TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE Portland, Oregon SOIL CONSERVATION SERVICE

FORESTRY NO. 17 Rev May 1986

HP-41CV "WOOD" PROGRAM FOR ZIG ZAG TRANSECT DATA SUMMARY

Program Number SCS-OR-ENG-85-5

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Reference: USDA Technical Bulletin No. 201, Rev. October 1949.

USDA Technical Bulletin No. 630.

OR-WOOD-1, USDA SCS Woodland Planning Worksheet, Portland, OR, July 1, 1969.

National Forestry Manual, USDA SCS, US Government Printing Office, Washington, D.C., September 1980.

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WOOD

Program Description

This program calculates the percent of each species (up to 5) inventoried, average tree spacing, average breast height diameter, existing D+ spacing, desired D+ spacing, actual trees per acre, desired trees per acre, excess trees per acre and the percentage of good, fair and poor trees. The calculations are based on data collected using the zig-zag transect. Input data includes an abbreviated species type, distance between trees in feet, diameter at breast height (DBH) of individual trees in inches and the individual tree condition of good, fair or poor.

The desired D+ spacing can be designated by the user (see Oregon Specification 654 for recommendations), or calculated based on Site Index supplied by the user. On the westside, Douglas-fir stands use Site Index derived from McArdle's 100-year base site curves, USDA technical bulletin no. 201. For the eastside, Douglas-fir and Ponderosa pine stands use Site Index derived from Meyer's 100-year curves, USDA technical bulletin no. 630. D+ spacing will correspond to recommended spacing in Oregon Woodland Inproved Harvesting Specification 654.

The results of the program will be accurate and representative of the unit being measured, provided that transects are located in typical parts of the forest stand. More than one transect may be needed per unit.

The zig-zag transect information is to be used for planning purposes only. Do not attempt to use for yield or valuation estimates. For instructions on the use of the zig-zag transect, see Part 535, Subpart B in the National Forestry Manual.

B. Equipment

This program is designed to run on the HP-41 series calculator with or without a printer attached. The HP-41 should have at least 319 registers of available memory for the program to run properly. The standard HP printer (82143A) or the HP-IL printer (82162A) may be used. The HP card reader (82104A) must be used to load the program by magnetic cards into the calculator memory. The HP tape drive (82161A) may be used to load the program from mini cassette tape.

WOOD

C. Instructions to Load Program

1. Turn the printer, tape drive and calculator on and position the print mode switch to the manual (**MAN**) position.
2. Clear all key assignments in the top row of the calculator keyboard by pressing keys [] (SHIFT), **ASN**, **ALPHA**, **ALPHA**, and each key in the top row. If no key assignments have been made to these keys, simply continue to the next step.
3. Press keys **XEQ ALPHA S I Z E ALPHA 110.**
4. Press keys [] (SHIFT) **GTO . .**
5. Insert the 7 magnetic cards labeled **WOOD** , sides 1 through 13 into the card reader or insert the proper mini cassette into the tape drive, press keys **ALPHA W O O D ALPHA** and **XEQ ALPHA R E A D P ALPHA.**

NOTE: If **TRY AGAIN** is displayed in step 3 or in step 5, some of the existing program memory will have to be cleared or additional memory added before the program can be loaded.

D. Instructions to Run Program

If the program is already loaded into the calculator memory, press keys **XEQ ALPHA W O O D ALPHA.** The calculator should respond by displaying **DESIRED D+=?** if no printer is attached or **OWNER-?** if a printer is attached. If you are loading the program by magnetic cards, the program will automatically start to run as soon as the last card is read into the card reader. If the program is not in the calculator memory, see the instructions to load program.

