User's Guide for the Mountain Pine Beetle in Lodgepole Pine Risk Rating Event Monitor Addfile (II)[1]
Based on Randall and Tensmeyer 2000

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Introduction

The Mountain Pine Beetle in Lodgepole Pine Risk Rating Event Monitor (EM) Addfile (II) (*mpb_lpp_RT.kcp*) is an FVS **k**eyword **c**om**p**onent file (a *.kcp* file) that calculates a stand's hazard rating based on a system proposed by Randall and Tensmeyer (2000). The system was designed for mountain pine beetle (MPB; *Dendroctonus ponderosae* Hopkins) in lodgepole pine (*Pinus contorta* var. *latifolia* Engelmann) in the Rocky Mountains. It represents a "hybridization" of the systems proposed by Amman et al. (1977) and Shore and Safranyik (1992). This EM addfile provides a numerical "risk susceptibility score" that ranks the risk of stands to attack by the MPB.

Overview

This EM addfile performs a set of sequential steps to determine a numerical risk rating score for all cycle-beginning years of an FVS simulation.. Factors considered in the hazard rating logic include:

- % of total basal area that is lodgepole pine
- total stand basal area
- total trees per acre
- stand elevation
- stand age
- average DBH of lodgepole pine (of trees greater than 5 inches)

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[1]This document is part of a package containing a number of files: (1) this document (*mpb_lpp_RT.pdf*), (2) the MPB in LPP Risk Rating EM Addfile *mpb_lpp_RT.kcp*, (which this document describes), and (3) one or more ArcView® legend file(s) that can be used by the custom ArcView® project FVS-EMAP. The package, a self-extracting WinZip® file (*mpb_lpp_RT.exe*), as well as the FVS-EMAP project software, is available online at:

http://www.fs.fed.us/foresthealth/technology/products.htm

For more information, contact: Eric Smith: email: elsmith@fs.fed.us phone: 970 295-5841

The step-wise progression of logic is presented in Table 1, below. The EM addfile reports only the numerical rating; it is up to the user to qualitatively interpret the numeric score. The qualitative interpretation of the numerical rating—as published in Randall and Tensmeyer 2000—is given in the table's final column.

Table 1. Step-wise logic of the Randall and Tensmeyer risk rating system, as followed by the *mpb_lpp_RT.kcp* EM addfile. The "original" column indicates the numerical rating as published in Randall and Tensmeyer (2000); the "modified" column represents the rating as reported by the addfile. Abbreviations used: BA = basal area; TPA = trees per acre; QMD = quadratic mean diameter.

Step	MPB in LPP Hazard Rating Logic (Performed stepwise)	Numerical rating		Hazard rating
		original	modified	
1	If % BA LPP = 0	0	1	Ex. Low
2	If % of BA in LPP < 25%	1	2	Low
3	If stand BA <80 or >250 sq ft / acre	2	3	Low
4	If TPA > 3" is <100 or > 800	3	4	Low
5	If QMD of LPP > 5" dbh is < 6" dbh	4	5	Low
6	If elevation (in m) > threshold A	4.5	6	Low
7	If stand age < 60 yrs	4.75	7	Low
8	If % of BA in LPP is 25-50%	5	8	Moderate
9	If stand BA is 80-120 sq ft / acre	6	9	Moderate
10	If TPA >3" is 100-300 or 600-800	7	10	Moderate
11	If QMD of LPP >5" dbh is < 8" dbh	8	11	Moderate
12	If elevation (in m) > Threshold B	9	12	Moderate
13	If stand age ≥ to 60 yrs and < 80 yrs	9.5	13	Moderate
14	Else	10	14	High

The program requires that the user enter appropriate elevation thresholds (referred to as EBREAKs) into the *.kcp* file. The threshold elevations (for steps 6 and 12) are site-specific, and vary depending upon latitude and longitude:

Threshold A = (24.4*longitude) - (121.9*latitude) + 5045.1
Threshold B = (24.4*longitude) - (121.9*latitude) + 4545.1

These formulae come from relationships developed by Hopkins (1919), and used by Shore and Safranyik (1992). The relationship was developed from data primarily from the eastern U.S. and has not been validated for the western United States. The thresholds derived from these formulae thus ought to be considered only a first approximation. Local expert opinion may provide more meaningful threshold values.

