *Weather Zone* field, you can scroll through existing weather zones by pressing F3 or PG UP and F4 or PG DN, or view the entire list by pressing SHIFT-F2.

When you finish entering data in all the fields, CONSUME displays the prompt "Execute? (Y/N)."

6. After you have checked all the data, type y and press ENTER to create the new unit record.

Or type n and press ENTER to edit any of the data you entered.

Or press ESC to clear all the fields in the screen and return to the Transaction Menu.

Basing a New Unit Record on an Existing One

You can use an existing unit record as the basis for a new one. This allows you to create new records for similar areas without creating them all from scratch. Once you have created the new record, you can modify the data in it as needed.

To base a new unit record on an existing record, you first display the data for the existing record. Then you type a new name and make any modifications to the data.

To base a new unit record on an existing record:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 2, and press ENTER.

The Unit Entry screen appears.

2. Type 1 and press ENTER to select Create from the Transaction Menu.
3. With the cursor in the *Unit* field, press SHIFT-F2 to choose an existing unit from a list of units. Use the arrow keys to highlight a unit, press ENTER to select it, and press F1 to return to the Unit Entry screen.

Or press F4 or PG DN to display the data for the next unit, or press F3 or PG UP to display the data for the previous unit.

4. When the data for the unit you want to use as the basis of a new unit appears, type the name for the new unit in the *Unit* field, and press ENTER.
5. Use ENTER or UP or DOWN ARROW to move between fields and make any changes for the new unit.

In the *Weather zone* field, you can scroll through a list of existing weather zones by pressing F3 or PG UP and F4 or PG DN, or view the entire list by pressing smn"-F2.

A prompt at the bottom of the screen explains the contents of each field. For more information, press SHIFT-F1, or see the descriptions at the beginning of this section.

6. When you finish modifying data, press F1 to save the new unit.

Or press ESC to clear all the fields in the screen and return to the Transaction Menu.

Modifying Unit Records

If a unit record contains incorrect or out-of-date data, you can make changes to the record. You may have entered data from a prescribed burn plan when you first created the unit record. As the planned burn date approaches, you need to verify the accuracy of these data and modify them as needed.

To modify a unit record:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 2, and press ENTER.

The Unit Entry screen appears.

2. Type 2 and press ENTER to select Modify from the Transaction Menu.

The cursor moves to the first data entry field. *Unit*.

3. Type the name of an existing unit.

Or press SHIFT-F2 to choose from a list of units. Use the arrow keys to highlight a unit, press ENTER to select it, and press F1 to return to the Unit Entry screen. To deselect a unit, press ENTER.

Or press F4 or PG DN to display the data for the next unit, or press F3 or PG UP to display the data for the previous unit.

4. When the name of the unit you want to modify is entered in the *Unit* field, press ENTER to make changes to the data for the unit.
5. Use ENTER or up or DOWN ARROW to move between fields and make any changes.

A prompt at the bottom of the screen explains the contents of each field. For more information, press SHIFT-F1, or see the descriptions at the beginning of this section.

6. When you finish modifying data, press F1 to save the changes.

Or press ESC to clear all the fields in the screen and return to the Transaction Menu.

Viewing Unit Records

You can use the Unit Entry screen to view the data in any unit record after it has been created. This gives you a quick way to view unit data as you create, modify, or delete unit records.

If you want a printed or onscreen listing of the data for several units, you can create a Unit Information report. See "Creating Reports" for more information.

To view a unit record:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 2, and press ENTER.

The Unit Entry screen appears.

2. Type 3 and press ENTER to select View from the Transaction Menu.
3. In the *Unit* field, type the name of a unit and press ENTER.

Or press SHIPT-F2 to choose from a list of units. Use the arrow keys to highlight a unit, press ENTER to select it, and press F1 to return to the Unit Entry screen. To deselect a unit, press ENTER.

Or press F4 or PG DN to display the data for the next unit, or press F3 or PG up to display the data for the previous unit.

4. When you finish viewing unit data, press ESC to return to the Transaction Menu.

Deleting Unit Records

After you conduct prescribed burns on units, you may want to delete their unit records. If you need to remove unit records that already exist, you can do so from the Unit Entry screen.

To delete a unit record:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 2, and press ENTER.

The Unit Entry screen appears.

2. Type 4 and press ENTER to select Delete from the Transaction Menu.
3. In the *Unit*field, type the name of an existing unit.

Or press SHIFT-F2 to choose from a list of units. Use the arrow keys to highlight a unit, press ENTER to select it, and press F1 to return to the Unit Entry screen. To deselect a unit, press ENTER.

Or press F4 or PG ON to view the data for the next unit, or press F3 or PG UP to view the data for the previous unit.

4. When the name of the unit you want to delete appears in the *Unit*field, press ENTER.

CONSUME displays the message "Execute? (Y/N)"

5. Type **y** and press ENTER to delete the unit record, or press **n** and press ENTER to return to the Transaction Menu.

Recording Daily Weather Data

CONSUME uses weather data to calculate adjusted 1000-hour fuel moisture. This fuel moisture value is then used to produce fuel consumption estimates for units in the database. Once you have created a weather zone and one or more unit records, you can create a report of fuel consumption estimates for the starting date in a weather zone. To get fuel consumption estimates for days subsequent to the starting date, you must enter daily weather data. If you have multiple weather zones, you need to enter daily weather data for each zone.

To predict large woody fuel moisture accurately, CONSUME requires an uninterrupted sequence of daily weather observation. This means you must create a daily weather record for each day between the starting date for a weather zone and the last date you want CONSUME to analyze. CONSUME does not allow you to enter daily weather data in nonsequential order. For instance, you cannot enter weather data for June 15 before you enter data for June 14. If you miss a weather observation, use the previous day's weather data, or estimate the data to the best of your ability.

Note: Once you add a daily weather record, you can change it, but you cannot delete it. The only way to remove weather records is to delete the weather zone. This will also delete all daily weather records for the weather zone.

You can use CONSUME to:

- Add daily weather records.
- Modify existing daily weather records.
- View existing daily weather records.

About Daily Weather Data

Each daily weather record includes the following data:

Weather zone The weather zone in which the daily weather readings were collected.

If you want to use a weather zone that is not recorded in the CONSUME data base, you must create the weather zone before you can create a daily weather record for it.

Date The date on which the daily weather readings were collected. You must create new records in date order. When you create a new record, CONSUME automatically enters the date after the last daily weather record. To modify or view existing weather data, you must enter a date that matches an existing daily weather record.

For example, if the last daily weather entry for a weather zone was July 15, 1990, CONSUME enters 071690 (July 16, 1990) as the date for the next daily weather entry. You must enter weather data for this date before moving on to the next date.

Weather zone data is based on a 24-hour observation period. For example, the observation period could be from 1400 hours to 1400 hours the following day.

Note; CONSUME will accept only 366 daily weather records for a weather zone. Once 366 records have been entered, each additional record that you add causes the oldest record to be deleted.

Maximum and minimum temperature The highest and lowest air temperature, in degrees Fahrenheit (°F), during the 24-hour observation period for the date in the *Date* field. For example, if the temperature on the starting date ranged from 50 to 75 °F, you would enter 50 in the minimum temperature field and 75 in the maximum temperature field.

Maximum and minimum relative humidity The highest and lowest relative humidity during the 24-hour observation period for the date in the *Date* field. For example, if the reported relative humidity on the starting date ranged from 35 to 85 percent, you would enter 35 in the minimum relative humidity field and 85 in the maximum relative humidity field.

CONSUME uses temperature and humidity data to determine adjusted 1000-hour fuel moisture.

Rainfall duration The hours of total rainfall in the 24-hour observation period of the date in the *Date* field.

If more than a trace of rain fell, enter 1. If rain fell for several hours, enter the cumulative total of all occurrences, rounded up to the next whole hour.

If it was raining at the time of the observation, enter the duration of rainfall up to that time. Account for the remainder of the rainfall the next day (if the total duration of the rainfall for both days exceeds 1 hour).

CONSUME uses the data in this field to estimate adjusted 1000-hour fuel moisture.

Significant rainfall The number of days since a significant amount of rain fell in a 48-hour period. A significant amount of rainfall is one-half inch on sites west of the Cascades/Sierra Nevada and one-quarter inch on sites east of the Cascades/Sierra Nevada. These amounts are necessary to saturate the duff layer.

For example, suppose the date in the *Date* field was Wednesday, July 14. If an inch of rain fell on the previous Saturday and Sunday (July 10 and 11), with no rainfall since, you would enter 2 in the *Significant rainfall* field.

CONSUME uses the data in this field to predict duff consumption.

Adding Daily Weather Records

Because CONSUME requires continuous weather data to predict large woody fuel moisture, you must add daily weather records for each day between the weather zone's start date and the last date you want CONSUME to analyze.

As a result, CONSUME allows you to add a new daily record only for the day immediately following the last record in a zone.

To add a daily weather record:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 3, and press ENTER.

The Daily Weather Entry screen appears.

2. Type 1 and press ENTER to select Add from the Transaction Menu.

The cursor moves to the *Weather zone* field.

3. Type the name of an existing weather zone.

Or press SHIFT-F2 to choose from a list of weather zones. Use the arrow keys to highlight a zone, press ENTER to select it, and press F1 to return to the Daily Weather Entry screen. To deselect a unit, press ENTER.

Or press F4 or PG DN to display the next zone name in the *Weather zone* field, or press F3 or PG UP to display the previous zone name.

CONSUME displays the weather information for the most recent daily weather record. In the *Date* field, CONSUME displays the date after the date of the most recent daily weather record. For example, if the most recent daily weather record was for July 4, 1992, CONSUME displays the information from July 4, and displays July 5, 1992 in the *Date* field.

4. Type or modify the data in each field of the Daily Weather Entry screen.

Use DOWN ARROW or ENTER to move from one field to the next.

A prompt at the bottom of the screen explains the contents of each field. For more information, press SHIFT-F1, or see the descriptions at the beginning of this section.

5. When the data are correct, press F1.

CONSUME saves the record, and displays the next date in the Date field.

When you finish entering records, press ESC to return to the Transaction Menu.

Modifying Daily Weather Records

If daily weather data need to be corrected, you can modify any of the daily weather records you have added.

You can view or print a listing of all the daily weather data in the CONSUME database from the Reports Menu. For more information, see "Creating and Interpreting Reports."

To *modify a daily weather record*:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 3, and press ENTER.

The Daily Weather Entry screen appears.

2. Type 2 and press ENTER to select Modify from the Transaction Menu.

The cursor moves to the first data entry field, *Weather zone*.

3. Type the name of an existing weather zone

Or press **smnr-F2** to choose from a list of weather zones. Use the arrow keys to highlight a zone, press **ENTER** to select it, and press **F1** to return to the Daily Weather Entry screen. To deselect a zone, press **ENTER**.