WOOD

User Instructions
SIZE-110

Step	Display	Instruction	Press Key
1.	OWNER-?	Key in the landowners name.	R/S
2.	ASSISTED BY-?	Key in your name.	R/S
3.	DATE-?	Key in the month (1-12).	R/S
4.	DATE-xx/?	Key in the day (1-31).	R/S
5.	DATE-xx/xx/?	Key in the year (19xx).	R/S
6.	DESIRED D+=?	Key in the desired D+ spacing in feet and go to step 9. If unknown press R/S and continue.	R/S
7.	SITE INDEX=?	Key in the Site Index of the predominate species.	R/S
8.	E OR W	Press the A (blue letter) key if the site inventoried is on the Eastside of the Cascade Mountains.	EAST-A(blue)
		Press the E (blue letter) key if the site inventoried is on the Westside of the Cascade Mountains.	WEST-E(blue)
9.	1. SPECIES?	Key in a letter code of the species encountered during the transect.	
		Examples; Western Hemlock-	WH
		Douglas Fir-	DF
		White Fir-	WF
		Port Orford Cedar-	POC
			R/S
10.	DIST=?FT	Key in the distance in feet between the previous and current tree of the transect. To correct data previously entered, press R/S and go to step 9.	R/S
11.	DBH=?IN	Key in the diameter of the current tree in inches. To correct data previously entered, press R/S and go to step 9.	R/S

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WOOD

E. User Instructions Continued

Step	Display	Instruction	Press Key
12.	G F P	Press the key in the top row of the keyboard associated with the letters displayed to indicate if the tree is in good, fair or poor condition.	
		Good Condition- **G**	**A**(blue)
		Fair Condition- **F**	**C**(blue)
		Poor Condition- **P**	**E**(blue)
		To correct data previously entered, press **R/S** and go to step 9.	
13.	2. SPECIES?	Repeat steps 9 through 12 for all of the data to be entered and press **R/S** at step 9 if the number of trees inventoried is less than 20.	**R/S**
		If no printer is attached, go to step 16 once all the data has been entered.	
14.	DATA OK? Y/N	If a printer is attached, the input data will be printed. If the data is okay, key in **Y** for yes and go to step 16.	**R/S**
		If there is a mistake in the data entered, key in **N** for no and continue.	**R/S**
15.	TREE NO?	Key in the number of the tree for which the data was entered incorrectly and repeat steps 9 through 12 and step 14.	**R/S**
16.	WORKING	The calculator will sort the data entered and compute the summary data. Run time is approximately 40 seconds.	
17.	AVG SPC=xxFT	The summary data will be printed if a printer is attached, see example problems for format.	
		If no printer is attached, the summary data will be displayed. Press **R/S** after viewing each answer.	**R/S**

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WOOD

E. User Instructions Continued

Step	Display	Instruction	Press Key
18.	END PRGM	The symbol for the termination of program execution will be displayed. All data is saved and can be reprinted or displayed by executing the following steps- To print data- 1. Insure calculator is off. 2. Attach printer. 3. Turn printer and calculator on. 4. Press R/S. To view summary data only- 1. Turn calculator on. 2. press R/S. See instructions to run program to repeat the program for another transect.	

F. Program Limits

The Site Index must be between 0 and 250 or it will be prompted for again.

The species abbreviation must be entered the same each time for the program to sort the data correctly.

Data may be entered for 1 to 20 trees but no more than 20 trees due to the storage limitations of the calculator.

WOOD

G. Example Problems

Example Problem #1-

Given- Transect site on the westside of cascades.
Site Index= 170

Species	Distance feet	Diameter inches	Condition
Western Hemlock	10	14	Good
Douglas Fir	10	15	Good
Douglas Fir	18	16	Good
Douglas Fir	15	16	Good
Douglas Fir	9	20	Good
Douglas Fir	5	8	Fair
Western Hemlock	12	6	Poor
Douglas Fir	3	8	Fair
Douglas Fir	5	8	Fair
Douglas Fir	8	16	Good
Douglas Fir	18	20	Good
Douglas Fir	12	18	Good
Douglas Fir	14	18	Good
Douglas Fir	32	12	Fair
Douglas Fir	18	16	Good
Douglas Fir	16	20	Good
Douglas Fir	30	16	Good
Douglas Fir	21	14	Good
Douglas Fir	36	18	Fair
Douglas Fir	2	12	Good