Users must explicitly enter their own site-specific thresholds in the *.kcp* file. (Thresholds will not automatically be calculated.) These thresholds (A & B) represent the elevations (in feet) above which bark beetle hazard may be deemed either "low" or "moderate", respectively. Threshold values as calculated by the formulae presented above, for various combinations of latitude and longitude, are presented in Table A1, below.

Table A1: Suggested first-approximation elevation thresholds (EBREAKs) to be used in the Randall and Tensmeyer Hazard Rating Event Monitor Addfile.

Latitude	Longitude	Elevation Threshold A	Elevation Threshold B
35	105	10960	9306
35	110	11360	9706
35	115	11760	10107
35	120	12161	10507
40	105	8960	7306
40	110	9361	7707
40	115	9761	8107
40	120	10161	8507
45	105	6961	5307
45	110	7361	5707
45	115	7761	6107
45	120	8161	6508
50	105	4961	3307
50	110	5361	3707
50	115	5761	4108
50	120	6162	4508

A separate, modified version of this *.kcp* file is available that bypasses the age-checking steps—steps 7 and 13. Accordingly, this modified *.kcp* file hazard rates stands using the same numerical rating scale (1-14), however no stand can be rated 7 or 13.

Using the Event Monitor Addfile

Note: the instructions below assume that the user wants to download the entire "package" (addfile, documentation, & ArcView® legend(s)). Users not desiring the entire package may, instead, download the EM addfile *mpb_lpp_RT.kcp* by itself, in which case the reader should begin at step 3 (after downloading).

1) Download the file *mpb_lpp_RT.exe* by following the link from FHTET's ***Products*** website at:

   http://www.fs.fed.us/foresthealth/technology/products.htm

   This file may be placed anywhere on your computer.

   This WinZip® self-extracting file contains a number of files:

   (i) the MPB in LPP Risk Rating EM Addfile (II) (*mpb_lpp_RT.kcp*),

   (ii) this User's Guide (*MPB_LPP_EM2_User_Guide.pdf*), and

   (iii) at least one optional ArcView® legend file (*mpb_haz1.avl*) to be used with FVS-EMAP. (More *.avl* files may be added in the future). See next section for more information about FVS-EMAP.

2) After downloading, begin the extraction process by double-clicking the self-extracting WinZip® file (*mpb_lpp_RT.exe*). Although the files may be extracted to anywhere on your computer; we recommend that you allow the extraction procedure to place the files into the default extraction destinations. By default, the EM addfile

and the User's Guide will be extracted to **C:/fvsdata**; and the ArcView legend file(s) will be extracted to **C:/fvs_emap/legends**.[2]

3) Before adding the *mpb_lpp_RT.kcp* Event Monitor addfile to a simulation, open it in a text editor and **verify that the elevation thresholds are correctly defined** for your location. The addfile—as downloaded—is configured for central Idaho (46 north latitude; 116 east longitude; EBREAK1=7400 feet; EBREAK2=5800 feet). You should adjust the definitions of the two EBREAK variables so they reflect the correct physiography-bark beetle biology relationship for your area.

   Be sure to save the edited *mpb_lpp_RT.kcp* file before continuing.

