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CALIFORNIA DEPARTMENT OF FORESTRY AND FIRE PROTECTION

NONINDUSTRIAL TIMBERLAND MANAGEMENT PLAN

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GROWTH AND YIELD GUIDELINES

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SACRAMENTO, CALIFORIA
DEPARTMENT OF FORESTRY AND FIRE PROTECTION

Table of Contents

Purpose **1**

Addressing Growth and Yield in NTMPs **1**

Introduction *1*

Demonstrating the Balance of Growth and Harvest Using Uneven-aged Regeneration Methods and Other Appropriate Silvicultural Prescriptions **2**

NTMP Content *3*

Silviculture *4*

Demonstration of MSP--Important Concepts **6**

Sustained Yield versus Long Term Sustained Yield *6*

Option B or C Demonstrations *10*

Option C [EH Note: this discussion is the same as found on page 6.] 10

Option B 11

What Constitutes a Demonstration? *11*

Data Presentation **11**

Commonly Used Models for Growth and Yield Projections **12**

Re-evaluations **13**

CAL FIRE's Approach to the Review of NTMP Growth and Yield Related Information **14**

Inventory *14*

Growth Projections and Harvest Schedule *14*

Silviculture *16*

APPENDIX I **18**

Information about NTMP Submissions, Return Rates, Reasons for Return, etc. *18*

2003 to 2005—Non-Industrial Timber Management Plans (NTMPs), Frequency of Return *19*

Reasons for Return 20

APPENDIX II **21**

CAL FIRE Review Guidelines for CAL FIRE Review Team Staff Evaluating Maximum Sustained Production in Nonindustrial Timber Management Plans (NTMPs) *21*

1. PURPOSE AND NATURE OF THE REVIEW GUIDELINES 21

2. ALL NTMPs 21

2.1 BALANCING GROWTH AND HARVEST OVER TIME 21

2.1.1 Inventory Estimates 21

2.1.2 Growth Projections 22

2.1.3 Planning Horizon 23

3. ADDITIONAL REQUIREMENTS FOR USING OPTION B 23

3.1 BALANCING GROWTH AND HARVEST OVER TIME 23

DRAFT

3.1.1 Growth Projections....23
3.1.2 Long Term Sustained Yield (LTSY)....23
3.1.3 Planning Horizon....24
3.1.4 Consistent Prescriptions....25
3.2. CONSTRAINTS IMPOSED BY OTHER FOREST VALUES....25
Information Requirement:....26
Review Guidelines: 26

APPENDIX III....27

Inventory Stratification....27
Stand versus Management Unit....27
Regulatory Requirements and Guidance....28
Application of the Forest Practice Rules....29
14 CCR § 913.2 [933.2, 953.2] Regeneration Methods Used in Unevenaged Management....29
14 CCR §1090.5(g)....29
14 CCR §1090.5(i) 30
14 CCR §1090.5(j) 30
Management Planning....30
Individual Tree Growth and Silvics of the Species Present....31
Stand Growth 32
Stand Typing and Stratification 33
(1) Density 33
(2) Site Productivity 34
(3) Age 35
Age—Structure Relationships 35
(4) Species Composition 35
Competition and Stand Differentiation....36
Inventory Designs for Making Management Decisions 36
Sampling Design and Intensity 37
Combining Stand Types 38
Defining an Appropriate Mapping Resolution for Sustainability Assessments....38
Aids to Delineation--Cruise Plot Mapping....39
RPF Efficiency—Professional Responsibility—Scope of Project 39
Conclusion 39

APPENDIX IV 40

CDF Policy Regarding Applicability of Intermediate Treatments In NTMPs That Demonstrate MSP by Option C....40
Summary of February Policy Memorandum 40
Policy Revision....41
Data Presentation....42
Acceptable Models for Demonstration....42
Re-evaluations 42
Effective Date of Policy Revision and Allowance for Variances 42
Conclusion 42

DRAFT

Deleted: Purpose . 1¶
Addressing Growth and Yield in NTMPs . 1¶
Introduction . 1¶
Demonstrating the Balance of Growth and Harvest Using Uneven-aged Regeneration Methods and Other Appropriate Silvicultural Prescriptions . 2¶
NTMP Content . 3¶
Silviculture . 4¶
Demonstration of MSP--Important Concepts . 6¶
Sustained Yield versus Long Term Sustained Yield . 6¶
Option B or C Demonstrations . 10¶
Option C . 10¶
Option B . 11¶
What Constitutes a Demonstration? . 11¶
Data Presentation . 11¶
Commonly Used Models for Growth and Yield Projections . 12¶
Re-evaluations . 13¶
CAL FIRE's Approach to the Review of NTMP Growth and Yield Related Information . 14¶
Inventory . 14¶
Growth Projections and Harvest Schedule . 14¶
Silviculture . 16¶
APPENDIX I . 18¶
Information about NTMP Submissions, Return Rates, Reasons for Return, etc. . 18¶
2003 to 2005—Non-Industrial Timber Management Plans (NTMPs), Frequency of Return . 19¶
Reasons for Return . 20¶
APPENDIX II . 21¶
CAL FIRE Review Guidelines for CAL FIRE Review Team Staff Evaluating Maximum Sustained Production in Nonindustrial Timber Management Plans (NTMPs) . 21¶
1. PURPOSE AND NATURE OF THE REVIEW GUIDELINES . 21¶
2. ALL NTMPs . 21¶
2.1 BALANCING GROWTH AND HARVEST OVER TIME . 21¶
2.1.1 Inventory Estimates . 21¶
2.1.2 Growth Projections . 22¶
2.1.3 Planning Horizon . 23¶
3. ADDITIONAL REQUIREMENTS FOR USING OPTION B . 23¶
3.1 BALANCING GROWTH AND HARVEST OVER TIME . 23¶
3.1.1 Growth Projections . 23¶
3.1.2 Long Term Sustained Yield (LTSY) . 23¶
3.1.3 Planning Horizon . 24¶
3.1.4 Consistent Prescriptions . 25¶
3.2. CONSTRAINTS IMPOSED BY OTHER FOREST VALUES . 25¶
Information Requirement: . 26¶
Review Guidelines: . 26¶
APPENDIX III . 27¶
Inventory Stratification . 27¶
Stand versus Management Unit ... [1]

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Purpose

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In response to public concern over the high number of Non-industrial Timberland Management Plans (NTMPs) returned as unacceptable for filing by the California Department of Forestry and Fire Protection (CAL FIRE), CAL FIRE held a series of workshops in 2004 with registered professional foresters (RPFs) and landowners. Even though the workshop participants raised many issues, the majority of the discussion centered on the subject of growth and yield information provided in plans as a demonstration of maximum sustained production of high quality timber products (MSP). CAL FIRE has prepared a summary of all the concerns raised during the workshops. The summary and other documents pertaining to the workshops are posted at the Forest Practice Publications and Memorandums webpage (http://www.fire.ca.gov/rsrc-mgt_content/downloads/NTMPWorkshopSummaryDocuments.pdf).

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CAL FIRE recognizes that many other issues in addition to growth and yield in NTMPs are of concern to attendees at the workshops. However, since so much time was expended in discussion of growth and yield, CAL FIRE has prepared this guidance document to assist consulting foresters, landowners and CAL FIRE staff in addressing this complex subject matter.

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Addressing Growth and Yield in NTMPs

Introduction

Neither the Forest Practice Act (Act) nor the Forest Practice Rules (Rules) provide a prescriptive approach to the informational requirements required to assess growth and yield in NTMPs. This analysis falls within the area of expertise of a "professional forester," as defined under PRC § 752, and the definition of "forestry," as defined in PRC § 753. Thus, CAL FIRE expects this analysis will be completed by a qualified professional.

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Given the general performance-based approach of the Rules, the RPF should demonstrate conformance with the Rules consistent with generally accepted approaches to growth and yield analysis. The plan should contain sufficient information for CAL FIRE to determine that the NTMP conforms to the Rules and Act per guidance provided in 14 CCR § 897(d) relative to application of judgmental terms. In reviewing the information provided, 14 CCR § 897(d) should guide CAL FIRE, and requests for additional information should be consistent with 14 CCR § 1037.5(g)(3). Where definitional issues arise, CAL FIRE will look to conventional professionally accepted sources of information, such as the Society of American Foresters' Dictionary of Forestry, and Forestry Handbook, among others. Where issues arise relative to forest management principles, CAL FIRE will rely on various academic forestry texts from the applied disciplines for clarification. Additional information relative to growth and yield review

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may be found in Appendix II— "CAL FIRE Review Guidelines for CAL FIRE Review Team Staff Evaluating Maximum Sustained Production in Nonindustrial Timber Management Plans."

CAL FIRE's review of growth and yield, inventory, and silvicultural elements of NTMPs is based on the concept of truthful self-reporting, with an increasing level of scrutiny based upon CAL FIRE's confidence in the information and approaches used to demonstrate achievement of a balance between growth and harvest. Elements that CAL FIRE will consider in evaluation of NTMPs are described below.

Recognizing that the demonstration of growth, harvest, and sustainability is a performance-based approach, the general criteria described below should not be viewed as rigid guidelines, which initiate specific actions on the part of CAL FIRE. However, this document is designed to highlight sensitive situations, which may lead CAL FIRE to conclude that more information may be needed to support it's judgment under 14 CCR § 897(d).

Demonstrating the Balance of Growth and Harvest Using Uneven-aged Regeneration Methods and Other Appropriate Silvicultural Prescriptions

The SAF Dictionary of Forestry defines a management plan as a: "predetermined course of action and direction to achieve a set of results, usually specified as goals, objectives, and policies—note a management plan is a working instrument that guides actions and that changes in response to feedback and changed conditions, goals, objectives, and policies." (Society of American Foresters, Helms, 1998)

The enabling legislation and Rules require that NTMPs must provide and demonstrate a clear program for managing the timber stands that meets the objectives specific to the individual non-industrial tree farmer. This is evidenced by PRC § 4593.3(f), which requires the following as one of the contents of an NTMP (emphasis added):

> A description of the existing stand, its current projected growth, alterations required to achieve the management objectives, the projected timber volumes and tree sizes to be available for harvest, and projected frequencies of harvest shall be part of the public record.

In general, both the Act and the Rules set forth a set of performance standards for NTMPs, which focus on uneven-aged management and balancing growth with harvest to insure sustainability of the harvesting planned under the NTMP. Growth and harvest are developed around the landowner's objectives while at the same time being subject to the provisions of the Rules that are in effect at the time the NTMP is approved. The performance-based approach associated with demonstrating sustainability of harvest activities under an uneven-aged silvicultural application often leads to differing opinions between RPFs and CAL FIRE regarding how much information is necessary to demonstrate conformance with the Act and the Rules.

CAL FIRE recognizes four core elements that define a management plan. These elements are as follows:

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PRC §§ 4593.2(d) and 4593.3

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¶
<#>The resulting sheltering affect from new rules.¶
<#>Economic relief in not having to prepare future Timber Harvesting Plans.¶
The approval of harvest activity in advance, thus allowing the land owner to take advantage of market fluctuations in a timely manner (PRC § 4593(c)

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Once the NTMP is approved, subsequent operations under the plan can be conducted under a simple notification, which is non-discretionary and allows the landowner to begin operations under the notice immediately. This ability to begin operations with a harvest notice is what provides the greatest flexibility for the landowner as it pertains to scheduling of harvests and the ability to take advantage of fluctuations in timber markets. These elements have been extended to the plan proponent in exchange for a clear program for managing the timber stands contained within the plan, and for a certification by the RPF that operations:¶
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<#>Will implement best management practices for the protection of wate ... [2]

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The Rules applicable at the time o ... [3]

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(1) Proper establishment of the baseline conditions.
(2) Identification of stocking levels that optimize site productivity for the given products desired and that balance harvest with growth into perpetuity.
(3) Defining the suite of intermediate or transitional prescriptions that leads to sustainable stocking levels.
(4) Monitoring.