Solution-

OWNER-EXAMPLE 1
ASSISTED BY- B WILSON
DATE-12/16/1985

U S D A S C S
Z I G - Z A G
T R A N S E C T

SPECIES	DIST FT	DIA IN	COND
1. WH	10	14	GOOD
2. DF	10	15	GOOD
3. DF	18	16	GOOD
4. DF	15	16	GOOD
5. DF	9	20	GOOD
6. DF	5	8	FAIR
7. WH	12	6	POOR
8. DF	3	8	FAIR
9. DF	5	8	FAIR
10.DF	8	16	GOOD
11.DF	18	20	GOOD
12.DF	12	18	GOOD
13.DF	14	18	GOOD
14.DF	32	12	FAIR
15.DF	18	16	GOOD
16.DF	16	20	GOOD
17.DF	30	16	GOOD
18.DF	21	14	GOOD
19.DF	36	18	FAIR
20.DF	2	12	GOOD

S U M M A R Y
WEST SITE INDEX=170
AVG SPC=15FT
AVG DBH=15IN
D+X=0
DESRD D+X=5
TREES/AC=194
DESRD/AC=109
EX TREES=85
DIA= 6 TO 20 IN

SPECIES-
90% DF
10% WH

QUALITY-
GOOD=70%
FAIR=25%
POOR=5%

WOOD

H. Program Listing

```
01♦LBL "WOOD"
02 FIX 0
03 CLRG

04♦LBL 15
05 CF 29
06 FC? 55
07 GTO 00
08 SF 21
09 AON
10 "OWNER-"
11 ACA
12 "⊢?"
13 PROMPT
14 ACA
15 PRBUF
16 "ASSISTED BY-"
17 ACA
18 ASTO X
19 CLA
20 ARCL X
21 "⊢ED BY?"
22 PROMPT
23 ACA
24 PRBUF
25 AOFF
26 "DATE-"
27 ASTO 00
28 "⊢?"
29 PROMPT
30 CLA
31 ARCL 00
32 ARCL X
33 "⊢/?"
34 PROMPT
35 CLA
36 ARCL 00
37 ARCL Y
38 "⊢/"
39 ARCL X
40 ACA
41 "⊢/?"
42 PROMPT
43 "/"
44 ARCL X
45 ACA
46 PRBUF
47 ADV
48 SF 12
49 " USDA SCS"
50 PRA
51 " ZIG-ZAG"
52 PRA
53 " TRANSECT"
54 PRA
55 CF 12
56 ADV
57 9
58 SKPCHR
59 "DIST  DIA"
60 ACA
61 PRBUF
62 "SPECIES  FT  "
63 "⊢ IN  COND"
64 PRA
65 FS? 00
66 GTO 02

67♦LBL 00
68 CLX
69 "DESIRED D+=?"
70 PROMPT
71 X≠0?
72 GTO 01

73♦LBL 19
74 CLX
75 "SITE INDEX=?"
76 PROMPT
77 X=0?
78 GTO 19
79 STO 02
80 250
81 X<Y?
82 GTO 19

83♦LBL 20
84 SF 27
85 " E  OR  W"
86 PROMPT
87 GTO 20

88♦LBL A
89 "EAST"
90 ASTO 03
91 12.09
92 -44 E-3
93 GTO 00

94♦LBL E
95 "WEST"
96 ASTO 03
97 9.25
98 -25 E-3

99♦LBL 00
100 RCL 02
101 *
102 +
103 RND

104♦LBL 01
105 STO 01
106 30.109
107 STO 00
108 1.021
109 STO 04

110♦LBL 21
111 CF 23
112 SF 29
113 CLA
114 AON
115 ARCL 04
116 "⊢ SPECIES?"
117 PROMPT
118 AOFF
119 FC? 23
120 GTO 02
121 "⊢  "
122 ASTO IND 00
123 CF 22
124 ISG 00
125 "DIST=?FT"
126 PROMPT
127 STO IND 00
128 FC? 22
129 GTO 16
130 ISG 00
131 CF 22
132 "DBH=?IN"
133 PROMPT
134 STO IND 00
135 FC? 22
136 GTO 16
137 ISG 00
138 SF 27
139 " G  F  P"
140 PROMPT
141 CF 27
142 GTO 16

143♦LBL A
144 22
145 GTO 00

146♦LBL C
147 23
148 GTO 00

149♦LBL E
150 24
```