4) Launch Suppose and build your FVS simulation (keyword) file.
5) Select the *Group* or individual *Stand* to which you want include the Event Monitor addfile by (1) toggling the applicable radio button ('Current Group' or 'Current Stand') in the main FVS 'Selections' window, and (2) selecting the applicable group or stand from the window above the 'Change Group Membership' button.
6) Select 'Edit Simulation File' from the main Suppose 'Selections' window.
7) Select 'Insert from file'.
8) Navigate to the directory where the .kcp file is located.
9) Select the file from the window browser; click 'Open'. The file is now included to all stands in the current group (or to the current stand—see step 5).
10) 'Close' the 'Edit Simulation File' window.
11) Continue building simulation file, and when done, click 'Run Simulation'.

Output

If you want the Event Monitor output variables written to a file other than the standard FVS output file, you may request one or more of the post-processors that will create separate COMPUTE variable output files. These are accessible via the 'Select Post Processors' button from the main Suppose 'Selections' window. Three different types of output files are available for COMPUTE variables (via three different post-processors). In the 'Select Post Processors' window, the choices are:

- Compute1-Table of COMPUTE Variables (with headers)
  This post processor produces a file of all COMPUTE variables displayed by stand and by year in a table with headers. The file has a filename extension ".cmp"
- Compute2-Table of Concatenated COMPUTE Variables (comma delimited)
  This post processor produces a file of all COMPUTE variables by stand, and by year, in a comma-delimited (machine readable) format. The file has a filename extension ".cp2"

[2] Thus, the default extraction procedure for this package assumes you are using the default directory structure provided with FVS-EMAP. If your installation of FVS-EMAP is different, then you will want to extract the *.avl* file to your FVS-EMAP project directory's 'Legends' subdirectory. Both extraction and use of the *.avl* file(s) are optional.

- Compute3-Table of COMPUTE Variable Averages
  This post processor creates a file containing averages (across stands, by year) for all COMPUTE variables. The file has a filename extension ".avc".

Displaying COMPUTE Variable Output in ArcView®

Output from this EM addfile, written to a *.cp2* file (via the Compute2 post processor), may be conveniently brought into ArcView® via **FVS-EMAP**. FVS-EMAP is a custom ArcView® project developed by FHTET, and available for download from FHTET at:

http://www.fs.fed.us/foresthealth/technology/products.htm

Users having an ArcView® shapefile (or an ARC/INFO® coverage) of the stands simulated in FVS, can use FVS-EMAP to **join** the FVS output data with their shapefile, resulting in **map displays** of user-defined COMPUTE variables over simulated time.

The ArcView® legend file that accompanies this package, while not necessary for the ArcView® project to work, facilitates the map creation process when making risk rating maps based on this application's output. If the legend file resides in the 'Legends' subdirectory—immediately subordinate to FVS-EMAP's project directory—then it will be available to the FVS-EMAP ArcView® project to be automatically loaded whenever a MPB hazard rating score is to be mapped. See footnote 2.

References:

Amman, Gene D, Mark D McGregor, Donn B Cahill, and William H Klein. 1977. Guidelines for reducing losses of lodgepole pine to the mountain pine beetle in the Rocky Mountains. USDA Forest Service Gen. Tech. Rep. INT-36. Intermountain Forest and Range Exp. Sta., Ogden, UT. 22pp.

Crookston, Nicholas L. 1990. User's guide to the Event Monitor: Part of Prognosis Model Version 6. USDA Forest Service Gen. Tech. Rep. INT-275. Intermountain Res. Sta., Ogden, UT 29pp. [Electronic Version (modified Sept. 2001) available online: http://www.fs.fed.us/fmsc/fvs/documents/gtrs_event_monitor.php (last accessed 11/01)]

Hopkins, A.D. 1919. The bioclimatic law as applied to entomological research and farm practice. Sci. Mon. 8:496-513.

Randall, Carol B, and Greg Tensmeyer. 200. Hazard rating system for mountain pine beetle in lodgepole pine using the Oracle database and the Forest Service IBM platform. Forest Health Protection Report 00-6. USDA Forest Service, Northern Region, Missoula, MT. 5pp.

Shore, T, and L Safranyik. 1992. Susceptibility and risk rating system for the mountain pine beetle in lodgepole pine stands. Forestry Canada BC-X-336.

