Penn State Oak Regeneration Guidelines (Version 1.1 5120104)

Introduction:

These guidelines are designed to aid forest managers in securing adequate oak regeneration before harvesting oak-dominated stands. What comprises "adequate" oak regeneration may vary from stand to stand. The guidelines provide a method for measuring a stand's oak regeneration potential in advance of harvest. The user must decide whether a stand's regeneration potential, measured in oak stocking in the third-decade after harvest, meets his or her regeneration goal.

The guidelines contain three parts. The first part describes procedures for collecting the data to estimate a stand's oak regeneration potential from seed-origin regeneration and stump sprouts, and 2) identify barriers to regeneration success. Work forms are included for collecting and summarizing seed-origin and sprout-origin data. The second part consists of two decision charts designed to determine an appropriate prescription based on stand conditions and the user's regeneration goal. Prescriptions are described in detail in the third part of the guidelines.

The guidelines augment professional judgment; they do not replace it. Although the guidelines are based on current research, it is not possible to identify every situation encountered in practice. Prescriptions should be adapted based on specific conditions and professional experience. As new research results become available, the guidelines will be revised to reflect our expanded understanding of the regeneration process.

I. Data Collection

Collect regeneration data using the Seed-Origin Oak Regeneration Work Form (pg l0) and the Sprout-Origin Oak Regeneration Work Form (pg 11). Measure 12 plots in stands of 15 acres or less. Add one additional plot per acre for stands over 15 acres, up to a maximum of 30 plots. Advanced oak regeneration is measured on milacre (3.7 ft radius) plots. Competing vegetation and sprout-origin regeneration data are collected on 1/20th acre (26.3 ft radius) plots. Use the same plot center for both plots.

A. Seed-Origin Regeneration Work Form

A1. Measure advance oak regeneration on milacre plots. On each plot, measure heights of all oaks at least l-yr-old and < 2" dbh (include larger stems if they will not be cut). Stems ≥ 1 ft may be measured to the nearest foot. Consider smaller stems as 0.5 ft tall. Add the heights together and record in Table 1 under "Total Height."

A2. Determine the "Stocking Value" from Table 2 that corresponds to the plot's total height Record the stocking value under "Plot Stocking" in Table 1.

A3. Assign the 2Oth acre (26.3 ft radius) around each plot to a vegetation cover class using the Vegetation Classification Guide (Table 3). Reading the guide from top to bottom, find the first class that describes the plot. For example, a plot that meets the criteria for both the "F" class and the "ML" class is assigned to the "F" class. Circle the appropriate code under "Vegetation Cover Class" in Table 1. Once a code is circled, underline any other classes that

apply. Except where stated otherwise, estimate cover looking downward from 5 ft above the plot. Use the Cover Guide (Figure 1) to aid in determining percentage cover.

A4. Record sprout-origin data (see instructions below) before moving to the next plot.

A5. Data summary. Count the number of plots where total height was > 0 (i.e., at least one stem of advance oak regeneration was present) record the sum in the "Totals" row, beside ">0", Do the same for plots where total height was ≥ 10 ft.

A6. Sum the values in the "Plot Stocking" column. Record the sum in the "Totals" row.

A7. Count the number of plots assigned to each vegetation cover class (circled codes)'. Record these sums in the "Totals" row. Each plot should be counted once. Do not count codes that are underlined.

A8. Calculate the percentage of plots where total height was > 0 by dividing the count by the number of plots measured and multiplying the product by 100. For example: 25 of 30 plots had a total height > 0, so the percentage of plots is 25 / 30 x 100 = 83%. Use the same procedure to calculate the percentage of plots where total height was ≥ l0 ft and the percentage of plots assigned to each vegetation cover class. Record these percentages in the "Percentages" row.

A9. Calculate seed-origin oak stocking by dividing the “Plot-Stocking” total by the number of plots measured. Record under "Seed-Origin Oak Stocking.” This value represents expected seed-origin oak stocking in the third-decade after harvest.