WOOD

Program Listing Continued

```
151♦LBL 00
152 STO IND 00
153 CF 27
154 FS? 01
155 GTO 32
156 RCL 00
157 INT
158 1 E3
159 /
160 STO 25
161 ISG 04
162 ISG 00
163 GTO 21

164♦LBL 02
165 FC? 55
166 GTO 40
167 RCL 25
168 30
169 +
170 STO 00
171 1.021
172 STO 04

173♦LBL 32
174 XEQ 88
175 RCL 29
176 FS? 01
177 STO 00
178 CLA
179 SF 29
180 ARCL 04
181 CF 29
182 10
183 RCL 04
184 X<Y?
185 "⊢ "
186 ARCL IND 00
187 ACA
188 ISG 00
189 4
190 RCL IND 00
191 ACX
192 LOG
193 INT
194 -
195 SKPCHR
196 ISG 00
197 CLA
198 3
199 RCL IND 00
200 ACX
201 LOG
202 INT
203 -
204 SKPCHR
205 ISG 00
206 RCL IND 00
207 XEQ IND X
208 ACA
209 PRBUF
210 FS?C 01
211 GTO 33
212 ISG 04
213 ISG 00
214 GTO 32
215 GTO 33

216♦LBL 22
217 "GOOD"
218 RTN

219♦LBL 23
220 "FAIR"
221 RTN

222♦LBL 24
223 "POOR"
224 RTN

225♦LBL 33
226 AON
227 "DATA OK? Y/N"
228 PROMPT
229 ASTO X
230 AOFF
231 "Y"
232 ASTO Y
233 X=Y?
234 GTO 40
235 "N"
236 ASTO Y
237 X≠Y?
238 GTO 33
239 SF 01
240 "CORRECTION"
241 PRA
242 "TREE NO.?"
243 PROMPT
244 STO 04
245 CF 00

246♦LBL 16
247 RCL 04
248 INT
249 4
250 *
251 26.109
252 +
253 STO 00
254 STO 29
255 GTO 21

256♦LBL 40
257 FS?C 00
258 GTO 10
259 32
260 XEQ 88
261 1 E-3
262 -
263 STO 00
264 RCL 32
265 STO 16
266 STO 17
267 CLX
268 STO 05
269 STO 06
270 STO 22
271 STO 23
272 STO 24

273♦LBL 25
274 RCL 16
275 RCL IND 00
276 ST+ 05
277 X<Y?
278 STO 16
279 RCL 17
280 X<>Y
281 X>Y?
282 STO 17
283 ISG 00
284 GTO 25
285 30
286 XEQ 88
287 3 E-3
288 -
289 STO 00
290 RCL 30
291 STO 11
292 11.015
293 STO 04
294 21 E-3
295 STO 15

296♦LBL 26
297 RCL 11
298 RCL IND 00
299 X=Y?
300 ISG 18
301 GTO 01
302 GTO 04
```