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FVS software and documentation is available from the Forest Management Service Center, online at:

http://www.fs.fed.us/fmsc/fvs/

For further information, contact Eric Smith at: elsmith@fs.fed.us . 970 295-5841

Appendix: The *mpb_lpp_RT.kcp* Event Monitor Addfile

Note: users may "clip" the information below into a separate file and use it as an FVS addfile. Copying this information to its own file should be done in such a way as to preserve column spacing. The mono-spaced Courier font used below preserves column spacing.

```
!
!  MPB in LPP Hazard Rating Event Monitor(2) File for FVS (Western Variants)
!
!     PRELIMINARY RELEASE - FOR EVALUATION PURPOSES ONLY
!
!  Prepared Jan, 2001 by: Tony Courter, INTECS International Inc. for
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!
!  Slightly modified 12/01 by Andrew McMahan, INTECS International Inc.
!
!*************************************************************************
! Provided by:
! Forest Health Protection's Forest Health Technology Enterprise Team (FHTET)
!
! Hazard ratings based on:
! "HAZARD RATING SYSTEM FOR MOUNTAIN PINE BEETLE IN LODGEPOLE PINE
!  USING THE ORACLE DATABASE AND THE FOREST SERVICE IBM PLATFORM"
!  by Carol Bell Randall, Entomologist, R-1 Forest Health Protection
!  and Greg Tensmeyer, Management Systems, Idaho Panhandle National
!  Forests, Published by Forest Health Protection, Report 00-6, April 2000
!
!*************************************************************************
! GENERAL INSTRUCTIONS
!*************************************************************************
!
! Target Species:  Lodgepole Pine(LPP)
!
! MPB Hazard decreases with increasing altitude.  As such, the user must
! determine location-specific "elevation breaks" which are used to
! delineate vertically-stratified Hazard zones.  Consult your local
! entomologist prior to defining the Event Monitor variables EBREAK1 &
! EBREAK2 in Code Block 0.  EBREAK1, the higher of the two elevation breaks,
! separates the "low" MPB Hazard from "moderate" MPB Hazard.  EBREAK2, the
! lower elevation break, separates "moderate" MPB Hazard from High MPB Hazard.
!
! Nez Perce Nat'l Forest, Idaho: EBREAK1 = 7400, EBREAK2 = 5800
!
! Nez Perce EBREAKs determined using Shore and Safranyik's (1992)
!   "location factor" index:
!
!   "Low" if elevation > (24.4 * long) - 121.9 * lat) + 5045.1
!   "Mod" if elevation > (24.4 * long) - 121.9 * lat) + 4545.1 (but < above)
!
!   (where "lat" = degrees latitude, and "long" = degrees longitude)
!
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!   and using ~46 degrees latitude, ~116 degrees longitude.
!
!   (EBREAKS above have been rounded to the nearest 100 feet.)
!
!*********************************************************************
! Variable definitions (abbreviations used: BA= basal area; LPP=lodgepole
! pine; QMD= quadratic mean diameter; MPB = mountain pine beetle; TPA =
! trees per acre.)
!*********************************************************************
!
! MPB_HAZ  = the stand MPB hazard score: 1 (extremely low) to 14 (high)
! LPBA     = the BA per acre of LPP.
! STANDBA  = the BA per acre of all trees in the stand.
! PER_PINE = the percentage of basal area LPP relative to total stand BA.
! TPA3     = the total number of all trees per acre greater than 3" dbh.
! QMDLP5   = the QMD of LPP greater than 5" DBH.