At the point at which growth and harvest are balanced for a particular management unit, the management objectives and demonstration of sustainability required in PRC §§ 4593.2(d) and 4593.3 should conform to the standards reflected in 14 CCR § 913.2 [933.2 and 953.2] Regeneration Methods Used in Unevenaged Management. These regeneration methods include Selection, Group Selection, and Transition and the applicable standards relative to post harvest stocking size and distribution of trees. In addition to Group Selection, Individual Tree Selection, and Transition, there are associated intermediate treatments, such as Commercial Thinning and Sanitation-Salvage, and special prescriptions, such as Fuelbreak and Special Treatment Areas, which are also appropriate in an NTMP.

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NTMPs should rarely apply Special Prescriptions to existing stands or intermediate stands. Where the management objectives include use of these methods, the NTMP analysis should account for these applications in the modeling and growth projections and should be described in sufficient detail for CAL FIRE to determine how these methods will influence MSP and long-term sustained yield (LTSY).

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The differences between the current stand condition and the desired condition, based on landowner objectives, needs to be recognized when developing and evaluating an NTMP. The variation in approaches to converting the current stand to the desired stand is limitless. This variation will be expressed through differences in characteristics such as stocking, species composition, and site productivity within an ownership and between ownerships. This is to be expected given these differences in consideration of landowner objectives and management constraints.

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NTMP Content

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The NTMP information should reflect professionally accepted standards, including stratification of the property into multiple stands when appropriate, designation of management units, aggregation and display of stand information, a description of the underlying inventory used to support the stand projections, the modeling approaches utilized, and the silviculture to be applied towards the desired future condition. The description of the underlying inventory used to support the stand projections should include the sampling intensity, age of the inventory, timber typing and sample stratification approaches that were used. Guidance relative to inventory stratification is found in Appendix III. For inventories older than 5 years, the inventory should be updated and the methods to update the inventory should be described. The NTMP should contain sufficient detail to demonstrate that the desired future condition does balance growth

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with harvest, is reasonable in terms of harvest levels, and complies with MSP. The NTMP should lay out a planned application of silvicultural treatments that conforms to the Rules, meets rule intent, and can function as a clear blueprint for management of the ownership under the terms of the NTMP, if changes in ownership or RPF occur.

The sustained yield demonstration in the NTMP should include the following information:

- The proposed management objectives and projected timber volumes and sizes available for harvest for each stand within the established management units.
- For each management unit, the RPF should describe the desired future condition of the stand(s) in terms of pre-harvest stocking, volume available for harvest, post harvest stocking, and growth. The RPF should demonstrate that:
    - The projected inventories are sustainable based on the indicated cutting cycle length and harvest intensity.
    - The volume available for harvest represents a level that is feasible for the prescribed logging system.
- A description of the current condition of stand(s) for each management unit.
- A description of how the planned schedule of management activities will achieve the desired future condition(s) for each management unit.

PRC § 4593.3(f) and 14 CCR §§ 1090.5(g), (h), (i), and (j) require that each NTMP contain the following information:

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- Designation of management unit(s) for the NTMP.

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- For each management unit the following information should be provided:
    - The current timber stand(s) characteristics.
    - The stand characteristics at the point where growth and harvest will be balanced.
    - The silvicultural prescriptions to be applied at each harvest entry to move the existing stand structure(s) to the desired future condition for the management unit(s) and the ownership as a whole.
- Silvicultural method to be applied at each entry to the stand(s) within the management unit(s), projected frequencies of harvest entries, and type of yarding methods to be used.

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Silviculture

In addition to the Selection and Group Selection uneven-aged systems specified under 14 CCR § 913.2(a) [933.2(a), 953.2(a)], the following silvicultural treatments are permitted in a NTMP:

- Transition (14 CCR § 913.2(b) [933.2(b), 953.2(b)]).

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- Intermediate Treatments (14 CCR § 913.3 [933.3, 953.3]), which include Commercial Thinning and Sanitation-Salvage.
- Special Prescriptions (14 CCR § 913.4 [933.4, 953.4]), which include Special Treatment Area Prescriptions, Rehabilitation of Understocked Area Prescriptions,

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Fuelbreak/Defensible Space prescriptions, and, with exception, Variable Retention (VR) prescriptions.

Where the management objectives include use of these methods, the NTMP analysis should account for these applications in the modeling and growth projections and should be described in sufficient detail for CAL FIRE to determine how these methods will influence MSP and LTSY.

CAL FIRE cannot allow VR prescriptions in an NTMP where the prescription bears a resemblance to an even-aged method. VR prescriptions will be allowed as long as the RPF establishes a convincing case to the Director that it is consistent with the goals and objectives of the NTMP legislation and the provisions of the Rules in effect at the time the NTMP is approved.

NTMPs submitted under an Option C demonstration of MSP can propose Intermediate Treatments or Special Prescriptions and meet MSP under 14 CCR § 913.11(c)(3) [933.11(c)(3) & 953.11(c)(3)]. When utilizing this approach, it would be important for the submitter to conduct an appropriate quantitative analysis that discloses how application of the prescription will support achievement of the desired future condition for each stand. Prior to conducting this analysis, it may helpful for the submitter to consult the CAL FIRE memo, "Revision of CDF policy regarding the applicability of intermediate treatments for NTMPs that demonstrate MSP by Option C [(14 CCR 913.11-,933.11-, 953.11-(c)]" dated July 15, 2002, and attached as Appendix IV.

Also, as discussed previously under the NTMP Content section, silvicultural applications should be described for each stand by management unit for each entry during the period of time necessary to bring the stand into a regulated condition. To maximize utility, it is important to provide sufficient detail in the descriptions so that CAL FIRE can corroborate the feasibility of the planned silviculture in terms of achieving and maintaining the desired future condition.

Demonstration of MSP--Important Concepts

Sustained Yield versus Long Term Sustained Yield

As defined in PRC § 4593.2 (d) and 14 CCR § 895.1, "sustained yield" means "the yield of commercial wood that an area of commercial timberland can produce continuously at a given intensity of management consistent with required environmental protection and which is professionally planned to achieve over time a balance between growth and removal."

Conversely, "long-term sustained yield" is defined as "the average annual growth sustainable by the inventory predicted at the end of a 100 year planning period" (14 CCR § 895.1). A critical element in harvest scheduling is the defining and implementing a series of planned silvicultural prescriptions. In situations where the desired crop takes 50 to 100 years to mature, the purpose of a 100-year planning horizon is to estimate the long-term outcomes of applying the planned program of management prescriptions over time. The calculation of LTSY defines a threshold that harvest levels may not exceed when averaged over a rolling ten-year period.

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For intermediate treatments and special prescriptions, complying with the stocking requirements of the individual treatment or prescription.¶
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Sustained yield should not be confused with LTSY, even though both terms are applicable to the demonstration of MSP for NTMPs (refer to 14 CCR § 913.11(b)-(c) [933.11(b)-(c), 953.11(b)-

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(c)]). 14 CCR § 1090.5(j) requires that the time period for balancing growth and harvest be

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identified in the NTMP; this coincidentally satisfies the sustained yield objective of PRC § 4593.3. In most cases, once an inventory reaches the point where growth and harvest can be sustained, LTSY has been demonstrated as well. The sustainable harvest level will need to reflect the range of site productivity, species mix, and current environmental constraints under the desired future management conditions.

The point at which all fully managed stands in the identified management units have reached a balance between growth and harvest is the point at which the NTMP as a whole meets the Act and Rule requirements (i.e., the sustained yield objective of the Act and the long term sustained yield requirement of the Rules). One should note, however, that some stands, given applicable constraints, may not achieve a balance between growth and harvest for a period of time exceeding 100 years. For example, sustained yield might not be achieved until year 130 (growth and harvest are not balanced within 100 years due to poor site productivity or the need to rehabilitate stands or both). In cases such as this, the annual projected yield must be limited so that the harvests do not exceed the growth considered sustainable by the inventory at 100 years (LTSY) for any rolling 10-year period. If this situation arises, it would be appropriate for the RPF to disclose and discuss such an instance, and identify the desired future condition and harvest proposed for these stands. The growth and harvest does not have to be balanced within the 100-year planning period. However, CAL FIRE should be able to verify that the harvesting planned for these areas is consistent with the constraint. For example, if the stands on a particular NTMP continue to increase in volume because the desired condition has not yet been met, the RPF should discuss how the balance will be achieved with an estimate of timing. Any associated modeling effort should also demonstrate that the stand is moving towards the desired future condition reflected in the RPF's discussion.

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Option B or C Demonstrations

The options for NTMPs to address MSP are either 14 CCR § 913.11(b) or (c) [933.11(b) or (c) and 953.11(b) or (c)], simply referred to as Option B or Option C. Important concepts about MSP that distinguish it from sustained yield include the following:

- Production of high quality timber products.
- Enhancing or restoring timberland productivity to improve site capacity to realize increased yields.
- Defining minimum sized seed trees in terms of DBH that are considered to have reached a maturity to produce viable seeds.
- Defining minimal density standards and rotation periods to prevent site degradation.
- Protecting the soil, air, fish and wildlife, water resources, and any other public trust resources.

Sustained yield is the harvest schedule solution that accounts for these components of MSP.

Two components that chiefly distinguish an Option B or an Option C are the seed tree standards and planning horizons. Option C includes specific parameters that define seed trees, whereas under an Option B the landowner may define different standards. Secondly, the planning horizon for an Option B is defined for a period of 100 years, whereas an Option C relies on meeting the standards set forth in 14 CCR § 913.11(c)(2)-(3) [923.11(c)(2)-(3), 953.11(c)(2)-(3)]. However, when Option C is chosen, per 14 CCR § 1090.5(j), there still remains a requirement to describe the period of time over which growth will be balanced with harvest. The NTMP will need to adequately demonstrate how and when this will occur.

Option C [EH Note: this discussion is the same as found on page 6.]

Compliance with the MSP standards of 14 CCR § CCR 913.11(c) [933.11(c), 953.11(c)] is not equivalent to compliance with the obligation to demonstrate sustained yield as defined in PRC §§ 4593.2(d) and 4593.3. PRC § 4593.3 makes meeting the objectives of sustained yield a requirement. If Option C under 14 CCR § 913.11(c) [933.11(c), 953.11(c)] is selected, the focus on the demonstration of sustained yield should be the identification of when growth and harvest are balanced, and demonstration of how the requirements of 14 CCR § 913.2(a)(2)(A)(4) and (a)(2)(B)(4) [933.2(a)(2)(A)(4) and (a)(2)(B)(4), 953.2(a)(2)(A)(4) and (a)(2)(B)(4)] will be met. Growth and harvest may be balanced with the first entry, or several cutting cycles may be required.