B. Sprout-Origin Regeneration WorkForm

B1. Collect data on 1/20th acre plots (26.3 ft radius). On each plot, measure the dbh (by diameter Class in Table 4) for all oaks ≥ 2 in. Use dot tallies to tally oaks under the apprpriate species names and diameter classes in Table 4. For example, a 16" black oak would be tallied in the “Black Oak” row and the "15-18 (inch)" column. Tally oaks from all plots together.

B2. Data summary. After measuring the last plot, calculate the average plot density of each species and diameter class. First, sum the dot tallies by species and diameter class. Second, record the total number of overstory plots measured in the "N" rows. Next, divide each tally total by N. Round to one decimal place and record this number in the “Average Density”

row. For example: 11 black oaks were tallied in the 15-18" diameter class on 30 plots, the average density is 11 /30 = 0.37 = 0.4.

B3. Multiply the average densities by the "Stocking Factors" and enter the products, with one decimal place, in the "Sprout Stocking" rows. For example: an average of 0.4 black oak were tallied in the 15-18" diameter class, stocking = 0.4 x 3.3 = 1.3

B4. Sum the sprout stocking values for each species and record the sum at the far right of the row, under "Species Total."

B5. Sum species totals and record under "Sprout-Origin Stocking:' This value represents expected sprout-origin stocking in the third-decade after harvest.

II. Determining a Prescription

1. Fill out the Regeneration Data Summary (Table 5) on page 12. Record the seed-origin oak stocking value calculated on the Seed-Origin Oak Regeneration Work Form. Likewise, record the sprout-origin oak stocking value calculated on the Sprout-Origin Oak Regeneration Work Form. Sum the two stocking values and record under "Total Oak Stocking". This represents expected oak stocking in the dominant, codominant, and intermediate crown classes during the third-decade after harvest. Record the percentage of plots in each vegetation class from the Seed-Origin Oak Regeneration Work Form. Sum the percentage of plots in the “F”, “ML”, "T", and ″OT” vegetation cover classes and record the sum under "Inhibiting Vegetation." Record the percentage of plots with total heights > 0 ft and the percentage with total heights ≥ 10 ft.

2. Use Charts I and II to determine a prescription to meet your regeneration goal. Begin at the top of Chart I. First consider whether "Total Oak Stocking" is consistent with the desired future stand condition. As a guide, oak stocking >50 percent represents an oak-dominated

stand during the third-decade after harvest. Oak stocking of 30-50 percent represents a strong oak component during the third-decade after harvest, with other species occupying the majority of the stand. Oak stocking of 15 to 30 percent represents a minor oak component and <15 percent represents little or no oak. Use this information to answer the first question .
on Chart I.

3. Follow Chart I and, if needed, Chart II until a prescription is found. Questions include reference numbers to find necessary information in Table 5. Prescriptions are described in detail below.

III. Prescriptions

Prescription I: Overstory Removal

The oak regeneration potential is adequate to regenerate the stand with an overstory removal. If expected total oak stocking is < 50 percent, the stand may not fully regenerate unless sources of non-oak regeneration are also present. Other resources should be used to determine the adequacy of non-oak regeneration. All, or most, stems > 2" dbh should be felled. Basal spraying of non-oak seedlings and saplings is recommended if inhibiting vegetation, primarily of class T, occurs on ≥ 60 percent of plots. The presence of abundant advanced oak regeneration indicates that deer browsing is not likely to inhibit regeneration success; therefore a fence is not recommended unless prior experience in the area suggests otherwise.

Prescription II: Overstory Removal with Post-Harvest Fence

The stand is ready to regenerate with an overstory removal. If expected total oak stocking is < 50 percent, the stand may not regenerate adequately unless source of non-oak regeneration are also present. Other resources should be used to determine the adequacy of non-oak regeneration All, or most, stems > 2" dbh should be felled. Basal spraying of non-oak seedlings and saplings is recommended if inhibiting vegetation, primarily of class T, occurs on ≥ 60 percent of plots. The lack of abundant advanced oak regeneration may indicate that deer browsing will inhibit regeneration success; therefore a post-harvest fence is recommended to maintain the current potential for oak regeneration. The fence should be constructed as soon as possible after the overstory removal is complete.