! STANDAGE = the age of the stand as reported in the inventory year.
! ELEVFT   = the elevation of the stand in feet.
!
! EBREAK1  = user defined elevation in feet above which MPB Hazard is Low
!            (see Code Block 6)
! EBREAK2  = user defined elevation in feet above which MPB Hazard is
!            Moderate (see Code Block 12)
!
! COUNT = Variable that is used as a incremental counter to insure correct
!         Flow-of-Control within the Event Monitor.  COUNT is used in
!         conditional statements to assure that (seemingly) previously
!         declared conditionals and/or variables are processed in the
!         correct order.
!
! EJECT = Variable flag used to "stop" the stepwise logic once a hazard
!         rating has been determined (i.e. once conditions in one of the
!         "code blocks" has been evaluated to be TRUE)
!
!*********************************************************************

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 0
!
! INITIALIZE VARIABLES prior to evaluation in Step-wise Progression Logic
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

COMPUTE            0

COUNT = 1
EJECT = 0

MPB_HAZ = 99

LPBA     = SPMCDBH(2,LP,0,0,999,0,999,0)
STANDBA  = BBA
PER_PINE = LPBA / BBA
TPA3     = SPMCDBH(1,LP,0,3,999,0,999,0)
QMDLP5   = SPMCDBH(5,LP,0,5,999,0,999,0)
STANDAGE = AGE
ELEVFT   = ELEV

!EBREAK1 =  (remove this and add your values here)
!EBREAK2 =  (remove this and add your values here)

! Above two lines for users to enter their own values (if using values
! different than those below.
! If you want to "preserve" the EBREAKS entered below (i.e. if you want to
! “save” the values but not use them) comment-out the lines below (by entering
```

```
! an exclamation point in the first column) and fill in the EBREAKS that
! you want to use in the two lines above; then "activate" the two lines
! above by removing the leading exclamation points.
! Alternatively, you may delete the values below, and enter your own values
! in the lines below.
! EBREAKS below for Nez Perce
! and calculated using Lat 46 / Long 116, and rounded to nearest 100 foot

EBREAK1 = 7400
EBREAK2 = 5800

END

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Step-wise progression logic.  A stand is assigned an ordinal MPB Hazard
! rating, from one to fourteen (1-14).  The Event Monitor variable COUNT is
! used to assure sequential Flow-of-Control, whereas the variable EJECT
! ceases evaluation of stand conditions as soon as one of the following
! conditions evaluates to "True".  These fourteen blocks of code are
! similar to the CASE statement found in other programming languages.
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 1 - Extremely Low Hazard - Randall & Tensmeyer Hazard = 0
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
PER_PINE EQ 0 AND COUNT EQ 1 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 1
EJECT = 1
END
ENDIF

IF
PER_PINE NE 0 AND COUNT EQ 1 AND EJECT EQ 0
THEN
COMPUTE            0
COUNT = COUNT + 1
END
ENDIF

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 2 - Low Hazard - Randall & Tensmeyer Hazard = 1
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
PER_PINE LT 0.25 AND COUNT EQ 2 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 2
EJECT = 1
END
ENDIF

IF
PER_PINE GE 0.25 AND COUNT EQ 2 AND EJECT EQ 0
THEN
COMPUTE            0
COUNT = COUNT + 1
END
ENDIF
```