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NTMPs submitted under an Option C demonstration of MSP can propose Intermediate Treatments or Special Prescriptions and meet MSP under 14 CCR § 913.11(c)(3) [933.11(c)(3), 953.11(c)(3)]. However, when the silviculture prescription cannot meet the Seed Tree retention standards (14 CCR § 913.1(c)(1)(A) [933.1(c)(1)(A), 953.1(c)(1)(A)), the submitter must establish a convincing demonstration for the Director that the objective of uneven-aged management is attainable within the specified timeline. See Appendix IV for further discussion of requirements.

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For intermediate treatments and special prescriptions, complying with the stocking requirements of the individual treatment or prescription.

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Option B

If a plan submitter elects to use Option B, LTSY should be estimated based on a 100-year planning period, but, as stated earlier, if growth and harvest is balanced, the level of growth and inventory at which this occurs, for all practical purposes, will be the same at the end of the 100-year projection.

What Constitutes a Demonstration?

The terms "demonstrate" and "demonstration" occurs over 20 times in the Act and Rules. Webster's 9th edition defines these terms as follows:

- To show clearly.
- To prove or make clear by reasoning or evidence.
- An act, process, or means of demonstrating to the intelligence.
- A showing of the merits of a product or service to a prospective consumer.

Besides satisfying the Rules and the requirements of the California Enviromental Quality Act, an NTMP is a management plan that is required to demonstrate how the plan will meet MSP and sustained yield. MSP is addressed in 14 CCR § 913.11 [933.11, 953.11] and sustained yield is addressed in PRC §§ 4593.2(d) and 4593.3. CAL FIRE must be able to verify that plan implementation remains consistent with the MSP and sustained yield projection(s). Plans in which the demonstration is verifiable only at a future point in time, such as a re-inventory point, do not necessarily allow CAL FIRE to assess compliance with PRC § 4594.7. Therefore, it is incumbent upon the RPF to demonstrate in the NTMP *at the time of NTMP submission* how the plan will meet MSP and sustained yield.

Data Presentation

The demonstration of sustained yield should reflect differences in site and species composition, as well as the environmental constraints applicable to the NTMP. In most cases, variation in site class, species mix, and environmental constraints will lead to a different solution relative to sustained yield for the management unit(s) described in the NTMP. It is important that the NTMP reflects the level of stand type stratification necessary to support these different management unit solutions.

To facilitate CAL FIRE review, it is recommended that the RPF preparing the NTMP growth and yield projections present information in formats that are commonly used within the professional forestry community. For instance, stand tables are universally recognized for communicating characteristics of a stand. For each stand type within the management unit, it is suggested that the data format consist of a single stand table that displays the average number of stems by each species and DBH class. Optimally, each stand table would be paired with a stock table. Regardless, it would be particularly helpful if each stand table included a detailed summary of the diameter class distribution of Group A species. Typically, a stand table(s) would present 2-

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inch diameter classes on a per-acre basis by species. Group B species would be reported by 2-inch diameter classes if hardwoods are to be treated as a part of the management actions under the NTMP. Hardwood species may also be lumped under one column if there is no reason to appraise a certain species representation separately.

Successful unevenaged management is predicated on "establishment and/or maintenance of a multi-aged, balanced stand structure" (14 CCR § 913.2 [933.2, 953.2]), and sustained yield is predicated on managing existing age class distributions and creating new age classes with each harvest. To assist CAL FIRE in evaluating sub-merchantable age class distributions, it is suggested that stand tables include density measures by diameter classes no greater than 2-inches. CAL FIRE will use this information to:

(1) Establish baseline conditions, so that the RPF and Department can, over time, appraise silvicultural success in establishing new age classes.
(2) Prevent a potential species shift or conversion in a stand composed of desirable conifer species to one composed of undesirable species.

Where single-tree selection is planned on site class IV and V timberlands, 1-inch DBH class resolution is recommended for regeneration size trees in order to appraise new age-class recruitment and development. On poor sites, the time span for a 1-year seedling to grow in size to a 1-inch DBH tree is roughly 10-20 years, which, in absence of baseline data, could translate into a significant delay of several decades before deficiencies are recognized, thus translating into delayed yields and delayed financial opportunity for the landowner.

To maximize their utility, it is important that growth projections include reasonable estimates of ingrowth in the absence of objective data with an explanation by the RPF as to how ingrowth was factored into the growth projections. It is also important for the RPF to differentiate, when sampling for the non-merchantable classes, between trees capable of developing into a future crop tree and those having poor form and vigor, which are not likely capable of developing into a crop tree.

Commonly Used Models for Growth and Yield Projections

Examples of models for demonstrating this requirement include, but are not limited to, FORESEE, CACTOS, CRYPTOS, FVS, stand table projection, or any validated proprietary, individual-tree simulation models capable of detail sufficient for the evaluation of MSP and sustained yield.

RPFs are encouraged to be aware of the practical limitations of growth and harvest models and draw appropriate conclusions relative to the outputs. Some of the limitations associated with various modeling techniques are described in a 1999 USDA Forest Service Pacific Southwest Research Station publication, "A Compendium of Forest Growth and Yield Simulators for the Pacific Coast States," by Martin Ritchey, available online at: (http://www.fs.fed.us/psw/publications/documents/gtr-174/gtr-174-cover.pdf and http://www.fs.fed.us/psw/publications/documents/gtr-174/gtr-174-content.pdf).

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Projections are only as reliable as the underlying data supporting them. Projections are not absolutes or enforceable standards in and of themselves. The stocking standards stated in the plan under Item 14 are the only enforceable stocking standards to which the NTMP will be held. Projections do, however, provide a guide against which to evaluate trends and serve as the basis for adjustments if inventory information indicates that the projections need to be adjusted upward or downward.

Re-evaluations

An assessment of sustained yield is a measure or a forecast of what a forest that is regulated to the structure a landowner desires can produce without depleting its productive capacity. Re-evaluations are an important aspect in long-term planning and may be necessary to evaluate original projections with actual progress. In Forest Management (Davis and Johnson, 1987) the authors note:

> **The empirical core of our claim to manage land scientifically and to ensure that owner objectives are met lies in our ability to predict quantitatively the future characteristics of current and regenerated stands of a given stand type managed under a specific prescription. If we cannot predict with acceptable accuracy, then it is hard to convince our clients that their goals are being met and that we foresters really know what we are talking about. Concepts are one thing, but the real world wants to know how much!**

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For properties where initial post-harvest stocking falls below the selection standards, which propose to utilize a series of silvicultural applications over time to create the desired stand conditions, CAL FIRE encourages the landowner to conduct sufficient stand inventories to monitor and record actual stand performance against modeled performance. Re-inventories may not be necessary for long periods if actual inventory levels are consistent with original projections.

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CAL FIRE's Approach to the Review of NTMP Growth and Yield Related Information

The following describes CAL FIRE's approach to the review of the growth and yield portion of an NTMP. The approach uses a tiered system, whereby CAL FIRE can identify situations that may demand more attention than others. Such situations depend on the contents, methodology, and assumptions built into the growth and yield information contained in an NTMP and CAL FIRE's ability to corroborate the final projections. Use of the tiered approach allows CAL FIRE to ascertain the conditions and analysis methods that will precipitate a more detailed review in order to clearly understand the proposed management strategy.

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The criteria relate to the existing conditions, the characteristics of proposed management, and the methodologies and assumptions utilized in determining the results. Three tiers, or levels of detail of review, along with the criterion for placing an NTMP into one of the tiers, are defined. Each tier builds on the previous tier, so that each criterion and review recommendation includes those in previous tiers. For example, in tier 2 review, one would examine all the issues listed under tier 1 as well as tier 2.

Inventory

Tier 1 Criterion: A recent inventory of the property, less than 5 years old.
Tier 1 Review:

(1) Do a quick check of inventory figures against applicable yield tables for the area, or rely on professional experience with the area.
(2) Determine the sufficiency of the sample design.
(3) Determine the inventory method (i.e., plot distribution, fixed v. variable, etc.)
(4) Determine the cruise specifications (i.e., what was measured and how).

Tier 2 Criterion: Inventory more than 5 years old, but updated for growth and harvest.
Tier 2 Review:

(1) Examine update methodology, including growth and harvest estimates, and assumptions.

Tier 3 Criterion: Inventory more than 5 years old, not updated or no estimate of standard error, or standard error greater than 15 percent.
Tier 3 Review:

(1) Request an update for growth and harvest.
(2) Detailed examination of inventory calculations and estimate the probable level of accuracy and magnitude of possible error. If significant, request the landowner scale back planned harvests to allow for possible error.
(3) Possibly require a re-inventory of the property either for initial plan review or some specified time period in the future depending on actual current stand conditions.

Growth Projections and Harvest Schedule

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Tier 1 Criterion: Growth projections developed with a well known publicly available growth model (FORESEE, Cactos, Cryptos, FVS, Organon, FPS), and models are used within their limits, with appropriate model calibrations.

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Tier 1 Review:

(1) Verify that models were used within their limits (i.e., no "free grow" with no harvest, Cryptos was not used in the Sierra, etc.)
(2) Verify that growth projections generally match observed growth rates in the area.
(3) Determine how harvesting was facilitated in the model.
(4) Determine how the mortality was accounted for.
(5) Determine how ingrowth was accounted for.
(6) Determine what volume tables were used and what merchantable top diameter was applied (for example, in CACTOS, this information is within the coefficient file).
(7) Determine how the user ran the model (i.e., interactive, batch, linear program, user specified, etc.)

Tier 2 Criterion: Growth projections developed with unpublished growth models, stand table projections, or empirical data, but well documented and defensible; or published growth models are used, but calibrated with local data.

Tier 2 Review:

(1) Examine whether assumptions used in modeling are realistic.
(2) Request data to back up calibrations.

Tier 3 Criterion: Growth projections developed with published or unpublished growth models or both, or empirical data, and appear to be over-generalized, have a lack of specificity, or appear to be outside of design capabilities for the method used. Also, estimated growth rates not supported by observed growth rates in the area based on direct observation (i.e., PHI), experience, or yield tables.

Tier 3 Review:

(1) Request detailed justification of all assumptions (e.g., computation of movement ratios).
(2) Examine all aspects of the analysis and make an assessment of the possible effects of cumulative errors from all sources.
(3) It may be necessary to lower estimates of growth and harvest to more conservative levels to allow for wide confidence limits on estimates.
(4) Possibly require a re-inventory by the RPF or a re-assessment by CAL FIRE field staff of the property at some specified time period in the future depending on actual current stand conditions and the prescription being applied.

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Silviculture

Tier 1 Criterion: Residual basal areas generally well above the minimums in the FPR for all silvicultural methods. Only selection, commercial thinning, or sanitation salvage or all three are used.

Tier 1 Review:

(1) Verify silvicultural applicability to the existing stand conditions. For example, commercial thinning requires that the average stand diameter increase or that the prescription improves forest health; therefore, it is incumbent that the application, as demonstrated in the field and within the projections, meets this requirement. For selection, it is incumbent that the application, as demonstrated in the field and within the projections, addresses current imbalances in age class distributions and provides provisions for establishment of new age classes.

Tier 2 Criterion: Alternative methods, group selection, or silviculture consistently modeled to the minimum retention standards in the FPR.

Tier 2 Review:

(1) Review the need for alternative methods.
(2) Review growth projections for group selection to verify that yields are realistically achievable in the area.
(3) Clarify landowner objectives for MSP and insure that a clear methodology is presented that achieves those objectives.
(4) Request information that demonstrates the alternative prescriptions are moving towards an uneven-aged distribution.
(5) For selection and transition methods, plan should address current imbalances in age class distributions, provide provisions for establishment of new age classes, and provide monitoring in age class development.