Or press **F4** or **PG DN** to display the next zone name in the *Weather zone* field, or press **F3** or **PG UP** to display the previous zone name.

4. When the name of the zone for the daily weather record you want to modify is entered in the *Weather zone* field, press **ENTER** to move to the *Date* field
5. Type the date for the record you want to modify.

Or press **SHIFT-F2** to choose from a list of dates. Use the arrow keys to highlight a date, press **ENTER** to select it, and press **F1** to return to the Daily Weather Entry screen. To deselect a date, press **ENTER**.

Or press **F4** or **PG DN** to display the next date in the *Weather zone* field, or press **F3** or **PG UP** to display the previous date.

6. Press **ENTER** to move to the *Maximum temperature* field.
7. Use **ENTER** or **UP** or **DOWN ARROW** to move between fields and make changes.

Because daily weather records must be in continuous chronological order, you cannot change the *Date* field in an existing daily weather record.

A prompt at the bottom of the screen explains the contents of each field. For more information, press **SHIFT-F1**, or see the descriptions at the beginning of this section.

8. When you finish modifying data, press **F1** to save the changes to the daily weather record.

Or press **ESC** to clear all the fields in the screen and return to the Transaction Menu.

If you save the record, the cursor returns to the *Weather zone* field. You can select a weather zone and modify another daily weather record, or press ESC to return to the Transaction Menu.

Viewing Daily Weather Records

You can use the Daily Weather Entry screen to view the daily weather data for any zone. For a complete listing of weather data, create a Weather Information report from the Reports Menu. For more information, see "Creating Reports "

To view a daily weather record:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 3, and press ENTER.

The Daily Weather Entry screen appears.

2. Type 3 and press ENTER to select View from the Transaction Menu.
3. In the *Weather Zone* field, type the name of a weather zone.

Or press SHIFT-F2 to choose from a list of weather zones. Use the arrow keys to highlight a zone, press ENTER to select it, and press n to return to the Daily Weather Entry screen. To deselect a zone, press ENTER.

Or press F4 or PG DN to display the next weather zone name in the *Weather Zone* field, or press FS or PG UP to display the previous weather zone name.

4. When the name of the weather zone record you want to modify appears in the *Weather Zone* field, press ENTER to move to the *Date* field.
5. Type the date for the record you want to view, and press ENTER.

Or press SHIFTS to choose from a list of dates. Use the arrow keys to highlight a date, press ENTER to select it, and press P1 to return to the Daily Weather Entry screen. To deselect a date, press ENTER.

Or press F4 or PG DN to display the data for the next date, or press F3 or PG UP to display the data for the previous date.

6. When you finish viewing daily weather data, press ESC to return to the Transaction Menu.

Creating and Interpreting Reports

Once you have entered weather zone, unit, and daily weather data, you can create several types of reports to predict consumption and summarize the contents of the database.

About Reports

The following reports are available:

- A **Fuel Consumption by Date** report estimates fuel consumption in one or more units on each date in a range of dates that you specify.
- A **Fuel Consumption by Adjusted 1000-Hour Fuel Moisture** report estimates fuel consumption in one or more units at each value of fuel moisture in a range of values that you specify.
- A **Target Adjusted 1000-Hour Fuel Moisture** report predicts whether, and on what date, the target fuel moisture for one or more units will be attained within 2 weeks of the last daily weather record.
- A **Weather Information** report summarizes weather zone and daily weather data that has been entered into CONSUME.
- A **Unit Information** report summarizes unit data that have been entered into CONSUME.

Creating Reports

You create a report by using a report options screen.

```

SCREEN 008                                6/15/92  2:39 P
                                FUEL CONSUMPTION BY
                                DATE REPORT
                                SCREEN

    BEGINNING DATE:                ENDING DATE:      █
    ALL UNITS? (Y/N):  █          FORMATTED REPORT? (Y/N): █
    DISPLAY ON SCREEN? (Y/N): █   SEND TO PRINTER? (Y/N): █
    REPORT NAME:  █                █

F1 Execute/  ESC Cancel/  SHIFT-F1 HELP
  Exit      Exit

P.1 Please enter the earliest date of the reporting period (MMDDYY).
  
```

Use report options screens like this one to set options for a report. Press F1 to create the report.

Use the following steps to create any CONSUME report.

To create a **report**:

1. If you are starting in the CONSUME Main Menu, use the arrow keys or keyboard to select option 4, and press ENTER.

CONSUME displays the Reports Menu screen.

2. Type the number of the report type you want to create and press ENTER.

CONSUME displays a report options screen for the report you are creating.

3. Set the options for the report you are creating.

Use ENTER or the arrow keys to move between fields.

See the next several sections for more information about the options for each report.

4. In the *Report name* field, type a name for the report, or leave the default report name that appears in the field.
5. If a report with the same name exists, CONSUME displays the message "Overwrite? (Y/N)." You can type y and press ENTER to overwrite the existing report, or type n and press ENTER to return to the *Report name* field and type a different name.

If there is no existing report with the same name, or if you type y in response to the "Overwrite?" prompt, CONSUME displays the message "Execute? (Y/N)."

If you are sending the report to your printer, be sure your printer is set up and on line.

6. Type y and press ENTER to create the report by using the options you have set.

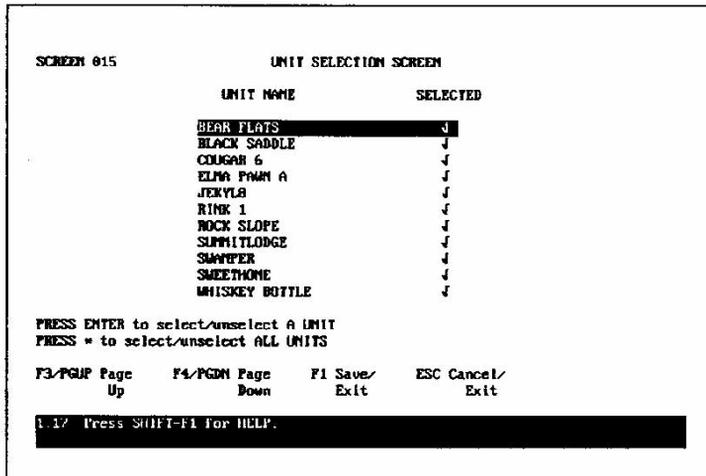
Or type n and press ENTER to return to the first field in the report options screen and make any changes.

Or press ESC to return to the Reports Menu screen.

Options for All Reports

Selecting Units or Weather Zones

You can create a report that includes all the units or weather zones in the CONSUME database by typing y in the *All units?* or *All weather zones?* field. To include only some of the units or weather zones, type n in the *All units?* or *All weather zones?* field or press SHIFT-F2. CONSUME displays a list from which you can select the units or weather zones you want.



Select the units to include in a report from this list. You use a similar list to select weather zones for a Weather Information report.

You select or deselect a unit or weather zone in the list by moving the highlight to the unit or zone and pressing ENTER. Units or zones that are selected have a check mark next to them.

Move the highlight up and down the list using the arrow keys or F3 or PG UP and F4 or PG DN.

To select all units or zones, press * (SHIFT-8).

When you have selected the units or weather zones you want, press F1 to save your selections and return to the report options screen. Or press ESC to return to the report options screen without saving any selections.

CONSUME will save your selections until you exit the Report Menu. This allows you to create several reports by using the same set of weather zones or units. If you want to change your selections, move the cursor to the *All units?* or *All weather zones?* field and press SHIFTS to view the list and make changes.

Creating a Formatted or Unformatted Report

Depending on the way you want to use CONSUME information, you can choose to create a report that is formatted or unformatted. You choose whether or not a report has formatting by typing y or n in the *Formatted report?* field in the report options screen.

- **Formatted reports** include descriptive headings and page numbers. Create a formatted report if you want to print the report, view it on screen in CONSUME, or use the report in a word processing program.
- **Unformatted reports** do not have headings and page numbers. Create an unformatted report if you want to use the report information in a spreadsheet or database program.

Displaying or Printing a Report

You can display a CONSUME report onscreen, send it to your printer, or display and print it at the same time.

After a report has been created, you also can view, modify, or print the report in another program. For more information, see "Using CONSUME Reports in Other Programs."

- You can view the report on screen inside CONSUME by typing y in the *Display on screen* field in the report options screen.
- You can print the report from CONSUME by typing y in the *Send to printer* field in the report options screen.

Naming a Report You give a report a name by typing it in the *Report name* field. Report names can be up to eight alphanumeric characters long. No spaces, commas, backslashes, or periods may be used. CONSUME automatically adds a .REP extension to the name you type. You can open the report file in any program that can read ASCII files.

If a report with the name you type already exists, CONSUME asks you if you want to overwrite the existing report. Type **y** and press ENTER to overwrite the report (all the information in the old report will be lost). Type **n** and press ENTER if you want to return to the *Report name* field and type a different name.

CONSUME suggests a name for each type of report. These default names are:

Report	Default Name
Fuel Consumption by Date	DATE.REP
Fuel Consumption by Adjusted 1000-Hour Fuel Moisture	ADJTH.REP
Target Adjusted 1000-Hour Fuel Moisture	TARGET.REP
Weather Information	WEATHER.REP
Unit Information	UNIT.REP

Fuel Consumption by Date Report Options

Beginning and ending dates In the Fuel Consumption by Date report options screen, you need to specify a range of dates in the *Beginning date* and *Ending date* fields, by using MMDDYY format. For example, if you want CONSUME to predict consumption for the dates July 18, 1992, through August 1, 1992, you would type 071892 in the *Beginning date* field and 080192 in the *Ending date* field.

The other options for Fuel Consumption by Date reports are described in the section "Options for All Reports."

For more information about Fuel Consumption by Date reports, see "Interpreting Reports."

Fuel Consumption by Adjusted 1000-hour Fuel Moisture Report Options

You must set the following options for a Fuel Consumption by Adjusted 1000-hour Fuel Moisture report.

Lowest/highest fuel moisture

In the *Lowest fuel moisture* and *Highest fuel moisture* fields, type the range of adjusted 1000-hour fuel moistures you want to evaluate. For example, if you want to find out what consumption would be at adjusted 1000-hour fuel moistures from 25 to 35 percent, type 25 in the *Lowest fuel moisture* field and 35 in the *Highest fuel moisture* field.

Fuel moisture increment

In the *Fuel moisture increment* field, specify the size of the incremental steps in the range of adjusted 1000-hour fuel moistures that will appear in the report. For example, if you want to examine fuel consumption estimates at adjusted 1000-hour fuel moistures of 25, 30, and 35 percent, type 5. To examine fuel consumption estimates at adjusted 1000-hour fuel moistures of 25, 26, and 27 percent, type 1.

Use weather data?