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 3 - Low Hazard - Randall & Tensmeyer Hazard = 2
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
( STANDBA LT 80 OR STANDBA GT 250 ) AND COUNT EQ 3 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 3
EJECT = 1
END
ENDIF

IF
STANDBA GE 80 AND STANDBA LE 250 AND COUNT EQ 3 AND EJECT EQ 0
THEN
COMPUTE            0
COUNT = COUNT + 1
END
ENDIF

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 4 - Low Hazard - Randall & Tensmeyer Hazard = 3
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
( TPA3 LT 100 OR TPA3 GT 800 ) AND COUNT EQ 4 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 4
EJECT = 1
END
ENDIF

IF
TPA3 GE 100 AND TPA3 LE 800 AND COUNT EQ 4 AND EJECT EQ 0
THEN
COMPUTE            0
COUNT = COUNT + 1
END
ENDIF

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 5 - Low Hazard - Randall & Tensmeyer Hazard = 4
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
QMDLP5 LT 6.0 AND COUNT EQ 5 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 5
EJECT = 1
END
ENDIF

IF
QMDLP5 GE 6.0 AND COUNT EQ 5 AND EJECT EQ 0
THEN
COMPUTE            0
COUNT = COUNT + 1
END
ENDIF
```

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 6 - Low Hazard - Randall & Tensmeyer Hazard = 4.5
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
ELEVFT GT EBREAK1 AND COUNT EQ 6 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 6
EJECT = 1
END
ENDIF

IF
ELEVFT LE EBREAK1 AND COUNT EQ 6 AND EJECT EQ 0
THEN
COMPUTE            0
COUNT = COUNT + 1
END
ENDIF

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 7 - Low Hazard - Randall & Tensmeyer Hazard = 4.75
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
STANDAGE LT 60 AND COUNT EQ 7 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 7
EJECT = 1
END
ENDIF

IF
STANDAGE GE 60 AND COUNT EQ 7 AND EJECT EQ 0
THEN
COMPUTE            0
COUNT = COUNT + 1
END
ENDIF

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 8 - Moderate Hazard - Randall & Tensmeyer Hazard = 5
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
PER_PINE GE 0.25 AND PER_PINE LT 0.50 AND COUNT EQ 8 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 8
EJECT = 1
END
ENDIF

IF
PER_PINE GE 0.50 AND COUNT EQ 8 AND EJECT EQ 0
THEN
COMPUTE            0
COUNT = COUNT + 1
END
ENDIF
```

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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 9 - Moderate Hazard - Randall & Tensmeyer Hazard = 6
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
STANDBA GE 80 AND STANDBA LT 120 AND COUNT EQ 9 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 9
EJECT = 1
END
ENDIF

IF
STANDBA GE 120 AND COUNT EQ 9 AND EJECT EQ 0
THEN
COMPUTE            0
COUNT = COUNT + 1
END
ENDIF

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 10 - Moderate Hazard - Randall & Tensmeyer Hazard = 7
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
((TPA3 GE 100 AND TPA3 LT 300) OR (TPA3 GE 600 AND TPA3 LE 800)) AND &
  COUNT EQ 10 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 10
EJECT = 1
END
ENDIF

IF
TPA3 GE 300 AND TPA3 LT 600 AND COUNT EQ 10 AND EJECT EQ 0
THEN
COMPUTE            0
COUNT = COUNT + 1
END
ENDIF

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 11 - Moderate Hazard - Randall & Tensmeyer Hazard = 8
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
QMDLP5 LT 8.0 AND COUNT EQ 11 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 11
EJECT = 1
END
ENDIF

IF
QMDLP5 GE 8.0 AND COUNT EQ 11 AND EJECT EQ 0
THEN
COMPUTE            0
COUNT = COUNT + 1
END
ENDIF
```

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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 12 - Moderate Hazard - Randall & Tensmeyer Hazard = 9
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
ELEVFT GT EBREAK2 AND ELEVFT LE EBREAK1 AND COUNT EQ 12 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 12
EJECT = 1
END
ENDIF

IF
ELEVFT LE EBREAK2 AND COUNT EQ 12 AND EJECT EQ 0
THEN
COMPUTE            0
COUNT = COUNT + 1
END
ENDIF

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 13 - Moderate Hazard - Randall & Tensmeyer Hazard = 9.5
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
STANDAGE GE 60 AND STANDAGE LT 80 AND COUNT EQ 13 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 13
EJECT = 1
END
ENDIF

IF
STANDAGE GE 80 AND COUNT EQ 13 AND EJECT EQ 0
THEN
COMPUTE            0
COUNT = COUNT + 1
END
ENDIF

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Code Block 14 - High Hazard - Randall & Tensmeyer Hazard = 10
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
COUNT EQ 14 AND EJECT EQ 0
THEN
COMPUTE            0
MPB_HAZ = 14
EJECT = 1
END
ENDIF
```