WOOD

H. Program Listing Continued

```
303♦LBL 01
304 RCL 19
305 X=0?
306 XEQ 05
307 RCL 12
308 RCL IND 00
309 X=Y?
310 ISG 19
311 GTO 02
312 GTO 04

313♦LBL 02
314 RCL 20
315 X=0?
316 XEQ 05
317 RCL 13
318 RCL IND 00
319 X=Y?
320 ISG 20
321 GTO 03
322 GTO 04

323♦LBL 03
324 RCL 21
325 X=0?
326 XEQ 05
327 RCL 14
328 RCL IND 00
329 X=Y?
330 ISG 21
331 ISG 15

332♦LBL 04
333 ISG 00
334 GTO 26
335 GTO 00

336♦LBL 05
337 RCL IND 00
338 ISG 04
339 STO IND 04
340 RTN

341♦LBL 00
342 26.029
343 STO 10

344♦LBL 27
345 18.021
346 STO 00
347 RCL 18
348 STO 04
349♦LBL 28
350 RCL 04
351 RCL IND 00
352 X>Y?
353 STO 04
354 ISG 00
355 GTO 28
356 RCL 04
357 STO IND 10
358 X=0?
359 GTO 01
360 RCL 18
361 X≠Y?
362 GTO 00
363 CLX
364 STO 18
365 11 E-2
366 GTO 01

367♦LBL 00
368 RDN
369 RCL 19
370 X≠Y?
371 GTO 00
372 CLX
373 STO 19
374 12 E-2
375 GTO 01

376♦LBL 00
377 RDN
378 RCL 20
379 X≠Y?
380 GTO 00
381 CLX
382 STO 20
383 13 E-2
384 GTO 01

385♦LBL 00
386 RDN
387 RCL 21
388 X≠Y?
389 GTO 00
390 CLX
391 STO 21
392 14 E-2
393 GTO 01

394♦LBL 00
395 CLX

396♦LBL 01
397 ST+ IND 10
398 ISG 10
399 GTO 27
400 31
401 XEQ 88
402 2 E-3
403 -
404 STO 00

405♦LBL 30
406 RCL IND 00
407 ST+ 06
408 ISG 00
409 GTO 30
410 33
411 XEQ 88
412 STO 00

413♦LBL 31
414 RCL IND 00
415 1
416 ST+ IND Y
417 ISG 00
418 GTO 31
419 RCL 00
420 INT
421 33
422 -
423 4
424 /
425 ST/ 05
426 ST/ 06
427 RCL 06
428 RND
429 STO 06
430 RCL 05
431 RND
432 STO 05
433 -
434 STO 07
435 43560
436 STO 04
437 RCL 06
438 X↑2
439 /
440 STO 08
441 RCL 04
442 RCL 01
443 RCL 05
444 +
445 X↑2
446 /
447 STO 09
448 -
449 STO 10
```

WOOD

1. Program Listing Continued

```
450♦LBL 10
451 CF 29
452 FC? 55
453 GTO 00
454 ADV
455 SF 12
456 "SUMMARY"
457 PRA
458 CF 12
459 RCL 02
460 X=0?
461 GTO 00
462 CLA
463 ARCL 03
464 "⊢ SITE INDEX="
465 ARCL 02
466 PRA

467♦LBL 00
468 FC? 55
469 TONE 9
470 "AVG SPC="
471 ARCL 06
472 "⊢FT"
473 AVIEW
474 "AVG DBH="
475 ARCL 05
476 "⊢IN"
477 AVIEW
478 "D+X="
479 ARCL 07
480 AVIEW
481 "DESRD D+X="
482 ARCL 01
483 AVIEW
484 "TREES/AC="
485 ARCL 08
486 AVIEW
487 "DESRD/AC="
488 ARCL 09
489 AVIEW
490 "EX TREES="
491 ARCL 10
492 AVIEW
493 "DIA="
494 ARCL 16
495 "⊢ TO "
496 ARCL 17
497 FS? 55
498 "⊢ IN"
499 AVIEW
500 FC? 55
501 GTO 00
502 ADV
503 "SPECIES-"
504 PRA

505♦LBL 00
506 26.029
507 STO 00

508♦LBL 35
509 CLA
510 RCL IND 00
511 X=0?
512 GTO 00
513 XEQ "X"
514 RCL IND 00
515 XEQ "Y"

516♦LBL 00
517 ISG 00
518 GTO 35
519 RCL 15
520 INT
521 X=0?
522 GTO 00
523 "OTHER="
524 XEQ "X"
525 AVIEW

526♦LBL 00
527 FC? 55
528 GTO 00
529 ADV
530 "QUALITY-"
531 PRA

532♦LBL 00
533 "GOOD="
534 RCL 22
535 XEQ "X"
536 AVIEW
537 "FAIR="
538 RCL 23
539 XEQ "X"
540 AVIEW
541 "POOR="
542 RCL 24
543 XEQ "X"
544 AVIEW
545 SF 29
546 FIX 2
547 "END PRGM"
548 CF 21
549 PROMPT
550 SF 21
551 FIX 0
552 FC? 55
553 GTO 10
554 SF 00
555 GTO 15

556♦LBL 88
557 CF 21
558 "WORKING"
559 AVIEW
560 SF 21
561 RCL 25
562 +
563 4 E-5
564 +
565 RTN

566♦LBL "X"
567 INT
568 RCL 22
569 RCL 23
570 +
571 RCL 24
572 +
573 /
574 1 E2
575 *
576 ARCL X
577 "⊢% "
578 RTN

579♦LBL "Y"
580 FRC
581 1 E2
582 *
583 ARCL IND X
584 AVIEW
585 END
```