Tier 3 Criterion: Ambitious plans for intensive management that boosts projected growth, but not supported by current or recent past management history. This may be evident by declining standing inventories or large diameter classes being removed in the early planning years. Also, alternative methods that go below the retention standards of the nearest standard method or where it is not clear that an uneven-aged stand is being established.

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Tier 3 Review:

(1) Compare silviculture with past history, with an economic feasibility component.
(2) Request detailed justification for assumptions.
(3) Some monitoring agreement may be in order if questions of feasibility remain an issue.

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Both the Act and the Rules require RPFs and the Director to utilize professional judgment when proposing and evaluating plans. Therefore, the criteria presented above should not be utilized as a checklist for the review of NTMPs, nor should it be referenced as the criteria by which NTMPs are determined to be in conformance with the Rules. The tiers presented above are intended to provide some guidance in the review of NTMPs. They are not intended to provide the sole

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criteria by which NTMPs are evaluated. They simply serve to illustrate the thought process that a reviewer of NTMPs may utilize in determining if the information in the NTMP complies with the provisions of the Forest Practice Act and Rules.

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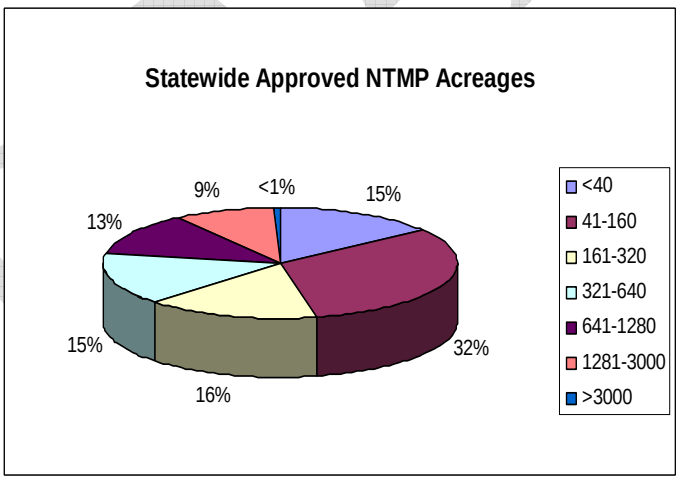
APPENDIX I

Information about NTMP Submissions, Return Rates, Reasons for Return, etc.

Since 1991-2005 there have been 640 NTMPs submitted statewide and 601 approved.

Administrative Region	Approved NTMPs	Acres Approved
North Coast Region	453 (75%)	208,158 (76%)
Cascade Region	96 (16%)	43,637 (16%)
Central Sierra Region	52 (9%)	22,478 (8%)
Total	**601**	**274,273**

Individual NTMP acreages range from 8 acres to 5131[23] acres, with an average of 456 acres and the following distribution:



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While the NTMP program has been utilized to the benefit of landowners in coastal and interior areas, NTMP review-related issues have led to high rates of plan return. CAL FIRE, in response to complaints from RPFs and concern expressed before the Board of Forestry and Fire Protection, compiled the following statistics for 2003 to 2005 NTMP return rates:

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2003 to 2005—Non-Industrial Timber Management Plans (NTMPs), Frequency of Return

TABLE 1: Number of "First Submittal" plans reviewed and the corresponding number returned (As of September 26, 2005)

North Coast Region		Cascade Region		Central Sierra Region		State Wide	
Reviewed	40	Reviewed	23	Reviewed	12	Reviewed	75
Returned	19	Returned	3	Returned	5	Returned	27

TABLE 2: Percentage of plans returned

Harvest Document Type	North Coast Region	Cascade Region	Central Sierra Region	State Wide TOTAL
NTMP	48%	13%	42%	36%

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Reasons for Return

TABLE 3: General reasons for plans being returned to the submitter.

Return Issues (pursuant to 14 CCR & PRC)	Occurrences		
	North Coast Region	Cascade Region	Central Sierra Region
Notice of Preparation (14 CCR § 1090.2)	9		
Domestic Water Notice Issues {14 CCR §§ 1090.2(g) & 1032.10}	12	1	
Archaeology Issues (14 CCR § 929)	10	1	1
Silviculture Issues (14 CCR § 913.4 [933.4, 953.4])	3		1
14 CCR § 897(b)(3) Issues*	6		2
14 CCR §§ 1090.5(g), (h), (i), or (j) or all four	11		2
Alternative Practice 14 CCR § 916.6 [936.6, 956.6]	2		
14 CCR § 1090.5(a), PRC § 4527,	2		
Timberland Owner	9		
Maps	3		1
Other	7	1	1
Total**	74	3	8

* Those plans identified as being returned under 14 CCR § 897(b)(3) had several rule requirements missing from the plan (some of which could be listed above), or was presented with so many inconsistencies or inaccuracies that it was not clear what was being proposed in the plan or both.

** A returned plan may have been returned for multiple reasons.

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APPENDIX II

CAL FIRE Review Guidelines for CAL FIRE Review Team Staff Evaluating Maximum Sustained Production in Nonindustrial Timber Management Plans (NTMPs)
(Originally circulated 10/30/95; Updated 06/01/07)

1. PURPOSE AND NATURE OF THE REVIEW GUIDELINES

These review guidelines have been developed for use by the California Department of Forestry and Fire Protection (CAL FIRE) staff reviewing NTMPs submitted under Option B (14 CCR § 913.11(b) [933.11(b), 953.11(b)]) or Option C (14 CCR § 913.11(c) [933.11(c), 953.11(c)]) of the state forest practice rules in California. Such guidelines are necessary because 14 CCR § 913.11(b) [933.11(b), 953.11(b)] requires advanced level quantitative analysis with many procedural variations. This is also the case with 14 CCR § 913.11(c) [933.11(c), 953.11(c)], since NTMP submitters are required to balance growth and harvest over time. Also, the rule language in 14 CCR § 913.11(b) [933.11(b), 953.11(b)] and the supporting findings provide CAL FIRE staff with substantial discretion in enforcing the rules. The guidelines are as general as possible so as to allow application to different forest types and regions, while at the same time providing the necessary practical guidance to CAL FIRE staff to allow consistent and fair application of the state forest practice rules.

2. ALL NTMPs

2.1 BALANCING GROWTH AND HARVEST OVER TIME

Although Option C does not require demonstrating LTSY as under Option A or B, PRC § 4593.3 and 14 CCR §§ 1090.5(h)-(j) require demonstrating a balance of growth and harvest over a time period selected by the submitter.

2.1.1 Inventory Estimates

PRC § 4593.2 defines sustained yield for NTMPs. Showing the balance of growth and removal over time requires an estimate of current inventory.

Informational elements:

a. An estimate of current standing inventory of the NTMP area, by management unit, in terms of species composition, age classes, stocking, volume per acre, and size class distribution. (14 CCR § 1090.5(g))

b. A description of the sampling procedure used to collect the inventory data. Information should include basic information such as inventory design, cruise methods (fixed-radius

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plots, variable-radius plots, or a mixture of both), cruise intensity, and information collected on each plot. (14 CCR § 1090.5(g))

c. A description of data processing procedures. Information should include methods and equations used in developing inventory estimates such as basal area and volume from raw data, units of measure, and merchantability limits.

d. An estimate of the precision of the inventory estimates in the units of measure used by the submitter to illustrate the balance between growth and harvest. Although no explicit inventory precision requirement is in the forest practice rules, an estimate of precision should be included to allow CAL FIRE to evaluate the validity of the inventory as a basis for subsequent growth projections and harvest scheduling analysis. A description of the equations, methods, and intermediate calculations should be included to allow CAL FIRE to verify the validity of the estimates.

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Review Guidelines:

The amount of detail and level of scrutiny to assign to review of items a. - d. above will vary according to the characteristics of the inventory as described by the submitter. If an up-to-date, complete inventory of the NTMP area is presented, with inventory estimates falling within expected ranges, a detailed review of data and methods is probably not necessary. If there are clear gaps in data or methods, such as incomplete coverage of the NTMP area or old data, CAL FIRE may ask the submitter for additional information including a discussion of how these short-comings might affect the projections of growth and harvest.

2.1.2 Growth Projections

Reliable growth projections are essential to balancing growth and harvest over time. However, because of the large number of variables involved, growth projection evaluation is probably one of the most difficult tasks in NTMP evaluation. If a stand table projection is used, the maximum desired period of projection is 15 years. The assumptions of consistent height-to-diameter relationship, representative local volume table, and growth rates do not allow a longer projection using this method. The assumptions of mortality and particularly ingrowth are important in validating the sustainability of the projections. This data may be used in the future to determine the success of the projections and aid in determining whether the objectives of uneven-aged management and sustained yield are being met. (PRC § 4594.7)

Information Requirements:

a. Model documentation. If a publicly available growth and yield model is used, such as CACTOS, CRYPTOS, or FVS (Prognosis), submitters should document all the user-specified options of the models, such as calibration to local conditions, merchantability limits, mortality, and ingrowth. Such documentation should establish the suitability of the model to the site.

b. A description of all the silvicultural prescriptions used in modeling growth over time.

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Review Guidelines:

Local expertise and published growth information should be the primary evaluation criteria for growth projections. Growth projections that fall within reasonable and expected ranges should not require detailed scrutiny. CAL FIRE may require more detailed explanation of growth projections that fall substantially above or below what would be expected in a particular area.

2.1.3 Planning Horizon

The submitter may select the planning horizon length, but it should be long enough so that sustainability may be evaluated. This includes showing how the minimum of 12-15 ft^2/acre of greater-than-or-equal-to-12-to-18-inch-dbh trees are to be maintained (depending on whether 14 CCR § 913.1(c)(1)(A) [933.1(c)(1)(A), 953.1(c)(1)(A)] or 913.2(b)(6) [933.2(b)(6), 953.2(b)(6)] apply).

Information Requirements and Review Guidelines:

A harvest schedule spanning the submitter-defined planning horizon as per 14 CCR § 1090.5(j).

3. ADDITIONAL REQUIREMENTS FOR USING OPTION B

3.1 BALANCING GROWTH AND HARVEST OVER TIME

3.1.1 Growth Projections

14 CCR §§ 913.11(b)(4) [933.11(b)(4), 953.11(b)(4)] requires an estimate of LTSY and further requires that harvest in all planning periods must be less than or equal to the LTSY estimate. Growth projections over a 100-year planning horizon are necessary to estimate LTSY by the definition in 14 CCR § 895.1. In order to evaluate the validity of the LTSY estimate, CAL FIRE also needs to evaluate the growth projections on which the LTSY estimate is based.

Additional Information Requirements:

a. Examples of 100-year growth and harvest projections for representative cover types, site classes, and silvicultural prescriptions found on the NTMP area. Enough projections should be submitted to enable CAL FIRE to evaluate the validity of the projections across representative conditions found on the NTMP area.

3.1.2 Long Term Sustained Yield (LTSY)

14 CCR § 913.11(b)(4) [933.11(b)(4), 953.11(b)(4)] requires an estimate of LTSY and further requires that harvest in all planning periods must be less than or equal to the LTSY estimate. Because of the large number of intermediate calculations that go into the LTSY estimate, CAL

FIRE needs information on the harvest scheduling model as well as the LTSY calculations in order to determine the validity of the LTSY estimate.