In the *Use weather data?* field, type y to have CONSUME use daily weather data to calculate the days since significant rainfall. Type n to have CONSUME use the default days since significant rainfall that you specify in the *Default days since significant rainfall* field.

Default days since significant rainfall

In the *Default days since significant rainfall* field, type the number of days since significant rainfall that CONSUME should use if daily weather is not available, or you do not want CONSUME to use daily weather. If all the units in the report will be based on daily weather data, you must still type a number in the *Default days since significant rainfall* field. A default must be entered in this field. This ensures that the report can be generated for all selected units, even if there is incomplete weather data for the specified current day. CONSUME uses days since significant rainfall to predict duff consumption.

The other options for Fuel Consumption by Adjusted 1000-Hour Fuel Moisture reports are described in the section "Options for All Reports."

For more information about Fuel Consumption by Adjusted 1000-Hour Fuel Moisture reports, see "Interpreting Reports."

Target Adjusted 1000-Hour Fuel Moisture Report Options

All the options for Target Adjusted 1000-Hour Fuel Moisture reports are described in the section "Options for All Reports."

For more information about Target Adjusted 1000-Hour Fuel Moisture reports, see "Interpreting Reports."

Weather and Unit Information Report Options

All the options for Weather Information and Unit Information reports are described in the section "Options for All Reports."

For more information about Weather and Unit Information reports, see "Interpreting Reports."

Printer Setup

CONSUME can print reports on any printer that is compatible with your computer and has a standard output device mode (sometimes called line printer mode). Most printers are in this mode when they are turned on. See your printer documentation for more information.

When CONSUME starts, it connects the DOS print driver to the system parallel port (LPT1). If your printer is connected to a different port, use the DOS **print** command to connect the DOS print driver to that port before you start CONSUME.

To connect the DOS print driver to a port other than LPT1:

1. At the DOS prompt, type **print** and press ENTER.

DOS displays the prompt *Name of list device [PRN]*

2. Type the name of the port you want to connect to.

For example, if your printer is attached to COM1, type
com1

3. **Press** ENTER.

Be sure your printer is set up and online before you print a report.

Using CONSUME Reports in Other Programs

All CONSUME report tiles are in ASCII (text only) format. You can open and work with CONSUME reports in many other programs (including most word processors, spreadsheets, and database management programs).

You might want to use CONSUME reports in other programs for several reasons:

- *Word processors:* Include report information in a paper, management report, or other document. Change fonts, styles, and paragraph formats to make the information attractive and easy to read.
- *Spreadsheets:* Combine CONSUME consumption predictions with other data to calculate smoke emission. Create charts that show CONSUME report information graphically. Do statistical analyses of weather, fuel loadings, consumption, or any other report information.
- *Database management programs:* Retrieve any information in CONSUME by using database querying and reporting tools. Maintain a comprehensive database of all management data by combining CONSUME report information with information in other databases.

To use CONSUME data with a word processing program, create a formatted report. To use CONSUME data with a spreadsheet or database management program, create an unformatted report.

You choose whether or not a report has formatting by typing y or n in the *Formatted report?* field in the report options screen.

Interpreting Reports

This section explains the contents of each type of CONSUME report. For more information about the calculations CONSUME uses for reports, see appendix C, "Scientific Background."

Viewing Reports

If you typed *y* in the *Display on screen* field when you created a report, CONSUME displays *ft* on your computer's screen. Use the following keys to move through the report:

DOWN ARROW	Scroll one line down
UP ARROW	Scroll one line up
F4/PG DN	Scroll one page down
F3/PG UP	Scroll one page up
HOME	Go to the top of the report
END	Go to the bottom of the report
ESC	Exit the report

Interpreting Fuel Consumption by Date Reports

A Fuel Consumption by Date report estimates consumption for one or more units over a specified period.

You create this report to determine the best dates for treating units with prescribed burns, to see what values CONSUME is using to predict consumption, and to compare consumption for several units on the same date.

Use Fuel Consumption by Date reports for these time periods:

- **Previous dates** to calculate consumption for units that were burned on previous days.
- **Current date** to determine whether a unit has reached a point where it can successfully meet management objectives when *ft* is burned.

```

CONSUME                                6/15/92 2:55 P PAGE 1
REPORT 001                            FUEL CONSUMPTION BY DATE REPORT
ESTIMATES ARE SORTED BY TOTAL UNIT CONSUMPTION PER DAY
-----
|                                     FUEL CONSUMPTION                                     |
| Adj/Unc                               0.0 0.26 1.1 3.1 9.1                               Total M |
| Th Hr Unit Diam Duff to to to to to to 28.1 Consumed s |
| Unit   FM   Size Red Red 0.25 1.0 3.0 9.0 28.0 Plus Duff in Unit g |
|      (%) (Ac) (In) (In) ----- (Tons/Acre) ----- (Tons) s |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
3/ 1/91
SWEETHOME 45.0 78 .6 .4 3 4 8 3 0 0 7 1910
ELWA FAWN A 46.5 78 .7 .5 3 4 9 3 3 0 10 2422

3/ 2/91
SWEETHOME 47.6 78 .6 .4 3 4 8 2 0 0 7 1883
ELWA FAWN A 46.2 78 .7 .5 3 4 9 3 3 0 10 2431
↓ Next ↑ Prior F4/PGDN Next F3/PGUP Prior NONE First END Last ESC Exit
Line Line Page Page Page Page Page Report

```

A Fuel Consumption by Date report shows consumption of each fuel category for a range of dates you specify.

The following information appears in a Fuel Consumption by Date report:

- Unit** The names of the units you are evaluating.
- Adj/Unc Th Hr FM (%)** The 1000-hour fuel moisture used to estimate consumption (as a percentage). If the fuels were cured, the adjusted 1000-hour fuel moisture was applied. If the fuels were uncured, the uncured 1000-hour fuel moisture was applied.
- If XXXX appears in the Adj/Unc Th Hr FM field, the fuel moisture was greater than 99.9 percent. The actual number is recorded in the CONSUME database and will appear in an unformatted report.
- Unit Size (Ac)** The number of acres in the unit to be treated.
- Diam Red (In)** The number of inches of diameter reduction in large (3- to 20+ inch-diameter [1000-hour, 10000-hour, and "10000P-hour]) woody fuels. CONSUME uses diameter reduction to calculate large woody fuel consumption.

- Duff Red (In)* The number of inches of duff reduction. CONSUME uses duff reduction to calculate duff consumption.
- Fuel Consumption* Consumption of fuels in the unit in each timelag category in tons per acre, consumption of duff in the unit in tons per acre, and total fuels consumed in the unit in tons.
- Msgs* Message codes might appear in the far right column of the report. CONSUME can display the following messages in a Fuel Consumption by Date report:

D HARVEST DATE falls after this date
The date is earlier than the harvest date.

H HIGH INTENSITY FIRE conditions predicted
CONSUME includes a set of equations to compensate for the lower consumption of large woody fuels that results from high-intensity fires. See appendix C for more information.

S SPRING-LIKE burning conditions predicted
CONSUME uses a different large woody fuel diameter reduction equation when springlike burning conditions are predicted. See appendix C for more information.

U UNCURED fuels predicted; uncured 1000-hour FM used
CONSUME uses a different fuel moisture value when fuels are uncured. See appendix C for more information.

W NO WEATHER DATA is available for this date; cannot estimate consumption
If you want to estimate consumption for a date with this message next to it, you need to go to the Daily Weather Entry screen and create a daily weather record for this date (and for all preceding dates not having daily weather records).

Fuel Consumption by Adjusted 1000-Hour Fuel Moisture Reports

A Fuel Consumption by Adjusted 1000-Hour Fuel Moisture report predicts fuel consumption for a range of 1000-hour fuel moistures. CONSUME assumes that all fuels are cured. You can specify weather data for this report in two ways:

- You can use the daily weather data in the database.
- You can specify a Default Days Since Rainfall value when you create the report. Use this option if daily weather are not available, or if you do not want to use daily weather data.

For more information, see "Fuel Consumption by Adjusted 1000-Hour Fuel Moisture Options."

Create a Fuel Consumption by Adjusted 1000-Hour Fuel Moisture report to help determine when a prescribed burn will meet smoke management site objectives.

		FUEL CONSUMPTION										Total	Plus	Duff	in Unit	g
Unit	Size	Diam Red	Duff Red	to 0.25	to 1.0	to 1.1	to 3.1	to 9.1	to 20.1	Plus	Duff	in Unit	g	(Tons)	(Tons)	(Tons)
(Ac)	(In)	(In)														
Fuel Moisture 35%																
SWEETHOME	78	1.7	1.0	3	4	8	6	1	0	18	3116	R				
ELMA PAWN A	78	1.8	1.3	3	4	9	7	7	0	25	4288	R				
Fuel Moisture 40%																
SWEETHOME	78	1.1	.7	3	4	8	4	1	0	12	2589	R				
ELMA PAWN A	78	1.2	1.0	3	4	9	5	5	0	18	3484	R				
Fuel Moisture 45%																
SWEETHOME	78	.6	.4	3	4	8	3	0	0	7	1918	R				
ELMA PAWN A	78	.7	.5	3	4	9	3	3	0	18	2467	R				
Next Prior F4/PGDN Next F3/PGUP Prior HOME First END Last ESC Exit Line Line Page Page Page Page Page Page Report																

A Fuel Consumption by Adjusted 1000-Hour Fuel Moisture report shows consumption of each fuel size class for a range of fuel moistures you specify.

The following information is included in a Fuel Consumption by Adjusted 1000-Hour Fuel Moisture report:

- Unit** The names of the units you are evaluating.
- Unit Size (Ac)** The number of acres in the unit to be treated.
- Diam Red (In)** The predicted inches of diameter reduction in large (3- to 20+ inch-diameter [1000-hour, 10000-hour, and 100000-hour]) woody fuels. CONSUME uses diameter reduction to calculate large woody fuel consumption.
- Duff Red (In)** The predicted inches of duff reduction. CONSUME uses duff reduction to calculate duff consumption.
- Fuel Consumption** Consumption of fuels in the unit in each timelag category in tons per acre, consumption of duff in the unit in tons per acre, and total fuels consumed in the unit in tons.

Msgs Message codes might appear in the far right column of the report. CONSUME can display the following messages in a Fuel Consumption by Adjusted 1000-Hour Fuel Moisture report:

H HIGH INTENSITY FIRE conditions predicted

CONSUME includes a set of equations to compensate for the lower consumption of large woody fuels that results from high-intensity fires. See appendix C for more information.

R DAYS SINCE SIGNIFICANT RAINFALL specified by user

The user, not CONSUME, provided the default number of days since significant rainfall when the report was created.

S SPRING-LIKE burning conditions predicted

CONSUME uses a different large woody fuel diameter reduction equation when spring like burning conditions are predicted. See appendix C for more information.