Prescription 111: *She/terwood and Fence*

A shelterwood treatment is recommended to improve the growth of existing advanced oak regeneration. Up to one-half of the initial basal area should be removed, but the residual stand should have more or less continuous canopy cover. Non-oaks should be the first trees marked for removal. Research results indicate overstory black birch and red maple strongly impact future stand composition. Consequently, all stems of these species should be removed where possible. Fencing is recommended after treatment. Understory vegetation does not appear to inhibit the establishment and growth of regeneration at this time and no understory treatments are recommended. The stand should be reevaluated two years following treatment.

Prescription IV. Understory Treatment and Fence

An Understory treatment to reduce inhibiting vegetation is recommended. Review the Vegetation Cover Class data recorded in Table 1 to formulate a prescription. Broadcast herbicide treatments are effective for controlling rhizomonous ferns, but may be less effective for mountain-laurel and tree vegetation. A basal herbicide application may be most effective for controlling tree vegetation. Prescribed fire, if it can be used, is another option for controlling inhibiting vegetation. Mechanical treatments, such as mowing, may be effective for treating mountain-laurel. Fencing is recommended after treatment to protect newly established seedlings. An overstory treatment is not recommended, as the understory treatment will likely negate its benefit to oak regeneration. The stand should be reevaluated two years after treatment.

Prescription V: Understory Treatment, Shelterwood, and Fence

An understory treatment to reduce inhibiting vegetation is recommended (see Prescription IV). In addition, the current level of advanced oak regeneration suggests that a shelterwood treatment may be appropriate (see Prescription Ill). However, the understory treatment (especially broadcast herbicide) may reduce the level of advanced oak regeneration. Understory treatments that are not expected to reduce advanced oak regeneration (i.e., prescribed burning, mowing, basal herbicide applications) may be done in conjunction with a shelterwood. Alternately, a shelterwood without an understory treatment may be appropriate if the level of inhibiting vegetation is only marginally high (30 - 40 percent of plots). Fencing is recommended to protect existing seedlings and allow new seedling to establish.

Prescription VI: Fence in Advance. Consider Shelterwood Or wait

Fencing is recommended to allow oak regeneration to establish without high levels of deer browsing. Understory vegetation does not appear to be a factor inhibiting the establishment and growth of oak regeneration. The current level of advanced oak regeneration appears too low to

benefit from an overstory treatment. However, a light shelterwood treatment (< 25 percent removal, mainly in smaller trees) may stimulate the establishment of new oak regeneration in some cases. The benefit of a shelterwood treatment must be weighed against the possibility that it will stimulate the establishment and growth of undesirable non-oak regeneration. Professional judgement and past experience should be used to determine whether this treatment is appropriate. Alternately, no treatments may be appropriate at this time and the stand should be reevaluated in 2 yrs.

Stand _____ Date _____ Collected by _____

Seed-Origin Oak Regeneration Work Form (Version 1.1)

Table 1. Understory Data Collection

	Total Height	Plot Stocking	Vegetation Cover Class					
Plot 1			F	ML	BB	T	OT	NO
Plot 2			F	ML	BB	T	OT	NO
Plot 3			F	ML	BB	T	OT	NO
Plot 4			F	ML	BB	T	OT	NO
Plot 5			F	ML	BB	T	OT	NO
Plot 6			F	ML	BB	T	OT	NO
Plot 7			F	ML	BB	T	OT	NO
Plot 8			F	ML	BB	T	OT	NO
Plot 9			F	ML	BB	T	OT	NO
Plot 10			F	ML	BB	T	OT	NO
Plot 11			F	ML	BB	T	OT	NO
Plot 12			F	ML	BB	T	OT	NO
Plot 13			F	ML	BB	T	OT	NO
Plot 14			F	ML	BB	T	OT	NO
Plot 15			F	ML	BB	T	OT	NO
Plot 16			F	ML	BB	T	OT	NO
Plot 17			F	ML	BB	T	OT	NO
Plot 18			F	ML	BB	T	OT	NO
Plot 19			F	ML	BB	T	OT	NO
Plot 20			F	ML	BB	T	OT	NO
Plot 21			F	ML	BB	T	OT	NO
Plot 22			F	ML	BB	T	OT	NO
Plot 23			F	ML	BB	T	OT	NO
Plot 24			F	ML	BB	T	OT	NO
Plot 25			F	ML	BB	T	OT	NO
Plot 26			F	ML	BB	T	OT	NO
Plot 27			F	ML	BB	T	OT	NO
Plot 28			F	ML	BB	T	OT	NO
Plot 29			F	ML	BB	T	OT	NO
Plot 30			F	ML	BB	T	OT	NO
Totals	>0 ≥10							
Percentages	>0 ≥10							
Seed-Origin Stocking								