LTSY is defined in 14 CCR § 895.1 as "the average annual growth sustainable by the inventory predicted at the end of a 100 year planning period." This definition is based on the idea that in a sustainable forest, growth will equal harvest (Davis and Johnson[24]). Meeting the BOF definition necessarily requires estimating average growth on after-harvest inventory in the last planning period and demonstrating that this growth is sustainable.

NTMP submitters may use proprietary harvest scheduling models or substitute a sequential stand-by-stand growth and yield analysis in lieu of a formal forest-wide harvest schedule. This is acceptable, however, it is still the submitter's responsibility to track total growth across the NTMP area over 100 years to estimate LTSY by the BOF definition.

Information Requirements:

a. A technical description of the harvest schedule, sufficiently detailed to satisfy reviewers that the resulting LTSY estimate is defensible. Less detailed descriptions would be required for well known analysis tools such as SARA than for proprietary models developed by the landowner. The documentation should contain a complete description of land base strata, silvicultural prescriptions used, and all assumptions pertaining to the harvest schedule. Plans for discretionary investments in future growth enhancing treatments can be supported by historical records of similar current investments.

b. An estimate of the resulting LTSY, a demonstration of the sustainability of that estimate, and a description of how the estimate was reached. This should include a list of the LTSY contributions from the major strata or logical stand groups used in the analysis. This list of LTSY contributions is necessary for CAL FIRE to establish the validity of the estimated LTSY.

c. Description that shows harvest in each planning period is less than the LTSY. This requirement is probably most easily met by providing a table showing growth on residual inventory, harvest, and pre- and post-harvest inventory in each planning period.

3.1.3 Planning Horizon

The BOF findings state:

> "... Should they choose to use (a) or (b) they will be required to balance growth and harvest over time (over the 100 year planning horizon)."

Also, as noted in the definition of LTSY, a planning horizon of 100 years is required to estimate LTSY.

Information Requirements and Review Guidelines:

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A harvest schedule as described above developed over a 100-year planning horizon, which includes growth on residual inventory in the last planning period.

3.1.4 Consistent Prescriptions

In addition to forest regulation issues, consistent prescriptions over time are a basic assumption in harvest scheduling. All other factors constant, a shift toward conservative prescriptions in the latter part of the planning period increases the LTSY estimate, but violates this assumption. Because CAL FIRE is charged with ensuring that the LTSY estimate developed as part of demonstrating MSP under 14 CCR § 913.11(b) [933.11(b), 953.11(b)] is correct, CAL FIRE needs enough information to determine if management prescriptions are consistent across the planning horizon.

Recalling the fundamental concepts of harvest scheduling helps define unrealistic management in the latter part of the planning horizon: in a situation where the crop to be harvested often takes 50 to 100 years to mature, the purpose of a long planning horizon is to estimate the long-term consequences of consistently applying near-term management trends over time, not to predict future events and how to react to them[25]. In the absence of forest control goals, a substantial change in management direction during the latter part of the planning horizon can artificially boost the LTSY estimate, thereby allowing higher immediate harvest levels.

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Information Requirements and Review Guidelines:

In order to determine whether the LTSY estimate is a realistic projection of management patterns into the future, CAL FIRE needs the following information:

a. Descriptions of all management prescriptions used in the harvest schedule.

b. A list of the acres assigned to each management prescription in each planning period.

All other factors constant, acres by prescriptions should be reasonably uniform throughout the planning horizon. However, the issue of consistent prescriptions must be separated from bona fide forest regulation issues. For example, in a forest with an initial structure that is different from what the landowner wants to achieve, changing management direction may be required throughout the planning interval in order to achieve a forest regulated to the landowner's goals at the planning horizon. As a general guideline for review, all substantial changes in management direction over the planning horizon should be linked to a well defined forest management goal in the harvest schedule.

3.2. CONSTRAINTS IMPOSED BY OTHER FOREST VALUES

14 CCR §§ 913.11(b)(2) [933.11(b)(2), 953.11(b)(2)] and 913.11(b)(3) [933.11(b)(3), 953.11(b)(3)] of the forest practice rules state that submitters must account for limits on productivity due to constraints imposed from consideration of other forest values, including but not limited to:

Soil, air,
Fish and wildlife,
Water resources,
Range and forage,
Employment and regional economic vitality, and
Recreation and aesthetic enjoyment.

In order to determine whether this requirement has been met, CAL FIRE needs sufficient information to ascertain whether limits on productivity are set by any of these other forest values. In order to evaluate whether the requirements of 14 CCR §§ 913.11(b)(2)-(3) [933.11(b)(2)-(3), 953.11(b)(2)-(3)] have been met, CAL FIRE also needs to determine if the submitters have accounted for constraints from other forest values in their estimate of LTSY. Other forest values are usually incorporated in harvest schedules by either restricting the timber land base, or the management prescriptions allowed. Either option has the potential to reduce the LTSY.

Information Requirement:

In order to meet the requirements of 14 CCR §§ 913.11(b)(2), (3), and (4) [933.11(b)(2), (3), and (4), 953.11(b)(2), (3), and (4)] the submitter must establish a link between the restrictions on timber production imposed by wildlife, watersheds, and other public trust resources and their analysis of timber growth and harvest:

a. Identify the constraints imposed by these other forest values.

b. Quantify them if relevant for their unique ownership.

c. Adjust the LTSY if any of the constraints do indeed affect timber productivity.

Steps a. - c. can be achieved by summarizing the acreage allocations and management prescriptions used to address each of the other forest values.

Review Guidelines:

The submitter should address each one of the other forest values listed in 14 CCR §§ 913.11(b)(2)-(3) [933.11(b)(2)-(3), 953.11(b)(2)-(3)] to the level of detail necessary for their unique ownership. For example, regional economic vitality and employment could consist of a brief description of anticipated effects. Wildlife constraints analyses in many cases could require addressing all the major species in the NTMP area that may be affected, using publicly available data such as the WHR database.

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APPENDIX III

Inventory Stratification

Is it Necessary in Appraising Sustainability?

Key terms: forest, stand, silvicultural system, forest regulation, components of growth, stand dynamics, stratification key, minimal mapping standards, RPF efficiency.

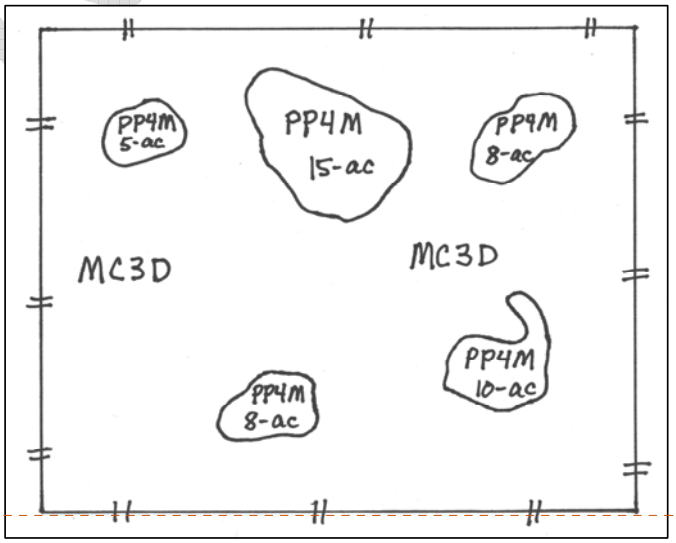
Stand versus Management Unit

In the practice of forestry the basic unit of resolution is a stand. Therefore, what considerations go into defining a stand? Is it equivalent to an ownership, a previous harvest plan encompassing broad areas such as an entire slope, or one or more drainages? Is a stand something having a refined resolution, which is more driven by ecological aspects in combination with these other elements?

Figure 1 represents a common case found in NTMPs. In this example, two distinct vegetative types are present, which are differentiated by species, tree size, and density. Some RPFs may choose to group both types together into one stand. Reasons for this strategy vary, including the stands' location relative to past THP or present ownership boundaries, the Forest Practice Rule's (Rules) lack of a minimum mapping standard for stand types, and minimum mapping standards for Erosion Hazard Rating (EHR) or site class determination. (EHR mapping standards are based on 20-acre minimums, whereas 10-acre standards apply to mapping of site class.)

Another related element is inclusion of disparate stands into one type based on geographical separation of individual polygons that comprise the distinct vegetative type. Again, referring to Figure 1; the PP4M stratum is made up of 5 individual polygons that are geographically separated, but collectively represent about one-fifth of the total area. This example holds true even if the PP4M stratum was represented by grass, brush, hardwoods, or recently established conifer plantations. A unique stratum that represents a significant proportion of the forest may be overlooked or discounted.

Figure 1. Representation of an ownership composed of two vegetative strata. Strata differences are explained by species composition, tree size, and density.



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Recently, Registered Professional Foresters (RPFs) preparing Non-Industrial Management Plans (NTMPs) and CAL FIRE Review Teams have been engaged in debate centered on the necessity of stratifying inventories as part of preparing a growth and yield sustainability assessment. NTMPs representing areas as large as 2,500 acres have been submitted to CAL FIRE based on one average stand description representing the range of vegetative conditions found across the plan area. Such plans include a vegetative spectrum from mature timber to hardwood-dominated to grassland ultimately planned for conifer reforestation. Other NTMPs have been based on a stratification key that produces four to eight strata. Examples include a 650-acre plan having 14 types, and a 2,500-acre plan having 18 types. ¶
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Some foresters contend one tree list—that reflects the average stand structure for an ownership—is sufficient to address management targets and concepts of sustainability across the multitude of forest composition, structure, and site productivity conditions that exist within an ownership. For discussion purposes the Department describes this as a total ownership approach. Typically, growth and harvest projections span one to several decades and conclusions made about desirable goals, and corresponding timelines to achieve these goals, are based on unsupported representations. ¶
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Conversely, other foresters divide forests into stands or strata composed of similar characteristics in order to appraise age class distributions (both within a stand and across multiple stands), stocking levels, and the varied productivity levels typically found across sizable landscapes. From this level of detail they subsequently make growth and harvest projections in developing a harvest schedule based on landowner goals. ¶
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because of its dispersion across the landscape.

The Rules do not specifically include a requirement to stratify an inventory into aggregates composed of like vegetation. Purely from an inventory standpoint, stratification is not necessary. The real question is whether stratification is necessary for the purpose of making management decisions and reliable projections of growth.

Regulatory Requirements and Guidance

The Rules provide no definition of a stand. However, authoritative forestry texts in mensuration, silviculture, and forest management offer definitions that are comparable to the one offered by the Society of American Foresters (SAF). SAF defines a stand--as it relates to silviculture-- as "a contiguous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit."[26]

Although the Rules do not define stand, they do include a term that is predicated on stratifying a forest into distinctive vegetative types. Comparable with usage in forestry texts, the Rules define silvicultural system as (emphasis added) "the planned program of forest stand treatments during the life of a stand. It consists of a number of integrated steps conducted in logical sequence leading to or maintaining a forest stand of distinctive form for the level of management intensity desired" (14 CCR § 895.1).

The Act and Rules do require stand level descriptions of the NTMP area. PRC § 4593.3(f) requires as a part of the contents of an NTMP (emphasis added):

> A description of the existing stand, its current projected growth, alterations required to achieve the management objectives, the projected timber volumes and tree sizes to be available for harvest, and projected frequencies of harvest.