Interpreting Target Adjusted 1000-Hour Fuel Moisture Reports

The record for each unit includes a target adjusted 1000-hour fuel moisture derived from a burn plan. Adjusted 1000-hour fuel moisture is a crucial factor in calculating consumption. To find if and when the unit will reach this target fuel moisture based on daily weather data, you can create a Target Adjusted 1000-Hour Fuel Moisture report.

A Target Adjusted 1000-Hour Fuel Moisture Report predicts whether, and on what date, the target fuel moisture for one or more units will be attained within 2 weeks of the last daily weather record.

To determine weather for these 2 weeks, CONSUME uses the following default values:

	Western WA/OR/CA		Eastern WA/OR/CA	
	Max.	Min.	Max.	Min.
Temp (°F)	80	40	90	50
Humidity (percent)	100	50	75	25

CONSUME assumes no rainfall duration for the 2 weeks. These default values cannot be changed.

```

CONSUME                                6/15/92 2:57 P PAGE 1
REPORT 003      TARGET ADJUSTED 1000-HOUR FUEL MOISTURE REPORT
                                UNITS SORTED BY ATTAINMENT DATE
-----
| Unit      Attainment   Target Adjusted |
|           Date         1000-Hour      |
|           |         Fuel Moisture |
|           |         (%)             |
-----
RINK 1      3/29/91      45
SWEETHOME  4/ 6/91      41
WHISKEY BOTTLE 4/ 8/91      40
BLACK SADDLE                                TARGET FM NOT REACHED W/IN TWO WEEKS
ROCK SLOPE                                TARGET FM ALREADY ATTAINED
ELPA PWRN A                                TARGET FM ALREADY ATTAINED
JEWYLA     5/10/91      35
SWAMPER                                TARGET FM ALREADY ATTAINED
BEAR FLATS                                TARGET FM ALREADY ATTAINED
COUGAR 6   7/21/91      30
↓ Next ↑ Prior F4/PGDN Next F3/PGUP Prior HOME First END Last ESC Exit
  Line  Line   Page    Page    Page    Page    Page    Page    Report
    
```

A Target Adjusted 1000-Hour Fuel Moisture report shows when each unit will attain Us target adjusted 1000-hour fuel moisture.

The following information is included in a Target Adjusted 1000-Hour Fuel Moisture report:

<i>Unit</i>	The names of the units you are evaluating.
<i>Attainment Date</i>	The date when the target adjusted 1000-hour fuel moisture will be attained. If there is no date in this column, see the <i>Status</i> column.
<i>Target Adjusted 1000-Hour Fuel Moisture</i>	The target fuel moisture entered into the unit record. This number is derived from prescribed burn plan information, and represents a level of consumption that will enable the prescribed burn to meet management objectives.
<i>Status</i>	If the unit will not attain the target fuel moisture within 2 weeks of the last date with daily weather data, CONSUME displays one of the following messages:

TARGET FM ALREADY ATTAINED

The unit has already attained the target fuel moisture on the last date with daily weather data.

TARGET FM NOT REACHED W/IN TWO WEEKS

The unit will not reach the target fuel moisture within 2 weeks of the last date with daily weather data.

NO WEATHER DATA AVAILABLE

The unit does not have a weather zone associated with it.

Interpreting Weather Information Reports

A Weather Information report shows weather data that has been entered into the CONSUME database for one or more weather zones. For each weather zone, the report shows the initial weather zone data and each daily weather record. The report also calculates adjusted 1000-hour fuel moisture for each date.

CONSUME		6/15/92 2:50 P PAGE 1									
REPORT 004		WEATHER INFORMATION REPORT									
WEATHER ZONE: HALL HOLLOW											
STARTING DATE: 06/15/91		INITIAL 1000-HOUR FUEL MOISTURE (%):		40							
LATITUDE (*):		45		INITIAL DAYS SINCE SIGNIFICANT RAINFALL:		5					
Daily WX	Temperature	Relative Humidity		Hours of	Days Since	Adjusted					
Date	Max Min	Max	Min	Rainfall	Significant	1000-Hr					
(MM/DD)	(*F)	--(%)--		(Hrs.)	(Days)	PM					
						(%)					
06/15	58 34	100	67	0	5	48.8					
06/16	59 32	100	54	0	6	39.5					
06/17	63 30	100	52	0	7	39.0					
06/18	61 34	100	52	0	8	38.6					
06/19	58 32	100	47	0	9	38.1					
06/20	62 37	100	51	0	10	37.7					
06/21	59 34	100	67	0	11	37.3					
06/22	63 41	100	51	0	12	36.9					
↓ Next	↑ Prior	F4/PGDN	Next	F3/PGUP	Prior	HOME	First	END	Last	ESC	Exit
Line	Line		Page		Page		Page		Page		Report

A Weather Information report summarizes weather zone and daily weather data in the CONSUME database.

The following information is included in a Weather Information report:

Weather zone data

For each weather zone included in the report, the Weather Information report shows all the weather zone data that has been entered in the Weather Zone Entry screen.

For more information about each type of data, see "Recording Weather Zone Data."

Daily weather data

For each weather zone included in the report, the Weather Information report shows all the daily weather data that has been entered in the Daily Weather Entry screen.

For more information about each type of data, see "Recording Daily Weather Data."

*Adjusted
1000-hour
FM(%)*

CONSUME calculates adjusted 1000-hour fuel moisture for each date that has daily weather data. Adjusted 1000-hour fuel moisture is a critical factor in predicting consumption of large woody fuels.

Interpreting Unit Information Reports

A Unit Information report shows data that has been entered into the CONSUME database for one or more units.

CONSUME		9/02/92 2:50 P		PAGE 1	
REPORT 005		UNIT INFORMATION REPORT			
UNIT: BEAR FLATS					
Weather Zone:	HALL HOLLOW	Acres:	24	10-Hr FM (%):	14
Target Adjusted 1000-HR FM (%):	42	Wind (MPH):	5	Ignition (Min):	55
Duff Depth (In):	.9	Slope (%):	10	Snow-Off Date:	05
Harvest Date (MM/YY):	0790	Subregion:	EW	Ownership:	F
-----Fuel Loadings (Tons per Acre)-----					
0.0 - 0.25 In:	4	0.25 - 1.0 In:	7	1.1 - 3.0 In:	6
3.1 - 9.0 In:	9	9.1 - 20.0 In:	5	20.1 Plus In:	3
UNIT: BLACK SADDLE					
↓ Next Line	↑ Prior Line	F4/PGDN Next Page	F3/PGUP Prior Page	HOME First Page	END Last Page
					ESC Exit Report

A Unit Information report summarizes unit data in the CONSUME database.

The following information is included in a Unit Information report:

Unit data

For each unit included in the report, the Unit Information report shows all the unit data entered in the Unit Entry screen.

For more information about each type of data, see "Recording Unit Data."

Quick Reference

Use this section to find quick information about each screen and key that you can use in CONSUME.

CONSUME Screens

Detailed information about each screen appears in the appropriate section of this Users Guide.

Menu Screens

Main Menu: Appears when you start CONSUME. Use this screen to choose an option to enter weather or unit data or create a report.

Reports Menu: Appears when you choose option 4 from the Main Menu screen. Use this screen to choose an option to create a report.

Data Entry Screens

Weather Zone Entry: Appears when you choose option 1 from the Main Menu screen. Use this screen to create, modify, view, or delete weather zone data.

Unit Entry: Appears when you choose option 2 from the Main Menu screen. Use this screen to create, modify, view, or delete unit data.

Daily Weather Entry: Appears when you choose option 3 from the Main Menu screen. Use this screen to add, modify, or view daily weather data.

Report Option Screens

Fuel Consumption by Date Report: Appears when you choose option 1 from the Reports Menu screen. Use this screen to select options for creating a report that shows fuel consumption for a range of dates.

Fuel Consumption by Adjusted 1000-Hour Fuel Moisture Report: Appears when you choose option 2 from the Reports Menu screen. Use this screen to select options for creating a report that shows fuel consumption for a range of adjusted 1000-hour fuel moistures.

Target Adjusted 1000-Hour Fuel Moisture Report: Appears when you choose option 3 from the Reports Menu screen. Use this screen to select options for creating a report that shows if and when adjusted 1000-hour target fuel moistures will be attained.

Weather Information Report: Appears when you choose option 4 from the Reports Menu screen. Use this screen to select options for creating a report that shows the weather data in the CONSUME database.

Unit Information Report: Appears when you choose option 5 from the Reports Menu screen. Use this screen to select options for creating a report that shows the unit data in the CONSUME database.

Selection Screens

Unit Selection: Appears when you press SHIFT-F2 while you are in a *Unit* field in a data entry screen, or in the *All Units?* field in a report options screen. Use the screen to choose units for data entry or reports.

Weather Zone Selection: Appears when you press SHIFT-F2 while you are in a *Weather Zone* field in a data entry screen, or in the *All Weather Zones?* field in the Weather Information Report options screen. Use the screen to choose weather zones for data entry or reports.

Date Selection: Appears when you press smn"-F2 while you are in a *Date* field in the Daily Weather Entry screen. Use the screen to choose a date for modifying or viewing a daily weather record.

Keyboard

General Keys

These keys are available throughout CONSUME.

SHIFT-F1	View help for the current screen or field.
CTRL-SHIFT-F-1	Exit CONSUME immediately.
CTRL-SHIFT-F2	Return to the Main Menu.

Data Entry Keys

Use these keys in the fields of CONSUME data entry screens.

UP ARROW	Move to the previous field.
DOWN ARROW	Move to the next field.
ENTER	Move to the next field.
RIGHT ARROW	Move the cursor one space to the right.
LEFT ARROW	Move the cursor one space to the left.
HOME	Move the cursor to the beginning of the field.
END	Delete from the cursor to the end of the field.
F1	Execute the current command (Create/Add, Modify, View, or Delete)

SHIFTS	View a list for a <i>Unit</i> , <i>Weather Zone</i> , or <i>Date</i> field.
F3 or PG UP	Scroll backward through available units, weather zones, or dates.
F4 or PG DN	Scroll forward through available units, weather zones, or dates.
BACKSPACE	Delete the character to the left of the cursor.
ESC	Cancel changes and return to the Transaction Menu.

Menu Keys

Use these keys in the Main Menu and Reports Menu screens:

UP ARROW	Move the selection arrow up.
DOWN ARROW	Move the selection arrow down.
HOME	Move the selection arrow to the first menu item.
END	Move the selection arrow to the last menu item.
1-5	Move to menu item with the corresponding number.
ENTER	Go to the screen for the option you selected.
ESC	Return to the previous menu, or exit CONSUME.

Report Keys

Use the following keys to view reports on screen in CONSUME.