WOOD

I. System Configuration

Data Registers

R00- Indirect Register
R01- Desired D+X
R02- Site Index
R03- West or East
R04- 43,560
     Indirect Register
R05- AVG DBH in feet
     Sum of DBH's
R06- AVG Spacing in feet
     Sum of spacings
R07- D+X
R08- Trees per acre
R09- Desired trees per acre
R10- Excess trees per acre
R11- Species type #1
R12- Species type #2
R13- Species type #3
R14- Species type #4
R15- Number of other species types
R16- Smallest diameter tree in inches
R17- Largest diameter tree in inches
R18- Number of species type #1
R19- Number of species type #2
R20- Number of species type #3
R21- Number of species type #4
R22- Number of trees in good condition
R23- Number of trees in fair condition
R24- Number of trees in poor condition
R25- Indirect storage register
R26- Largest percent of species
R27- Second largest percent of species
R28- Third largest percent of species
R29- Smallest percent of species
     Indirect Register
R30 to R109- Input Data

Status

Size- 110
Total Registers Reqd- 319
User Status- off

Flags

#	Initial S/C	Set Indicates	Clear Indicates
00	C	Print output only	Nonactive
01	C	Correcting data	Nonactive
12	C	Enlarged Print	Normal Print
21	S or C	Printer Enabled	Printer Disabled
22	C	Numeric Input	No Numeric Input
23	C	Alpha Input	No Alpha Input
27	S or C	User Status On	User Status Off
29	S	Decimal Set	No Decimal Set
55	S or C	Printer Attached	No Printer Attached

WOOD

I. Program Algorithms

Definition of Terms-

AVG DBH- Average diameter of tree at breast height in inches.

AVG SPC- Average spacing of trees in feet.

DESRD D+X- Value of X to determine tree spacing desired in feet.

DESRD/AC- Number of trees per acre desired.

DIA- Diameter range of trees measured in inches.

D+X- Value of X to determine tree spacing measured in feet.

EX TREES- Number of excess trees per acre positive or negative.

SITE INDEX- Height of tree at 100 years of age.

TREES/AC- Number of trees per acre measured.

Equations-

AVG SPC=(sum of tree spacing)/20

AVG DBH=(sum of DBH's measured)/20

D+X= AVG SPC - AVG DBH

Westside-

DESRD D+X=((SITE INDEX) x -0.025) + 9.25

Eastside-

DESRD D+X=((SITE INDEX) x -0.044) + 12.09

$$\text{TREES/AC} = 43{,}560 / (\text{AVG SPC})^2$$

$$\text{DESRD/AC} = 43{,}560 / (\text{AVG DBH} + \text{DESRD D+X})^2$$

EX TREES= TREES/AC - DESRD/AC

WOOD

K. Program Magnetic Cards

Program cards available upon request from state staff forester or area foresters.