14 CCR § 1090.5(g) requires as a part of the contents of an NTMP (emphasis added):

> A description by management unit(s) of the timber stand characteristics including species composition, age classes, projected growth, present stocking level, present volume per acre, size class distribution, stand management history, and potential pest or protection problems.

CAL FIRE suggests using stratification to ensure accurate and verifiable projections of sustainable growth and yield. This should allow CAL FIRE to verify the demonstration of MSP and sustainability at any point in time over the course of implementation. Plans based on stratification permit CAL FIRE to evaluate growth and yield projections during the plan review process and track in subsequent NTOs whether the proposed management complies with the Rules and the management scheme outlined in the plan.

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Deleted: lans based on unsupported representations that can only be verified after a future re-inventory has been completed do not meet the test of demonstration. Also, once an NTMP is approved, Legislation removes governmental discretion to review harvest notices, allowing operations to commence immediately. For this reason, p

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Application of the Forest Practice Rules

Specific factors found in the Rules that RPFs should utilize when considering identifying stands are listed below. Forest Practice Rule requirements will be utilized by CAL FIRE in evaluating the information provided in an NTMP relative to growth and yield.

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14 CCR § 913.2 [933.2, 953.2] Regeneration Methods Used in Unevenaged Management

Concepts about sustainability are based on properly assessing and managing existing age class distributions, and promoting development of new age class cohorts. Collated and averaged information diminishes the ability to assess variance within and between stands. This may make it difficult for CAL FIRE to determine whether or not the proposed harvest activities conducted under an NTMP will be consistent with the stocking requirements of the Rules.

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14 CCR § 913.2 [933.2, 953.2] states:

> Unevenaged management is utilized to establish and maintain an unevenaged stand structure. Unevenaged management attributes include the establishment and/or maintenance of a multi-aged, balanced stand structure, promotion of growth on leave trees throughout a broad range of diameter classes, and encouragement of natural reproduction.

Unevenaged stand structure, multi-aged, balanced stand structure, and promoting natural reproduction are concepts that are addressed at the stand level. Differences in species silvics and site productivity will influence the post harvest growing stock density levels, regeneration levels, rate of ingrowth, and the selection of a cutting cycle period. For example, to successfully establish a new age class and capture site productivity under an uneven-aged silvicultural system, overstory retention criteria for timber site classification I lands would be expected to differ from that for site classification IV. Given this point, a reserve growing stock level of 160 ft^2/acre of basal area prescribed for site class I is likely too high for site IV in promoting natural regeneration. Combining inventory data from multiple stands may not facilitate proper assessment of the management strategies and silvicultural application necessary at the stand level.

14 CCR §1090.5(g)

This code section requires information on "species composition, age classes, present stocking levels, size class distributions, stand management history, potential pest or protection problems." In terms of making management decisions, each of these attributes is most meaningful when information is collected and expressed at the stand level. For example, in many environments hardwoods are a vigorous competitor on southern aspects and can directly suppress conifer growth. Broad approaches that rely on stand averages of widely differing stand types may fail to disclose actual stand characteristics.

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14 CCR §1090.5(i)

This rule requires information about "projected frequencies of harvest" and "silvicultural prescriptions for harvesting." Forests are typically composed of stands characterized by a unique structure, density, composition, and productivity rate. These stands may have their own unique silvicultural prescriptions and corresponding yield streams. Even though the plan preparing RPF may recognize the areas that he or she intends to harvest during the initial entry in an approach that treats the entire ownership as one stand, failure to evaluate the unique and differing yield contributions from differing stands may compromise the quantitative assessment of sustainability.

14 CCR §1090.5(j)

This code section requires the RPF to specify "[t]he period of time over which growth will be balanced with harvest." The concept of balancing growth with harvest over time should communicate the same ideas as sustainability, sustained yield, long-term sustained yield, and non-declining even flow. A growth and yield projection is a forecast of desired sustainable harvest levels, which includes the intermediate or transitional treatments necessary to reach those desired harvest levels. If the initial quantitative growth and yield analysis projects that the balance between growth and harvest will occur in the fifth decade, but in time balance actually occurs in the fourth or even sixth decade, this fact does not invalidate the initial analysis. One must recognize that a forecast is simply that. The forecast is based on what is known today; this includes the defined management goals and accuracy levels of the growth model. Growth models such a Forest Vegetation Simulator (formally known as *Prognosis*) are constantly re-fitted as re-measurement data is obtained. From a projection standpoint, stochastic events such as wildfire or insect outbreaks are not normally addressed unless they occur in clearly predictable cycles.

Management Planning

The principal elements that go into a forest management plan are based on an understanding of the following:

- A forest is defined as (emphasis added) "an ecosystem characterized by a more or less dense and extensive tree cover, often consisting of stands varying in characteristics such as species composition, structure, age class, and associated processes, and commonly including meadows, streams, fish, and wildlife." [28] Concepts of forest management are based on dividing a landscape into areas having like characteristics. Contained within a forest management plan is a schedule of forest regulation.
- Forest regulation is defined as "the technical aspects of controlling stocking, harvests, growth, and yields to meet management objectives including sustained yield." [29] Various disciplines within forestry, such as mensuration, silviculture, growth and yield, harvest scheduling, and financial appraisals, coupled with environmental assessments such as those based on California Wildlife Habitat Relationships and rates of harvest within watersheds, all rely on stratifying a forest inventory for the purpose of making management decisions.

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Deleted: [27] describe "three essential elements…required to manage and plan a forest in any coherent, quantitative way. Each element has a corresponding management decision that must be made at the outset of planning." These essential elements include the following:¶
<#>A land-type classification scheme which is based on dividing a forest into homogeneous stands.¶
<#>A management activity schedule describing the timing, methods, and conditions by which the vegetation and other resources will be manipulated or disturbed to achieve desired outcomes, including ¶
<#>Logging rules (e.g., marking prescriptions). ¶
<#>A timber thinning and harvest schedule.¶
<#>Regeneration techniques for the next tree crop.¶
<#>A quantitative growth and yield projection, which "numerically describes how much timber is expected for commercial harvest; specifically, volumes removed at each thinning and final harvest entry for both the existing and subsequent regenerated stands."¶
¶
The Rules do not explicitly speak to item (1), but much of the documentation in the Board's Silviculture Rule Making Files include chapters excerpted from forestry text books. Much of the subject matter is based on the concept of stands or homogeneous vegetative units. ¶
¶
Item (2) is encompassed in the Rules for what are defined as silvicultural methods and silvicultural system. 14 CCR § 895.1 states that silvicultural methods is synonymous with silvicultural system, which is defined as "the planned program of forest stand treatments during the life of a stand. It consists of a number of integrated steps conducted in logical sequence leading to or maintaining a forest stand of distinctive form for the level of management intensity desired." ¶
¶
Item (3) is addressed in various sections of the Act and Rules. 14 PRC § 4593.2 of the Act along with 14 CCR § 895.1 define sustained yield as "the yield of commercial wood that an area of commercial timberland can produce continuously at a given intensity o ... [4]

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An assessment of sustainability includes three parts:

(1) Proper establishment of the baseline conditions.
(2) Identification of stocking levels that optimize the site for the given products desired.
(3) Identification of the intermediate or transitional treatments that are necessary to reach desired stocking levels.

Making accurate growth and yield projections requires that a forest is divided into units composed of like characteristics. Models such as Forest Vegetation Simulator and CRYPTOS are constructed based on tree and site data originating from stands that have unique characteristics. Key elements for any growth projection include consideration of the following factors:

- Individual Tree Growth and Silvics of the Species Present.
- Stand Growth.
- Stand Typing and Stratification.
- Competition and Stand Differentiation.
- Inventory Designs for Making Management Decisions.

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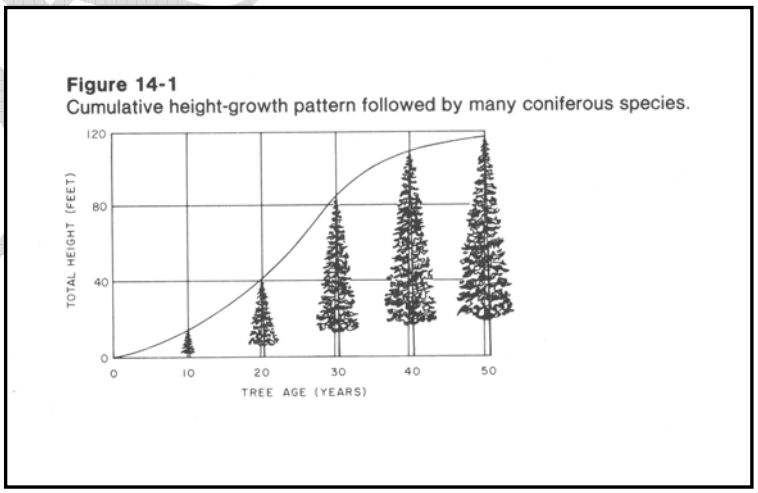
Individual Tree Growth and Silvics of the Species Present

Designing a harvest schedule is dependant on making accurate growth projections, which requires recognition of tree growth theory and components of stand growth. As illustrated in Forest Measurements (Avery and Burkhart, 1983), Figure 2 depicts the cumulative height growth pattern followed by many coniferous species. The shape of this curve (elongated S-shaped pattern) is described as sigmoid, and the significance is that most functions of tree growth such as diameter, basal area or cubic volume can be described by this pattern.[30] The exact form or amplitude along both the x- and y-axis of a cumulative growth curve will vary by

Figure 2. The cumulative height-growth pattern followed by many coniferous species. X-axis is total tree age; y-axis is total height in feet.

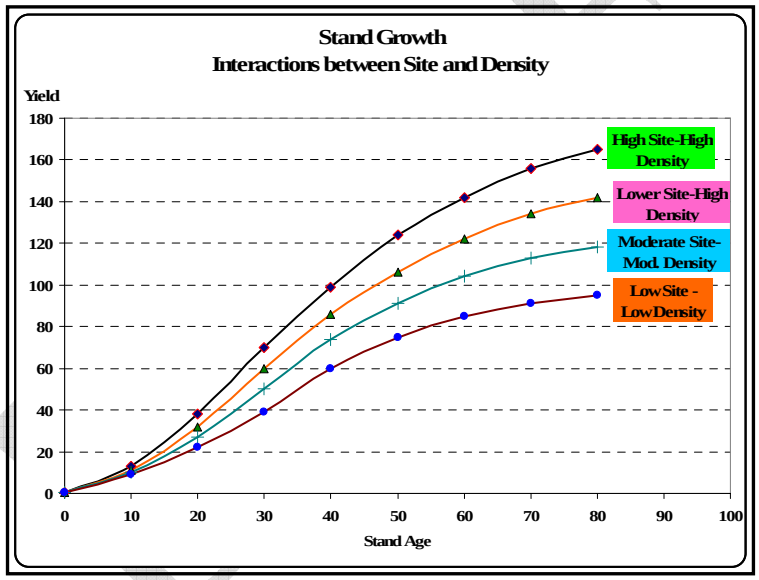


independent variable used, therefore, measured growth rates, for example by diameters, cannot be extended to patterns in height growth and vice versa.

Stand Growth

The summation of each individual tree growth curve would produce similar sigmoid-shaped curve patterns to reflect stand growth. Figure 3 represents a simplified illustration of stand growth where differences are a function of density and site. Appreciably altering any one variable will result in a different yield trajectory. What is important to note in Figure 3, other than differences in yield, are productivity rates at specific points in time. For example, between the high-density curves at the 30-to-40 year period, the difference in productivity is roughly 12%, whereas the difference between the highest and lowest yield curves for the same period is about 28%. Once again, reliable growth projections are dependent on developing representative stand types, and stand typing is a crucial element of harvest scheduling.