UP/DOWN ARROW	Scroll through the report one line at a time.
F4/PG DN	View the next page of the report.
F3/PG UP	View the previous page of the report.
HOME	View the first page of the report.
END	View the last page of the report.
ESC	Leave the report and return to the previous screen.

Zone and Unit Selection Keys

Use these keys to select zones and units to include in reports from the Weather Zone, Unit, and Date Selection screens.

ENTER	Select or deselect the highlighted item.
* (asterisk)	Select or deselect all the items in the list.
UP/DOWN ARROW	Scroll through the list one item at a time.
F3/F4	Page through the list one screen at a time.
FI	Accept the currently selected items.
ESC	Cancel the index screen without accepting selections.

References

The following works are referred to in appendix C, "Scientific Background."

Cooper, Kathy Lois. 1985. The occurrence of a dry lower duff layer in western Washington and Oregon. Seattle, WA: University of Washington. 120 p. M.S. thesis.

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Hall, Janet. 1991. Comparison of fuel consumption between high and moderate intensity fires in logging slash. *Northwest Science*. 64(4): 158-165.

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Appendix A: Tips and Cautions

Setting up your database: When you install CONSUME, the database contains sample data. When you are ready to start using CONSUME to enter your own data, you may want to delete this unit and weather zone data.

Using on-line help: Use CONSUME's on-line help screens to find information about screens and fields quickly. Press SHIFT-F1 to view a help screen for your current location.

Deleting weather zones: When you delete a weather zone record, you also delete all the daily weather records associated with that weather zone.

Initial 1000-hour fuel moisture: Adjusted 1000-hour fuel moisture is a crucial factor in predicting large woody fuel consumption. To get accurate adjusted 1000-hour fuel moisture, the value you enter in the *Initial 1000-hour fuel moisture* field for a weather zone must accurately reflect the actual fuel moisture of the large woody fuels on the units in the weather zone.

Scroll through data in entry screens: In any of the CONSUME data entry screens, you can scroll through records quickly by pressing F4 or PG DN and F3 or PG UP while you are in a *Unit*, *Weather Zone*, or *Dare* field.

XXXX placeholders in reports: When the adjusted 1000-hour fuel moisture is greater than 99.9 percent, CONSUME displays "XXXX" in reports. The database and all CONSUME calculations continue to use the actual figure. The actual figure will appear in unformatted reports.

Using CONSUME reports with word processors: Open a CONSUME report file in a word processing program to include the report in a document or to add formatting to the report information.

Using CONSUME reports with spreadsheet programs: Open a CONSUME report file in a spreadsheet program to analyze the report information further (for example, to create a chart showing consumption at different levels of fuel moisture).

Calculating consumption of natural fuels: To determine consumption of natural fuels in a unit, enter 9999 in the *Harvest date* field in the Unit Entry screen

Making backups: The information in the CONSUME database is stored in two files, UNIT0100.BTR and WTHR0100.BTR. Reports are stored in files with the extension .REP. To protect your data from accidental deletion or disk failure, you should make regular backup copies of all these files.

Appendix B: Troubleshooting

This appendix provides troubleshooting information. If you do not find the answer to your problem here, contact the Seattle Forestry Science Lab, Fire and Environmental Research Applications Group, Software Support, Pacific Northwest Research Station, at (206)553-7815.

Error Messages

If there is a problem with the CONSUME program and it terminates, you will see one of these error messages:

Data Base Error
File Error
Fatal Error
Error in Screen Specs
Error in Field Specs
Run-time Error

See the appropriate section below for more information about each of these messages.

Data Base Errors

If you get a data base error, CONSUME is not able to interact correctly with DOS when it accesses the data base files (UNIT0100.BTR and WTHR0100.BTR).

The most common data base errors and the corrective actions you should take are shown below. If you get an error that is not listed, contact the Fire and Environmental Research Applications Group.

DATABASE ERROR 02; I/O ERROR

Cause: An error occurred while CONSUME was reading or writing to one of the database files. The database file or your hard disk might have been damaged, or the database file might have been modified by an incompatible application (for example, a user might have unintentionally changed the database file by using a text editor).

Correction: Do not attempt to use the current database files. Use a DOS utility (such as CHKDSK) to verify that your hard disk is functioning correctly, and then replace the database files with the most recent backup copies.

DATABASE ERROR 12; FILE NOT FOUND

Cause: One of the database files was moved, deleted, or renamed.

Correction: Move the database files back into the CONSUME directory. If there is any possibility that the files were modified by an application other than CONSUME, you need to replace the database files with the most recent backup copies.

DATABASE ERROR 18; DISK FULL

Cause: There is no more space on the hard disk for adding database information.

Correction: Delete unneeded files from your hard disk to make room for more CONSUME information, and restart CONSUME. You do not need to replace the existing database files; however, you do need to re-enter the record you were adding or modifying when the error occurred.

DATABASE ERROR 20; RECORD MANAGER NOT ACTIVE

Cause: The record manager (a program CONSUME uses for database access) cannot be located by CONSUME. The file BTRIEVE.EXE may be missing from the CONSUME directory, or you may have typed congo instead of consume at the DOS prompt to start CONSUME.

Correction: If BTRIEVE.EXE is missing, copy it from the CONSUME install disks. If BTRIEVE.EXE is not missing, be sure you type **consume** when you start CONSUME. You do not need to replace the database files when this error occurs.

DATABASEERROR 80; CONFLICT

Cause: Multiple applications are trying to access the database at the same time. This error could occur on a network or in a multitasking system (such as Windows).

Correction: Be sure that only one instance of CONSUME is accessing the database at one time. If the error was caused by an application other than CONSUME accessing the database, you need to replace the existing database files with the most recent backup copies.

DATABASE ERROR 94; PERMISSION ERROR

Cause: CONSUME cannot access the database because of an operating system restriction (for example, a read-only file attribute or an operating system security check).

Correction: Check the attributes of the database files, and remove the read-only attribute if necessary (see your DOS manual for information about removing this attribute). If CONSUME is on a network, make sure the user has access rights to the CONSUME directory.

File Errors

If you get a file error, CONSUME is not able to interact correctly with DOS when it accesses a report file (any file in the CONSUME directory with a .REP extension) or the CONSUME help file (CONSUME.HLP).

The most common file errors and the corrective actions you should take are shown below. If you get an error that is not listed, contact the Fire and Environmental Research Applications Group.

FILE ERROR 6416; FILE NOT FOUND

Cause: CONSUME was looking for a file (probably the help file) and could not find it.

Correction: Make sure all the CONSUME files are in the CONSUME directory, and that they have not been renamed. Any missing files (except database files that you have modified) can be restored from the CONSUME install disks.

FILE ERROR 6418; TOO MANY FILES CONNECTED

Cause: DOS did not allow CONSUME to open another file, because the maximum number of files allowed by DOS already was open.

Correction: Close files currently in use by other applications. You also can increase the number of DOS files allowed by modifying the FILES= line of the CONFIG.SYS file.

FILE ERROR 6422; NO SPACE LEFT ON DEVICE

Cause: There is no space left on the disk drive for creating reports.

Correction: Delete unneeded files from your hard disk to make room for more CONSUME reports.

FILE ERROR -1; END OF FILE ENCOUNTERED

Cause: CONSUME was trying to read a file (probably the help file CONSUME.HLP) and encountered the end of the file unexpectedly, because the file has been modified by another application.

Correction: Make sure the help file has not been modified, and that other applications have not modified report files while CONSUME is running.

Internal Errors

CONSUME has four possible internal errors:

FATAL ERROR
ERROR IN SCREEN SPECS
ERROR IN FIELD SPECS
RUN-TIME ERROR

These errors can all occur for several reasons:

Cause: The hardware or operating system software (DOS) you are using are not 100 percent IBM compatible.

Correction: Make any necessary changes to the hardware or DOS version so they are 100 percent IBM compatible. After you have done so, reinstall CONSUME.

Cause: There has been a hardware failure in your system (for example, a faulty memory device).

Correction: Run system diagnostics or other system utilities to check your system hardware. Restart your computer, and watch for system startup error messages.

Cause: You have identified a flaw in the CONSUME system.

Correction: Contact the Fire and Environmental Research Applications Group.

Appendix C: Scientific Background

This appendix provides scientific background for the CONSUME program, including:

- An introduction to the research and assumptions on which CONSUME is based.
- A general overview of the algorithms CONSUME uses.
- Documentation of the major equations used to calculate consumption.

A technical background document, *Documentation of Consumption Algorithms in CONSUME*, is available from the Seattle Forestry Sciences Laboratory, Fire and Environmental Research Applications Group, 4043 Roosevelt Way NE, Seattle, WA 98105. This internal document provides more detailed information about the algorithms used in CONSUME.

Introduction

In the early 1980s, the Fire and Air Resource Management project of the Pacific Northwest Research Station began to develop fuel-consumption models for prescribed burning situations in the Pacific Northwest. From the data collected at nearly 175 operational prescribed burns, a set of consumption algorithms has been formulated and incorporated into CONSUME.

This version of CONSUME incorporates the results of recent research. CONSUME now includes calculations that account for springlike and summerlike burning conditions, uncured fuel moisture, and high-intensity conditions. These factors lead to more precise results than previous versions of CONSUME could provide. For more information about these changes, contact the Seattle Forestry Science Lab, Fire and Environmental Research Applications Group, Software Support, Pacific Northwest Research Station, to obtain detailed technical documentation.

In certain cases, CONSUME uses preliminary consumption models, pending the development of more complete and accurate models. As these improved models become available, they will be incorporated into future versions of CONSUME.

CONSUME Algorithms

CONSUME uses several different models to calculate consumption of fuels of different sizes.

- **Small (1- and 10-hour) fuels** are assumed to consume completely in any burn.
- **Consumption of small (100-hour) fuels** is calculated based on several factors, including 10-hour fuel moisture content, wind speed, and slope.
- **Large (1000- to 10000-hour) fuel** consumption is based primarily on adjusted 1000-hour fuel moisture. Other factors include the consumption of 100-hour fuels and duration of ignition time.
- **Duff consumption** is calculated based on duff depth, days since rainfall, and the consumption of large fuels.

This Users Guide refers to fuels by timelag category (1-hour, 10-hour, and so on). The following table shows fuels by timelag category and their corresponding diameters.

Diameter	Timelag
<i>Inches</i>	<i>Hours</i>
0.0-0.25	1
0.26-1.0	10
1.1-3	100
3.1-9	1000 ¹
9.1-20	10000
20.1+	10000P ²

The rest of this appendix provides more detailed information about each consumption model.

Small (1-Hour, 10-Hour, and 100-Hour) Woody Fuel Consumption

CONSUME assumes that all 1-hour and 10-hour fuels in a unit are consumed during a burn, regardless of weather, location, or other conditions. This was determined from data collected in the field. Managers generally do not meet objectives if they burn a unit when only a small portion of the 1-hour and 10-hour fuels are consumed.