Table 2. Stocking Values

Total Height (ft)	Stocking Value
0.0	0
0.5	5
1.0	9
1.5	14
2.0	18
2.5	22
3.0	25
3.5	29
4.0	32
4.5	35
5.0	39
5.5	41
6.0	44
6.5	47
7.0	49
7.5	52
8.0	54
8.5	56
9.0	58
9.5	60
10.0	62
10.5	64
11.0	66
11.5	67
12.0	69
12.5	70
13.0	72
13.5	73
>14.0	75

Figure 1. Cover Guide

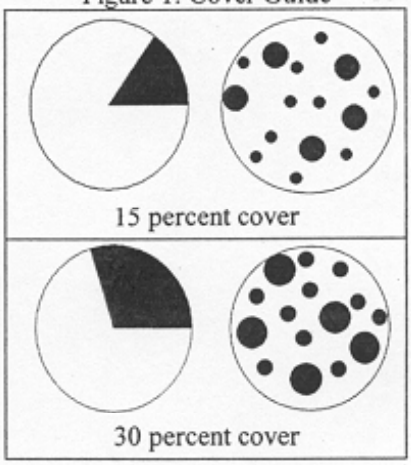

Table 3. Vegetation Classification Guide (20th acre plots)

Cover to 5' except Tree

Code	Description
F	≥ 30% cover by rhizomonous ferns (hayscented, New York, and bracken fern).
ML	≥ 15% cover by mountain-laurel.
BB	≥ 30% cover, primarily huckleberry or blueberry.
T	≥ 30 % non-oak tree or shrub cover from 5 – 20ft.
OT	≥ 30% cover by non-oaks, but not in any other category.
NO	< 30% total cover (i.e., mostly bare).

Stand _____ Date _____ Collected by _____

1/20 Ac Plots

Sprout-Origin Oak Regeneration Work Form (Version 1.1)

Table 4. Overstory Data Collection

	Diameter Class (in)									
	2-6	7-10	11-14	15-18	19-22	23-26	27-30	31-34	>34	
Chestnut Oak										
N (plots)										
Average Density										Species Total
Stocking Factor	x 9.4	x 8.9	x 8.3	x 7.6	x 6.7	x 5.8	x 4.9	x 4.0	x 3.1	
Sprout Stocking =										
N. Red Oak Scarlet Oak										
N (plots)										
Average Density										Species Total
Stocking Factor	x 6.6	x 6.3	x 6.0	x 5.7	x 5.3	x 4.9	x 4.5	x 4.1	x 3.7	
Sprout Stocking =										
Black Oak										
N (plots)										
Average Density										Species Total
Stocking Factor	x 6.9	x 6.0	x 4.7	x 3.3	x 2.0	x 1.1	x 0.5	x 0.3	x 0.1	
Sprout Stocking =										
White Oak										
N (plots)										
Average Density										Species Total
Stocking Factor	x 4.7	x 3.4	x 2.2	x 1.2	x 0.6	x 0.3	x 0.2	x 0.1	0.0	
Sprout Stocking =										
								Total Sprout-Origin Stocking		

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Chart I – Regeneration Treatment Evaluation (Version 1.1)