Figure 3. The interplay between site and density in total yield.



Sampling to determine growth movement ratios for growth and harvest projections from a stand-table projection worksheet reflect competition and productivity levels that are expressed at the stand level. The rate of tree growth, whether measured in diameter, height, form, or volume, is heavily dependent on relative age.[31] Consequently, future projections of growth based on measures of past growth should be limited to short periods of time, typically not more than 15 years. Otherwise, large errors will result by assuming that future growth is equivalent to past growth. Avery and Burkhart (1983) provide a rule-of-thumb that growth predictions from diameter relationships are most reliable during the midlife of a tree when size increases can be

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characterized by the central (near linear) portion of the cumulative growth curve (see Figure 2, curve segment corresponding to years 20 to 30). In addition, growth projections derived from increment borer samples can contribute erroneous estimates as patterns in radial growth can vary significantly based on the radii that is measured.

Stand Typing and Stratification

The purpose of stand typing[32] is to divide a forest into units having similar characteristics for the purpose of devising silvicultural prescriptions that produce desirable products without depleting the productive capacity of a site. A prescription is "a planned series of treatments designed to change current stand structure to one that meets management goals that normally considers ecological, economic, and societal constraints."[33] In developing a stratification key, the decision criterion for sub-dividing a forest into smaller sub-units should include the components of growth, possibly differences in harvest systems, and differences in silviculture targets.

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Important components of growth at the stand level include: (1) density, (2) site productivity, (3) age, and (4) species composition. Each component plays a significant role in growth as the interplay of these components affects growth patterns. Consequently, it is important to understand and recognize these significant components, since the application of a specific growth and yield model (emphasis added) "assumes a relatively homogeneous stand with regard to independent variables (e.g., age, site index, BA) used to predict stand values. If there is significant variation in variables such as site or stand density for a given area, the area must be stratified into reasonably homogeneous stands and predictions made separately for each of these stands to ensure accurate results."[34]

When assessing whether to differentiate two potential strata, the RPF may want to devise site and area rules (or thresholds) as part of the decision process in a stratification key. Site rules refer to relative differences in those stand variables that are being compared, such as differences in density or timber site classification. Area rules refer to the relative representation in terms of area or acreage between any two potential strata that are being appraised in terms of a site rule. For example, an ownership has been cruised and candidate stand A has an average basal area of 200 ft^2/acre, and candidate stand B has an average basal area of 160 ft^2/acre. Stand A represents 80% of the total timbered ownership, and stand B represents the remaining 20%. The differences in basal area and the acreage covered by each respective stand may result in significantly different silvicultural prescriptions and corresponding yield stream contributions to the overall harvest schedule. Depending on the level of significance in the difference, such differences could justify separate appraisals. Ultimately, the RPF is responsible for defining an appropriate stratification key that results in reliable projections of growth.

Successful stratification of most forests can be accomplished based on species composition, density, tree size, and site productivity. Sometimes tree size and site productivity are similar across a forest, thus reducing a stratification key down to two variables.

(1) Density

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Stand density has a significant effect on yield. A major consideration in appraising sustained yield is ascertaining optimum density levels to maximize productivity. As differences in stand density increase, the corresponding differences in growth, along with applied silvicultural treatments and targets (i.e., residual stocking and diameter distributions), and their timings, may differ sufficiently to justify separate appraisals.

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(2) Site Productivity

Site index[35] is the standard measure of site quality. Growth curves of site index represent the interaction between a specific species' population and its environment. Site index is typically applied as an independent variable in growth and yield forecasting. Krumland and Eng (2005)[36] report (emphasis added):

> Experimentation with the CRYPTOS and CACTOS growth models (Wensel et al., 1987, 1986) indicates that altering site index input values by 10 percent results in differences in growth estimates of 2-15 percent depending on which stand attribute is being examined (basal area, cubic volume, board foot volume, stand density, age of development, species composition and a variety of other factors). As a rough rule of thumb, percentage differences in site index result in differences in growth predictions of a comparable magnitude.

The Rules define site productivity by five site class ranges. From a technical aspect, site class has the most profound impact on growth projections. Preferably, strata should be modeled by site class. For example, site class I should be modeled separately from site II, and so on. However, MSP analysis should be based on site class groupings that follow the Rules' minimum stocking standards. These standards are based on three independent site class groupings: (1) site class I; (2) site class II and III; and (3) site class IV and V.

Deleted: The Department will consider deviations from this, such as combining a high site class IV ground with a low site III, provided that modeling and actual on-the-ground targets are not based on the minimum standards for a given site class, but have a higher retention standard.

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(3) Age

Age is another important variable as it relates to an even-aged stand[37] and an uneven-aged stand[38]. Age is important in designing a group selection prescription and in creating new age classes under single-tree selection.

As a substitute for age, differences in stand structure such as distributions of basal area or trees per acre by 2-inch DBH classes may be an acceptable way to describe a stand having more than one age class. Conceivably, the two stands in Figure 4 could have the same age, but differ by site productivity.

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Age—Structure Relationships

Structure thresholds are a bit more problematic to define. Appreciable differences in structure that require different prescription targets should necessitate separate analysis. The two stands portrayed in Figure 4 have precisely the same BA but differ in diameter distributions, which could result in different growth trajectories and different prescriptions.

(A word of caution: avoid the temptation to assume that a bi- or multi-modal diameter distribution reflects a stand having more than one age class. Many second growth stands having originated from a single event may have two or more modes as a result of one or more harvest entries. Thus, what appears to be a multi-age stand is actually made up of trees originating at the same time.)

(4) Species Composition

Species composition will vary with environmental factors and management objectives. Generally speaking, individual species found in a mixed species stand will have their own unique growth curves. Insofar as the yield curves associated with different species aggregations are sufficiently unique, the RPF may have to develop specific silvicultural prescriptions. As differences in species composition affect the choice of silvicultural treatments and their timings, the RPF may consider separate appraisals.

RPFs should also recognize that the potential number of individual stand types that are generated based on a particular stratification key can be overwhelming. Stratifying highly variable landscapes can be a challenge to foresters. Standard typing keys may require modification or aggregation into larger analysis units or both in order to make the analysis manageable from a modeling and prescription writing perspective. Often this will involve combining stand types that are relatively similar. Considerations for combining stand types into larger strata are presented further in this document.

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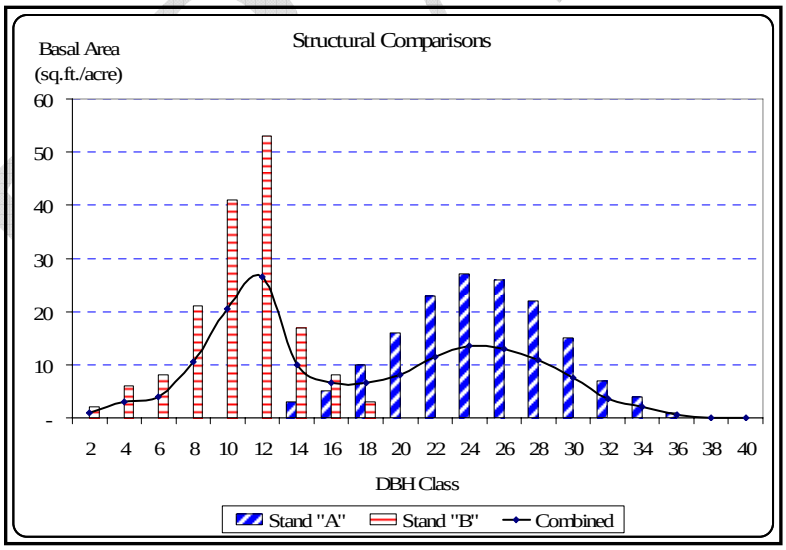
Competition and Stand Differentiation

Stocking density, crown position, species, and genetics are all important elements that define competition within a species and between species at the stand level. As a result of competition, a stand will differentiate over time as differentiation of crown classes progresses. For these reasons, foresters should cautiously assess the correlation of tree size with age and not automatically assume that the smaller DBH classes found in a stand reflect younger age classes.

Inventory Designs for Making Management Decisions

Purely from an inventory standpoint, stratification is not necessary if the sole purpose is to determine total standing inventory. However, reliable growth projections are based on simulating prescriptions that emulate what will be implemented on the ground. Another analogy can be explained using Figure 4, which describes diameter distributions for a stratified forest. Both stands, although having the same basal area (159 ft^2/acre), are represented by contrasting diameter distributions, which are on different growth trajectories, and, as a result, should be managed differently. In this example, combining both stands to reflect one average stand for the ownership and subsequently making growth and harvest projections could produce unreliable results, which would likely not reflect the actual on-the-ground management prescription. Two scenarios are presented below that illustrate this point.

Figure 4. Diameter distributions for two discrete stands, and both combined.



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Scenario #1:

Figure 4 portrays two discrete stands that represent a forest. Desired management is based on group selection where initial entries are commercial thinning stand "B" and those portions of stand "A" that are not regenerated by group selection. Both stands originated from a single event and are even-aged. The commercial thinning prescription calls for moving the diameter distribution towards the dominant and co-dominant elements of each stand, harvesting most of the suppressed and intermediate elements, and spacing out the dominants and co-dominants. As for the over-lapping diameter distributions, most of the 14- to 18-inch DBH classes will be harvested in stand "A," whereas a majority of this same distribution will be retained in stand "B."

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Using a growth model, whether an individual tree model like CRYPTOS, or a spread sheet type Stand Table Projection, it is impossible to aggregate data from multiple stands and site classes, make projections of growth and harvest under various silvicultural prescription and then disaggregate the single stand data back into their respective strata at the level of detail necessary to implement a marking prescription.

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Scenario #2:

The combined curve in Figure 4 represents the average for both stands combined. This curve has a bi-modal distribution and on first appearance conveys a stand having two distinctive age classes. Although the plan preparing RPF may be able to associate each mode with actual on-the-ground location and envision the future for each stand, without substantial qualification this data conveys limited information useful to management planning. Any growth projections based on this data will not be reliable. Moreover, in a combined distribution, if single-tree selection is prescribed, a combined sample does not lend itself to addressing age class distributions and whether applied management practices will ameliorate or exacerbate potential gaps. A successful sustainability plan is based on appropriate management of existing age class distributions and creating new age classes.

Sampling Design and Intensity

The foundation of every statistical problem begins with concepts that define a population. Statistical texts define population as a set of data that characterizes an attribute. This attribute relative to the evaluation of sustained yield is growth. The second element of a statistical problem is the sample, which is defined as a subset of data selected from a population. The third element of a statistical problem is the inference. A statistical inference is defined as an estimate or a prediction about a population based on information contained in a sample. The forth and most important element of a statistical problem is a measure in the reliability of the inference.

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Recognizing these elements of statistics, the primary purpose in stratifying a forest into like stands is to make inferences about growth that has associated with it a level of reliability (i.e., statistical significance). The Act and Rules do not define statistical standards for NTMPs. However, 14 CCR § 1091.4.5(c)(4) defines standards for the Sustained Timber Production

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Assessment of a Sustained Yield Plan. The Rules define standards in terms of standard errors that are no greater than 15% of their respective inventory estimates for the major vegetative types (emphasis added).