The equations for 100-hour fuel consumption were derived from fuel consumption theory, with several of the coefficients determined from a burn study (Ottmar and others 1990) and from fire spread research (Rothermel 1972).

¹ The true definition for 1000-hour fuels is 3 to 8 inches in diameter. It is common practice, among forest managers, to define 1000-hour fuels as 3 to 9 inches in diameter. CONSUME has adopted the 3- to 9-inch-diameter definition.

² Fuels 20.1 inches or more in diameter have a timelag greater than 10,000 hours.

1-Hour and 10-Hour Fuel Consumption Equations

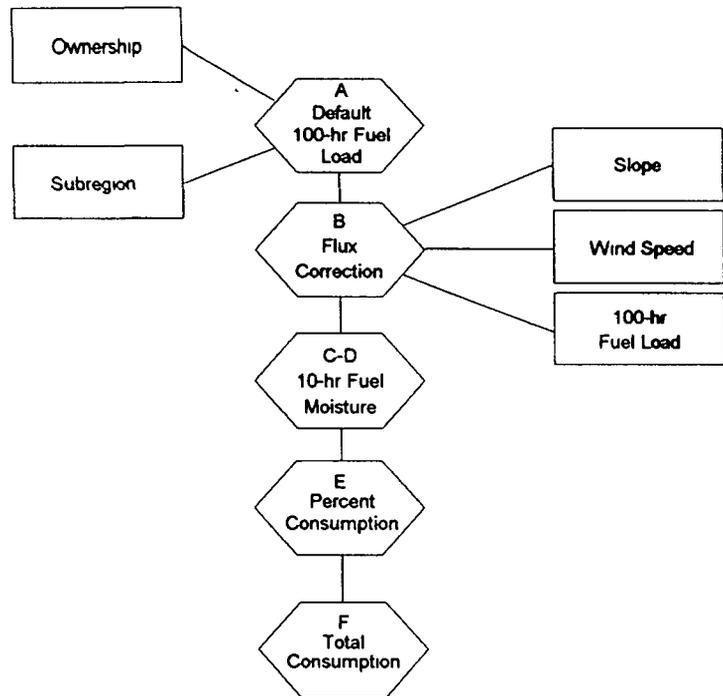
The consumption of 1-hour and 10-hour fuels equals their pre-burn loadings in tons per acre.

1-hour fuel consumption = 1-hour fuel load

10-hour fuel consumption = 10-hour fuel load

100-Hour Fuel Consumption Equations

The following flow chart shows the factors that are used in determining 100-hour fuel consumption.³



CONSUME uses this algorithm to calculate consumption of 100-hour fuels. The lettered sections and equations are explained below.

³ See "About this Manual" for an explanation of flowchart symbols.

A: Default 100-hour fuel load

A theoretical relation among wind speed, slope, and heat flux has been developed. It is based on a typical unit (20 percent slope, zero wind speed, ignited by hand) with an average fuel loading. Therefore, one of the factors used to determine the heat flux correction (section B) is a default 100-hour fuel load. CONSUME determines this default load from geographical area and owner class, by using the following tabulations (Howard 1981):⁴

Owner Class	Western OR/CA	Western WA
Forest Service	6.9	8.1
State/other Federal	6.7	8.7
Private	7.2	6.9

Owner Class	Eastern OR/CA	Eastern WA
Forest Service	2.0	2.5
State/other Federal	2.0	2.5
Private	2.0	2.5

B: Heat flux correction

A theoretical heat flux correction formula is used to calculate the drying of fuels during ignition and consumption. CONSUME calculates the heat flux correction based on a ratio of 100-hour fuel loading, default 100-hour fuel loading, slope, and wind speed.

⁴ All figures in tons per acre.

$$\text{Heat flux correction} = \left(\frac{\text{100-hour fuel load}}{\text{Default 100-hour fuel load}} \right) * \left(\frac{\text{Slope} - 20}{60} + \frac{\text{Wind speed}}{4} \right)$$

100- hour fuel load: 100- hour fuel loading of unit (tons/acre)

Default 100-hour fuel load: Based on owner class and location (tons/acre) (see section A)

Slope: Average slope of unit (percent)

Wind speed: Midflame wind speed at time of burn (miles/hour)

20: Slope of typical unit (percent)

60: Coefficient (slope required to double rate of fire spread [Rothermel 1972]) (dimensionless)

4: Coefficient (effective wind speed required to double rate of fire spread (Rothermel 1972)) (dimensionless)

C: 10-hourfuel moisture correction

CONSUME uses 10-hour fuel moisture as part of the calculation to determine percentage of consumption of 100-hour fuels. 10-hour fuel moisture is adjusted based on propagating heat flux correction (section B)

10-hour FM correction =

$$\text{Fuelmoisture flux} * \left(\frac{\ln(\text{Heat flux correction})}{\ln(2)} \right)$$

Fuel moisture flux: 3.0 percent (amount of change in moisture content for each doubling of flux [Rothermel 1972])

D: Adjusted 10-hour fuel moisture content

The factor from section C is used to adjust 10-hour fuel moisture (percent), by using the following equation:

$$\text{Adjusted 10-hour fuel moisture} = \\ \text{10-hour FM} - \text{10-hour FM correction}$$

E: Percent consumption of 100-hour fuels

CONSUME uses the following theoretical equation to determine percent consumption of 100-hour fuels.

$$\text{Percent 100-hour consumption} = \\ 0.9 - (\text{Adjusted 10-hour FM} - 12) * 0.0535$$

12: Moisture content at which 100-hour fuels will not completely consume. (Rothermel 1972) (dimensionless)

0.0535: Slope of the line determined from real data regression (Ottmar and others 1990) (dimensionless)

F: Total 100-hour fuel consumption

By using the percent consumption (section E), CONSUME calculates the total consumption of 100-hour fuels in tons per acre.

$$\text{Total 100-hour fuel consumption} = \\ \text{100-hour fuel loading} * \text{Percent 100-hour fuel} \\ \text{consumption}$$

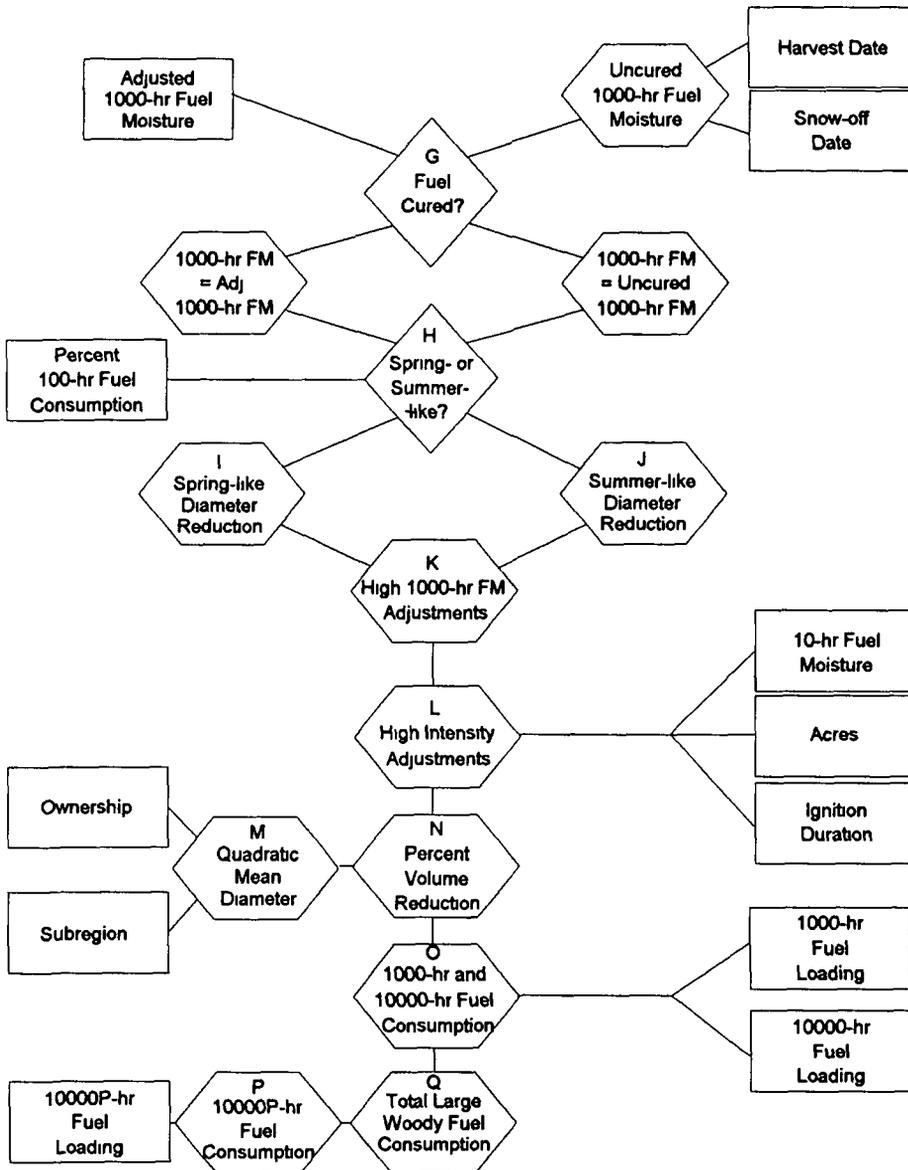
Large Woody Fuel Consumption

Adjusted 1000-Hour Fuel Moisture

The most important factor in determining total large woody fuel consumption is adjusted 1000-hour fuel moisture content. CONSUME predicts this variable by using the adjusted 1000-hour fuel moisture algorithm. CONSUME uses the adjusted 1000-hour fuel moisture model to calculate unit average large woody fuel moisture. The model is a modification of the 1000-hour fuel moisture model of the National Fire Danger Rating system, to make better predictions for the consumption of Douglas-fir, hemlock, mixed conifer, and lodgepole pine fuels common to the Pacific Northwest. The adjusted 1000-hour fuel moisture model requires daily measurements of rain duration, maximum and minimum relative humidity, and maximum and minimum temperature. For a detailed description of the model, see Ottmar and Sandberg (1985).

Diameter Reduction

Diameter reduction (DRED) is the reduction of the diameter of a cylindrical log caused by fire and is measured in inches. CONSUME uses days of curing, fuel moisture, and consumption of 100-hour fuels to estimate the diameter reduction of large woody fuels. Diameter reduction for 1000- and 10000-hour fuels is independent of the original diameter (Sandberg and Ottmar 1983). The following flow chart and equations explain how CONSUME estimates diameter reduction.



CONSUME uses this algorithm to calculate consumption of large (1000-hour and 10000-hour) woody fuels. The lettered equations are explained below.