Table 5. Regeneration Data Summary

		Vegetation Class Percentages							(4) Height > 0	(5) Height ≥ 10ft
Seed-Origin Oak Stocking	50									
Sprout-Origin Oak Stocking	34	F	ML	T	OT	(2) Inhibiting Vegetation (F + ML + T + OT)	(3) BB	NO	67	67
(1) Total Oak Stocking (Seed + Sprout)	84	33	0	67	0	100	0	0		

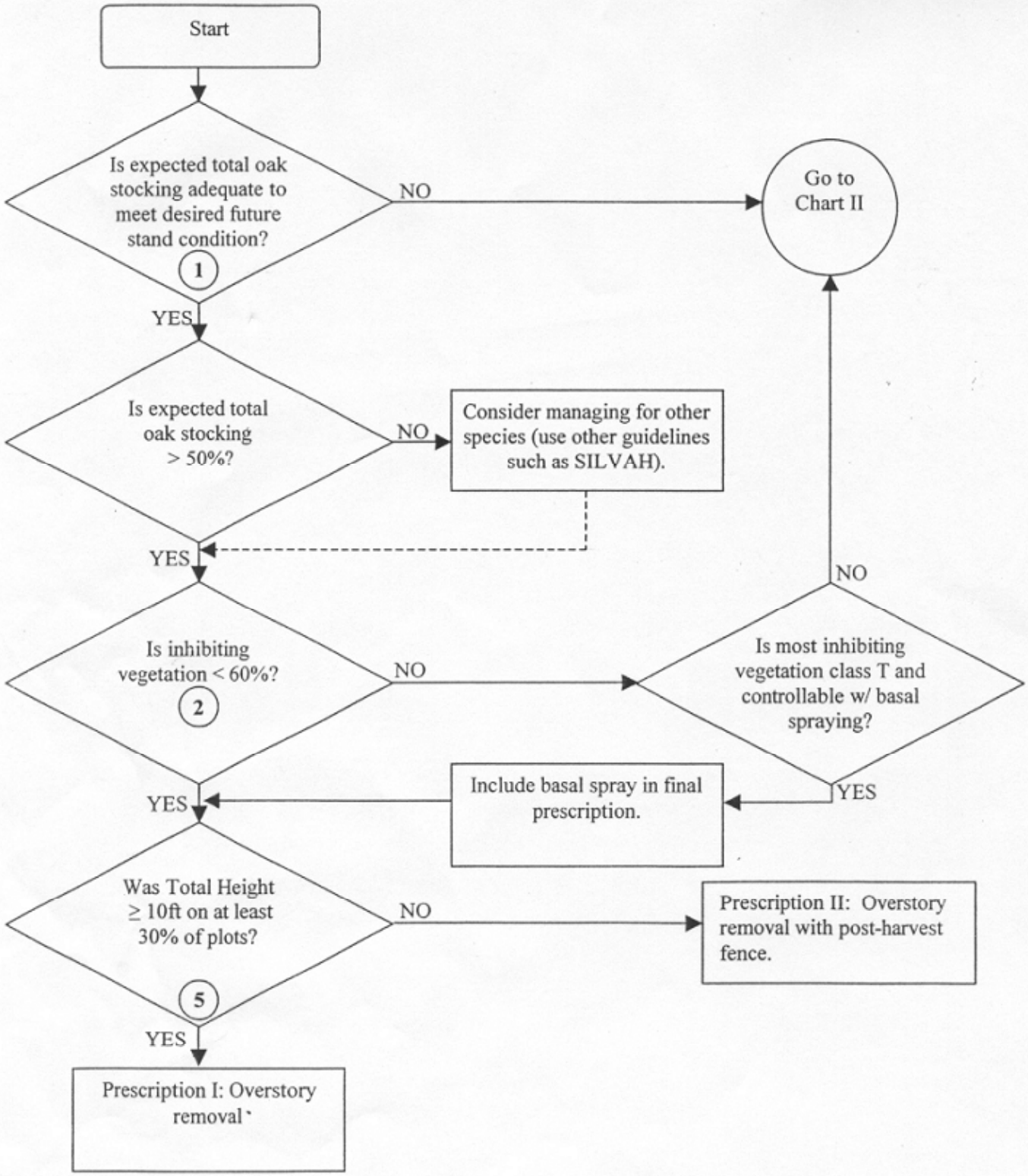
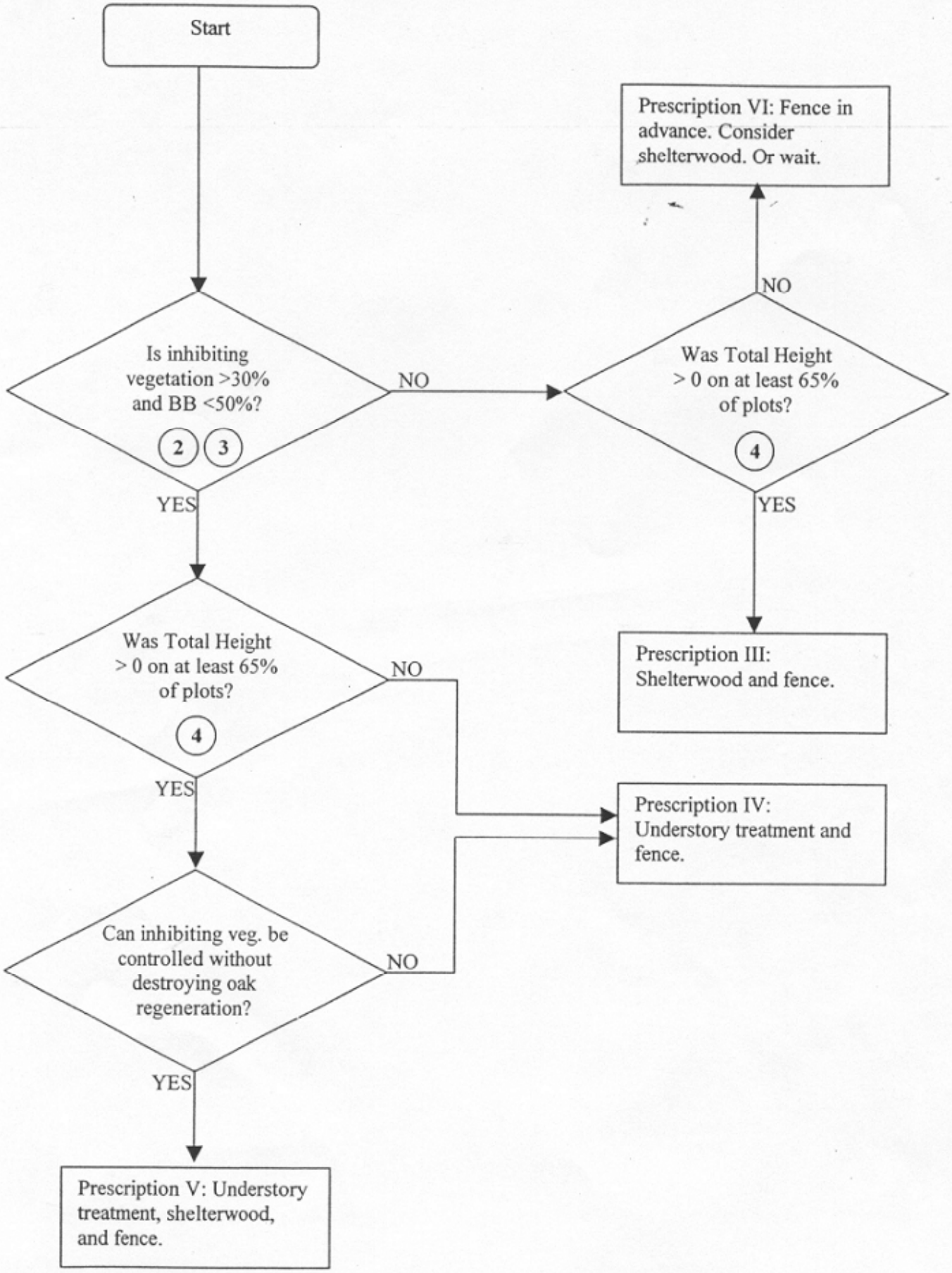
Chart II – Regeneration Problem Diagnostics (Version 1.1)