G: Evaluating if curing has occurred

The 1000-hour and 10000-hour fuels are cured when their fuel moisture drops to 60 percent (approximately 3 drying months).

CONSUME uses a three-step process to determine if fuels are cured.

First, CONSUME estimates an uncured 1000-hour fuel moisture:

Uncured fuel moistures $119.64 \exp(-0.0069 * \text{Days since harvest})$

Uncured fuel moisture: Fuel moisture content of large woody material that has not had time to cure.

Days since harvest: Number of days without snow on the unit since harvest; determined from snow-off date and harvest date.

Second, CONSUME determines if the uncured fuel moisture is greater than the adjusted 1000-hour fuel moisture. If it is, CONSUME uses it instead of adjusted 1000-hour fuel moisture in diameter reduction equations (sections I, J, K, and L).

Third, CONSUME determines if the selected 1000-hour fuel moisture (regardless of adjusted 1000-hour fuel moisture or uncured fuel moisture) is greater than 60 per cent. If it is, the large woody fuels are uncured, and CONSUME uses the uncured fuel moisture in diameter reduction equations (sections I, J, K, and L).

H: Evaluating whether springlike burning conditions occurred

CONSUME uses the percentage of consumption of 100-hour fuels to find whether burning conditions are springlike or summerlike.

If the consumption of 100-hour fuels is less than 80 percent, conditions are springlike, and CONSUME uses equation I to calculate diameter reduction.

If the consumption of 100-hour fuels is greater than 80 percent, conditions are summerlike, and CONSUME uses equation J to calculate diameter reduction.

Between 75 and 85 percent, CONSUME uses a step function to smooth the transition between springlike and summerlike conditions.

I: Springlike diameter reduction equation

If burning conditions are springlike, CONSUME uses the following equation to calculate diameter reduction in inches (Ottmar and others 1990):

$$\text{Diameter reduction} = -0.096(\text{ADJ-Th}) + 4.6495$$

ADJ-Th: Adjusted 1000-hour fuel moisture content (percent)
(Ottmar and Sandberg 1985)

J: Summerlike diameter reduction equation

If burning conditions are summerlike, CONSUME uses the following equation to calculate diameter reduction in inches (Sandberg and Ottmar 1983). CONSUME also uses several additional equations when high-intensity fire conditions exist (see "High-Intensity Fire Conditions" for more information).

$$\text{Diameter Reduction} = -.125(\text{ADJ-Th}) + 6.27$$

ADJ-Th: Adjusted 1000-hour fuel moisture content (percent) (Ottmarand Sandberg, 1985)

K: High fuel moisture diameter reduction equations

If adjusted 1000-hour fuel moisture is extremely high, it is necessary to smooth diameter reduction so that it approaches, but never reaches, zero. This prevents an estimated diameter reduction of less than zero.

If the adjusted 1000-hour fuel moisture is 44 to 60 percent, CONSUME uses the following equation to calculate diameter reduction in inches:

$$\text{Diameter Reduction} = -.0178(\text{ADJ-Th}) + 1.499$$

ADJ-Th: Adjusted 1000-hour fuel moisture content (percent) (Ottmar and Sandberg, 1985)

If the adjusted 1000-hour fuel moisture is greater than 60 percent, CONSUME uses the following equation to calculate diameter reduction in inches:

$$\text{Diameter Reduction} = -.005(\text{ADJ-Th}) + .731$$

ADJ-Th: Adjusted 1000-hour fuel moisture content (percent) (Ottmar and Sandberg, 1985)

L: High-intensity fire adjustment to diameter reduction

The intensity of fire can limit the consumption of large woody fuels. Mass ignition causes small fuels to be consumed more rapidly, increasing the intensity of the fire. This can shorten the fire duration, causing large fuels to absorb less energy and have less consumption.

CONSUME takes this into account by reducing the amount of diameter reduction of 1000-hour and 10000-hour fuels as fires increase in intensity.

Several variables influence the possible levels of fire intensity. CONSUME uses 10-hour fuel moisture, duration of ignition time, unit size, and adjusted 1000-hour fuel moisture to determine fire intensity. The following tabulation shows how fire intensity affects diameter reduction.

<u>Fire intensity</u>	<u>DRED reduction</u>
	<i>Percent</i>
Extreme	33
Very high	22
High	11
Medium	Not reduced

Extreme-intensity fires

CONSUME uses the following factors to determine whether a fire is of extreme intensity:

- 10-hour fuel moisture content must be less than 15 percent
- Adjusted 1000-hour fuel moisture must be less than or equal to 40 percent.

Unit size must be greater than or equal to 10 acres

If a fire meets these conditions, CONSUME then evaluates if the size of the burn and speed of ignition result in a mass ignition:

For units of less than 10 acres, extreme-intensity fires cannot occur.

For units of 10 to 20 acres:

Maximum ignition duration = Acres

For units of more than 20 acres:

$$\text{Maximum ignition duration} = (0.5 * \text{Acres}) + 10$$

Maximum ignition duration: The total number of minutes that can elapse in the ignition period and still be considered a mass ignition.

Acres: The number of acres treated with prescribed fire.

If ignition duration is less than maximum ignition duration, the intensity of the fire is extreme. CONSUME reduces diameter reduction by 22 to 33 percent, depending on the 10-hour fuel moisture and the adjusted 1000-hour fuel moisture.

Very high-intensity fires

If a fire does not meet conditions for extreme-intensity fires, CONSUME uses the following factors to determine whether the fire is of very high intensity:

- 10-hour fuel moisture content must be less than or equal to 15 percent.

Adjusted 1000-hour fuel moisture must be less than or equal to 50 percent.

If a fire meets these conditions, CONSUME evaluates whether the size of the burn and speed of ignition result in a mass ignition.

For units of up to 20 acres:

$$\text{Maximum ignition duration} = 2 * \text{Acres}$$

For units of more than 20 acres:

$$\text{Maximum ignition duration} = \text{Acres} + 20$$

Maximum ignition duration: The total number of minutes that can elapse in the ignition period and still be considered a mass ignition.

Acres: Number of acres treated with prescribed fire.

If ignition duration is less than maximum ignition duration, the intensity of the fire is very high. CONSUME reduces diameter reduction by 11 to 22 percent, depending on the 10-hour fuel moisture and the adjusted 1000-hour fuel moisture.

High-intensity fires

If a fire does not meet the conditions for very high-intensity fires, CONSUME uses the following factors to determine whether the fire is of high intensity:

- 10-hour fuel moisture content must be less than or equal to 18 percent.
- Adjusted 1000-hour fuel moisture must be less than or equal to 50 percent.

If a fire meets these conditions, CONSUME evaluates whether the size of the burn and speed of ignition result in a mass ignition:

For units of up to 20 acres:

Maximum ignition duration = 4 * Acres

For units of more than 20 acres:

Maximum ignition duration = (2 * Acres) + 40

Maximum ignition duration: The total number of minutes that can elapse in the ignition period and still be considered a mass ignition.

Acres: The number of acres treated with prescribed fire.

If ignition duration is less than maximum ignition duration, the intensity of the fire is high. CONSUME reduces diameter reduction by 0 to 11 percent, depending on the 10-hour fuel moisture and the adjusted 1000-hour fuel moisture.

Medium-intensity fires

If a fire does not meet any of the above conditions, CONSUME does not reduce diameter reduction.

M: Quadratic mean tables

The quadratic mean diameter represents the diameter of a log in a woody size class with average volume. Quadratic mean diameter is used to convert calculated inches of diameter reduction into percent volume reduction.

The quadratic mean diameters of large woody fuels differ by size class, geographical location, and type of owner (Peterson and others 1991).

CONSUME uses the following tabulations to determine quadratic mean diameters for 1000-hour fuels.⁵

<u>Owner Class</u>	<u>Western OR/CA</u>	<u>Western WA</u>
Forest Service	5.3	5.5
State/other Federal	5.2	5.3
Private	5.3	5.5
<u>Owner Class</u>	<u>Eastern OR/CA</u>	<u>Eastern WA</u>
Forest Service	5.2	5.0
State/other Federal	5.2	5.0
Private	5.1	5.0

⁵ All figures in inches.

CONSUME uses the following tables to determine quadratic mean diameters for 10000-hour fuels.⁶

Owner Class	Western OR/CA	Western WA
--------------------	----------------------	-------------------

Forest Service	12.3	12.2
State/other Federal	12.0	11.9
Private	11.6	11.2

Owner Class	Eastern OR/CA	Eastern WA
--------------------	----------------------	-------------------

Forest Service	13.7	11.4
State/other Federal	13.7	11.4
Private	11.9	11.9

All figures in inches

N: Percent volume reduction equations

CONSUME calculates the percent volume reduction of 1000-hour and 10000-hour fuels with the following equations. Separate quadratic mean diameters are used for 1000-hour and 10000-hour fuels.

For 1000-hour fuels, the volume reduction equation is:

% Volume Reduction 1-

$$\frac{\text{1000-hour Quadratic Mean Diameter-Diameter Reduction}^2}{\text{1000-hour Quadratic Mean Diameter}}$$

1000-hour Quadratic Mean Diameter: see table M

⁶ All figures in inches

For 10000-hour fuels, the volume reduction equation is:

% Volume reduction =

$$1 - \frac{\text{10000-hour quadratic mean diameter} - \text{Diameter reduction}^J}{\text{10000-hour quadratic mean diameter}}$$

10000-hour quadratic mean diameter: see table M

0:1000-hour and 10000-hour fuel consumption equations

CONSUME calculates total 1000-hour and 10000-hour consumption in tons per acre with the following equations.

1000-hour fuel consumption =

$$\% \text{ 1000-hour fuel volume reduction} * \text{1000-hour fuel loading}$$

10000-hour fuel consumption =

$$\% \text{ 10000-hour fuel volume reduction} * \text{10000-hour fuel loading}$$

P: 10000P-hour fuel consumption

The percentage of consumption for materials 20 inches or more in diameter (10000P-hour timelag fuels) is estimated by assuming 5 percent consumption when adjusted 1000-hour fuel moisture is less than 30 percent, 4 percent consumption when fuel moisture is 31 percent, 3 percent consumption when adjusted fuel moisture is 32 percent, 2 percent consumption when adjusted fuel moisture is 33 percent, 1 percent consumption when adjusted fuel moisture is 34 percent, and 0 percent consumption when adjusted fuel moisture is 35 percent. The formula was determined from a small amount of diameter reduction data collected during 1980-82. The data were difficult to interpret because most large logs were rotten in the center and consumed from the inside outward.

CONSUME uses the following tabulation to calculate 10000P-hour fuel consumption:

ADJ-Th	10000P-hour fuels consumed
- . - - - -	<i>percent</i> - - - -
35	0
34	1
33	2
32	3
31	4
30	5

Q: Total large woody fuel consumption

Total large woody fuel consumption in tons per acre is the sum of the consumption of 1000-, 10000-, and 10000P-hour timelag fuels in tons per acre.

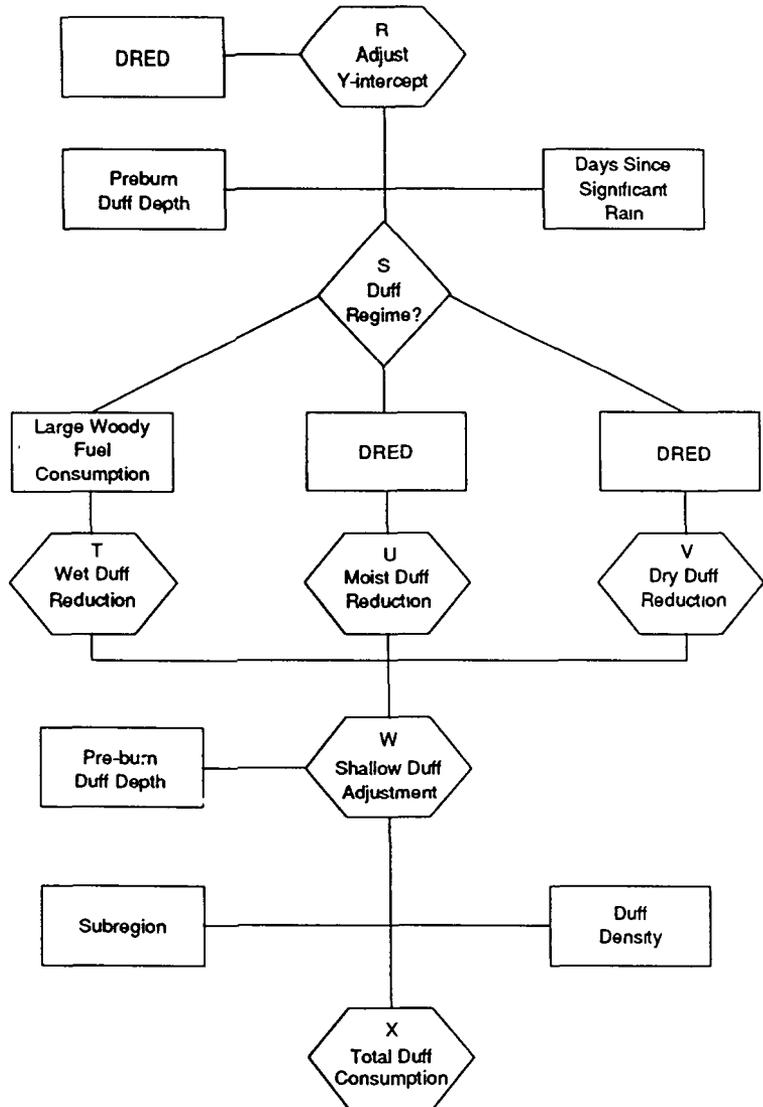
Total large woody fuel consumption =

**1000-hour fuel consumption + 10000-hour fuel
consumption + 10000P-hour fuel consumption**

Duff Consumption

Major variables that control duff consumption include woody fuel consumption, diameter reduction, preburn duff depth, and duff moisture content. Because actual duff moisture content is difficult to measure, CONSUME classifies duff as wet, moist, or dry based on the number of days since significant rain. The duff consumption algorithm is divided into separate regimes for wet, moist, and dry duff (Ottmar and others 1985).

The following flow chart shows the factors that are used in determining duff consumption.



CONSUME uses this algorithm to calculate duff consumption. The lettered sections and equations are explained below.

R: Y-intercept adjustment

CONSUME uses an adjustment factor to modify the duff reduction equations (T, U, and V) as they approach the Y-axis. Without this Y-intercept adjustment, duff consumption would be overestimated for burns with very low consumption of large woody fuels. The adjustment factor is the absolute minimum of (Diameter Reduction/1.68) and 1.

Diameter reduction: Diameter reduction of large woody fuels (see sections I, J, K, and L)

1.68: Average quadratic mean diameter of 100-hour fuels

S: Drying period equations

CONSUME uses different moisture regimes to estimate duff reduction. The selection of the appropriate moisture regime is dependant on the preburn duff depth and the days of drying prior to the burn.

CONSUME uses the preburn duff depth to estimate the days of drying necessary to change the duff moisture from wet to moist, and from moist to dry. These drying periods are then compared with the days since significant rainfall to select the appropriate duff reduction regime.

$$\text{Days to moist} = 21 * \frac{\{\text{Duff}_3\text{depth}\}^{1.18}}{3}$$

$$\text{Days to dry} = 57 * \{\text{Duff}_3\text{depth}\}^{1.18}$$

Days to moist: The days without significant rainfall required to reach the threshold between the wet and moist regimes.

Days to dry: The days without significant rainfall required to reach the threshold between the moist and dry regimes.

Days since significant rainfall: The number of days since a significant amount of rain fell. Significant rainfall is 0.5 inches on the west side of the Cascades, and 0.25 inches on the east side. This is the amount of rainfall required to saturate the duff layer (Cooper 1985).

If days since significant rainfall is less than days to moist, CONSUME uses the wet duff regime. If days since significant rainfall is greater than days to moist, but less than days to dry, CONSUME uses the moist duff regime. If days since significant rainfall is greater than days to dry, CONSUME uses the dry duff regime.

T: Wet duff reduction equation

If CONSUME determines (in section S) that the duff is wet, it uses the following equation to determine duff reduction (Ottmar and others 1985):

$$\text{Wet duff reduction} = (0.537 * \text{YADJ}) \\ + [0.057 * (1000\text{-hour consumption} + 10000\text{-hour} \\ \text{consumption} + 10000\text{P-hour consumption})]$$

Wet duff reduction: Duff reduction in wet regime (inches)

YADJ: Y-intercept adjustment

1000-hour consumption: Consumption of 1000-hour fuels in tons per acre (see section O)

10000-hour consumption: Consumption of 10000-hour fuels in tons per acre (see section O)

10000P-hour consumption: Consumption of 10000P-hour fuels in tons per acre (see section P)

U: Moist duff reduction equation

If CONSUME determines (in section S) that the duff is moist, it uses the following equation to determine duff reduction (Ottmar and others 1985):

$$\text{Moist duff reduction} = (0.323 * YADJ) + (1.034 * VDiameter\ reduction)$$

Moist duff reduction: Duff reduction in moist regime (inches)

YADJ: Y-intercept adjustment

Diameter reduction: Diameter reduction of large woody fuels in inches (see sections I, J, K, and L)

V: Dry duff reduction

If CONSUME determines that the duff is dry (section S), it uses the following equation to determine duff reduction:

$$\text{Dry duff reduction} = \text{Moist duff reduction} + \text{Days since rainfall} - \text{Days to dry}$$

Dry duff reduction: Duff reduction in dry regime (inches)

Moist duff reduction: See section U

Days since rainfall: Days since significant rainfall

Diameter reduction: Diameter reduction of large woody fuels (see sections I, J, K and L)

Days to dry: See section S

W: Shallow duff adjustment

Shallow duff has more inorganic material in it, and this causes less consumption. CONSUME makes an adjustment to account for this:

- If preburn duff depth is less than 1 inch, duff reduction is multiplied by 0.5.
- If preburn duff depth is less than 2 inches, duff reduction is multiplied by 0.75.

The transition between 1 and 2 inches is smoothed with a step function.

X: Total duff consumption

Total duff consumption in tons per acre is calculated using bulk density and duff reduction (sections T, U, V, or W).

Bulk density is 18.7 tons per acre per inch on the west side, and 12.1 tons per acre per inch on the east side.

Total duff consumption = Duff reduction * density

Density: Duff bulk density (18.7 west side, 12.1 east side)

Total Biomass Consumption

CONSUME uses the following calculations to determine total biomass consumption in tons per acre and tons per unit:

Total woody fuel consumption per acre = 1-hour fuel consumption per acre + 10-hour fuel consumption per acre + Total 100-hour fuel consumption per acre + Total large woody fuel consumption per acre

Total biomass consumption per acre = Total woody fuel consumption per acre + Total duff consumption per acre

Total unit biomass consumption = Total biomass consumption per acre * Acres

Glossary

Activity fuels: Fuels resulting from or altered by forestry practices such as timber harvesting, thinning, etc., as opposed to naturally created fuels.

Adjusted 1000-hour fuel moisture (ADJ-Th): Adjusted 1000-hour fuel moisture is an estimated fuel moisture (derived from temperature, relative humidity, and precipitation data) that represents the average unit fuel moisture of large woody fuels in the Pacific Northwest more precisely than the National Fire Danger Rating System. Adjusted 1000-hour fuel moisture predicts the fuel moisture of Douglas fir, hemlock, mixed conifers, and lodgepole pine. It has not been evaluated for predicting fuel moisture of long-needled pine.

Clearcut: A timber harvest method in which all, or nearly all, trees in a stand of timber are cut in one operation.

Diameter reduction (DRED): Reduction in the diameter of a cylindrical log caused by fire.

Duff: Humus and other partially decayed material on the forest floor.

Fuel loading: The amount of fuels present in a unit, expressed quantitatively in terms of mass of fuels per unit area.

Fuel moisture: The amount of water present in fuels. Generally, fuel moisture content is expressed as a percentage of a material's oven-dry weight.

Heat flux: The amount of heat transferred across a surface of a unit area in a unit of time. Also known as "thermal flux."

High-Intensity fire: A fire caused by mass ignition of a unit, resulting in long flame lengths, violent fire behavior, fire whirls, and high intensities. Research has shown that high intensity fires consume a smaller quantity of fuels than moderate intensity prescribed burns.

Large fuels: Dead wood consisting of sound or rotten roundwood greater than 3 inches in diameter.

Natural fuels: Fuels that have fallen or died through natural causes.

Prescribed burn: A controlled application of fire to wildland fuels that have been subject to logging activity, to obtain planned objectives for silviculture, wildlife habitat management, grazing, fire hazard reduction, and so on.

Significant rainfall: The amount of rainfall in a 48-hour period required to saturate the duff layer. A significant amount of rain is one-half inch on sites west of the Cascades/Sierra Nevada and one-quarter inch on sites east of the Cascades/Sierra Nevada.

Small fuels: Dead wood consisting of sound or rotten roundwood 0 to 3 inches in diameter.

10-hour fuel sticks: A manufactured stick or set of sticks of known dry weight. By exposing them to the weather and weighing them periodically, you can use fuel sticks to determine changes in the moisture content of 10-hour fuels in a unit.

Timelag: The time necessary for a fuel particle to lose ± 63 percent of the difference between its initial fuel moisture content and its equilibrium moisture content. The timelag of sound or rotten roundwood fuels depends on their diameter, as shown in appendix C, "Scientific Background."

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