In CAL FIRE's review of inventory data presented in an NTMP, one of the key evaluation points is how representative the sampling methodology is. **S**pecifically, does the sample data reasonably reflect what is on the ground? In order to ensure a high level of statistical validity associated with growth projections, CAL FIRE recommends a sample design and intensity that will produce reliable growth projections for the major strata found on a plan.

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Combining Stand Types

Considering all of the variables and any vagaries that might be associated with an inventory stratification process and growth and harvest simulation, the potential number of stand types (i.e., strata) that could be derived based on a selected standard could be unmanageable. When a project presents a large count in stand types, appraising for growth on each stratum could translate into an overly burdensome task that likely could compromise bringing the project to fruition. Consequently, gross stratification of the lesser represented populations may be prudent with proper justification that resulting projections of growth remain reasonable.

For projection purposes, combining different stand types into larger stratum is a reasonable strategy for approaching situations where the number of stand types is unwieldy from a growth projection standpoint. In general, these situations typically occur due to limited area of a distinct stand type or types being represented on the NTMP to justify making a separate projection. Where this occurs, it may be necessary and acceptable to combine the acreage with larger similar stand types. This situation can also occur when unmappable microsite conditions make delineation infeasible.

Under either of these situations, where it is necessary to combine strata that are similar in terms of density, composition, and productivity, the RPF will need to develop a reasonable approach to modeling. This approach should reflect the aggregation strategies, describe the decision process and criteria utilized to create the strata, and include management guidance in the terms of prescriptions that provide clear direction relative to how stands will be marked and managed under the current and future harvests planned under the NTMP. The initial stratification key and associated mapping should also be maintained by the RPF for reference during implementation.

Defining an Appropriate Mapping Resolution for Sustainability Assessments

Defining a minimal mapping unit is a major consideration in developing a long-term management plan. Issues of stocking and productivity are critical elements in a sustainability assessment that should be addressed at more appropriate scales than what is defined for EHR or site class mapping standards. Sustainability is based on managing existing age class distributions, creating new age classes, and enhancing stocking levels that approaches an optimum level given carrying capacity of the site. In an uneven-aged system, successful natural regeneration is partly a function of seed dispersal from seed trees. Considerations for moving an

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ownership towards productivity levels that approach optimum levels should give weight to those elements that have the greatest bearing on realizing potential for each site.

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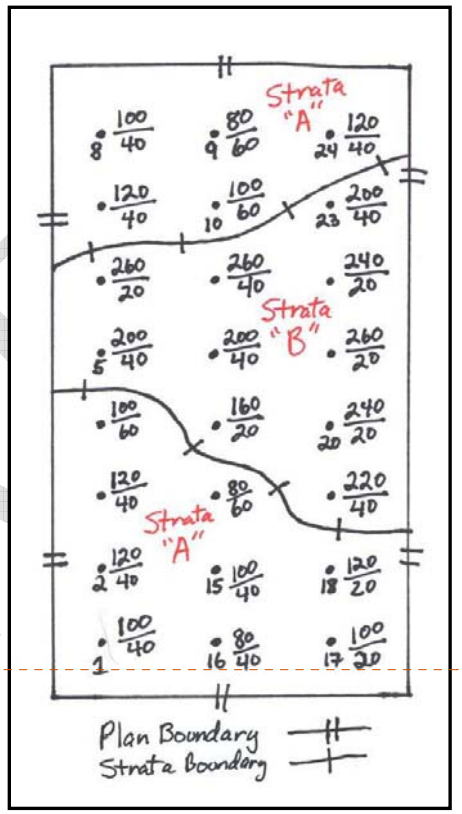
Aids to Delineation--Cruise Plot Mapping

Another useful aid for evaluating strata differences is a cruise plot map. This is constructed along the lines of a planimetric map of the ownership or management unit[39] at a scale that allows inscription of each plot location and associated plot number, along with conifer and hardwood density measures in a numerator and denominator form next to each plot. Figure 5 illustrates an example commonly used with aerial photography as an aid in delineating potential strata. In the absence of high resolution aerial photography (e.g., 1:15,840—4”/mile), additional field work will likely be required to accurately map strata boundaries.

Figure 5. Example of a cruise plot map for strata delineation.



RPF Efficiency—Professional Responsibility—Scope of Project

RPFs should consider the scope and complexity of a project, which requires producing a harvest schedule that complies with the Rules, in relation to his or her technical skills, and, as necessary, consult with appropriate qualified professionals (see PRC §752(b) of Professional Foresters Law).

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Conclusion

To a large extent, regulations addressing maximum sustained production and sustained yield are a performance-based approach, reflecting the landowner’s management objectives, with baseline stocking defined by the Forest Practice Rules. In many cases landowners may and have elected to exceed the minimum stocking standards to achieve a higher productivity level or a variety of other management objectives. The rules allow the RPF to define performance standards with the expectation that RPFs rely on standards and practices recognized in each respective discipline of forestry. The subject of this paper addresses fundamental issues that RPFs should recognize as important building blocks for use in preparing an NTMP. Ultimately, since an NTMP represents a permanent harvest permit, an NTMP must be sufficiently detailed so that subsequent RPFs that assume a plan in the future will be able to continue to implement it.

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APPENDIX IV

CDF Policy Regarding Applicability of Intermediate Treatments In NTMPs That Demonstrate MSP by Option C

State of California **The Resources Agency**

M e m o r a n d u m

To: Region Chiefs
Assistant Region Chiefs
Unit Chiefs
Forest Practice Staff

Date: July 15, 2002
R30
Telephone: (707) 576-2275

Website: www.fire.ca.gov

From: Dean Lucke
Assistant Deputy Director, Forest Practice
Department of Forestry and Fire Protection

Subject: Revision of CDF policy regarding the applicability of intermediate treatments for NTMPs that demonstrate MSP by Option C [(14 CCR 913.11-, 933.11-, 953.11-(c)].

On February 1, 2002, CDF defined policy as it relates to the use of intermediate treatments in a NTMP that proposes the demonstration of MSP under an Option C. This memorandum defines modification to this policy after receiving rule interpretation from the Board of Forestry and Fire Protection's Interim Committee during the June 2002 meeting.

Summary of February Policy Memorandum

The Forest Practice Rules (FPR) provide two standards for a NTMP to demonstrate MSP. CDF's February memorandum defining policy was the result of interpreting code section that distinguishes an Option B from an Option C for demonstrating MSP. CDF's interpretation was that since the legislature mandated uneven-aged management for NTMPs, an Option C MSP standard is achieved by complying with code section CCR 913.11(c)(2) which is as follows:

> *For unevenaged management, complying with the seed tree retention standards pursuant to 913.1 (c)(1)(A),…*

Thus, compliance under the Option C MSP standard is achieved when the prescription retains at least eight 18-inch DBH, or four 24-inch DBH, or combination thereof, in seed trees from the onset of any prescription implementation. Alternatively, if a proposed NTMP included a silviculture prescription of an intermediate treatment that could not meet the seed tree retention standards of 913.11(c)(1)(A), the submitter was then restricted to demonstrating MSP for the NTMP under an Option B standard. By this, CDF concluded that a NTMP had to demonstrate

MSP entirely by only one standard, either Option B or C, as the NTMP could not be partitioned into two MSP standards.

The original policy directive was the result of CDF having concerns that previously approved plans had continued to invoke intermediate treatments that appeared to be absent of a commitment to transition to uneven-aged management and the establishment in new age classes. Additionally, CDF had observed an increase in submitted plans proposing to commence with an intermediate treatment without defining a definite schedule in converting to uneven-aged management.

Policy Revision

CDF subsequently presented this policy to the Board's Interim Committee during the June 2002 meeting. As a result of discussions with the Interim Committee, CDF has revised the policy to reflect the following:

NTMPs submitted under an Option C demonstration of MSP can propose intermediate treatments and meet MSP under 913.11 [933.11 & 953.11] (c)(3) which specifies the following:

> *For intermediate treatments and special prescriptions, complying with the stocking requirements of the individual treatment or prescription.*

However, when the silviculture prescription cannot meet the seed tree retention standards [913.1 (c)(1)(A)], the submitter must comply with provisions detailed below to establish a convincing case to the Director that the objective of uneven-aged management is attainable within the specified timeline.

For a stand proposed for harvest that cannot comply with the seed tree retention standards [913.1 (c)(1)(A)], the NTMP must include a growth and yield analysis sufficiently detailed by pre- and post-harvest stand measures to allow assessment of the trajectory in stand development, to that point in time that the stand can be managed to comply with the seed tree retention standards. To establish a convincing case the following must be provided with the submittal of the NTMP:

(1) For each stand type[1], a stand table of the existing condition in per-acre basis;
(2) For each stand type, pre- and post-harvest stand tables for each growth and harvest period to that point in time that the stand can be managed to comply with the seed tree retention standards;
(3) For each stand type, beginning gross and net inventory in Scribner board feet (per acre basis), along with existing basal area, and the projected pre- and post-harvest basal area for each period demonstrated in item #2 above.
(4) Any stand that conceivably receive "staged harvesting"[2] shall provide discussion of the techniques that the RPF will utilize to ensure that each staged harvest does not over-harvest inventory that is required to ensure that the subsequent growth culminates in the stand characteristics projected at the end of the cutting cycle; Otherwise CDF will interpret that the stand will be entered only once in each cutting cycle.

Data Presentation

For each stand type identified in items 1 and 2 above, data format shall consist of a single stand table for each stand type. This table shall encompasses each Group A species by 2-inch diameter class in per-acre basis, and without coalescing species into groups. Group B species may be lumped under one column if there is no reason to appraise a certain specie representation separately.

Acceptable Models for Demonstration

Acceptable models for demonstrating this requirement are CACTOS, CRYPTOS, FVS, or stand table projection.

Re-evaluations

At the end of each cutting cycle until the point in time that the stand can be managed to comply with the seed tree retention standards, the RPF shall conduct a cruise to ascertain actual conditions with that projected, and provide a report of the analysis to CDF. The cruise shall follow conventional forestry standards and cruise plots shall be sufficiently monumented on the ground so that CDF can have the opportunity to retrace the layout in evaluating the adequacy of the cruise. Negative departures of 20% or more in actual seed trees from that projected will trigger an evaluation by CDF as to the commitment of the submitter to comply with the intent of the NTMP program.

Effective Date of Policy Revision and Allowance for Variances

This policy shall become effective immediately. However, for plans currently in review or submitted by January 1, 2003, a variance may be requested by the submitter if the detailed data cannot feasibly be obtained for those periods (i.e. cutting cycles) necessary to demonstrate when compliance with the seed tree standards will be met. In no circumstance will a variance be granted for projection of stand development in the first period. Any variance that is granted will be conditioned on the submitter providing the remaining information prior to the start of any harvests activity in the subsequent period.

Conclusion

NTMPs submitted under an Option C demonstration of MSP can propose intermediate treatments and meet MSP under 913.11 [933.11 & 953.11] (c)(3), which specifies "*For intermediate treatments and special prescriptions, complying with the stocking requirements of the individual treatment or prescription*," provided that the submitter conducts an advanced quantitative analysis having data resolution levels and timelines as discussed above.

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Page ii: [1] Deleted ehuff 9/2/2010 1:02:00 PM

Purpose **1**

Addressing Growth and Yield in NTMPs **1**

Introduction *1*

Demonstrating the Balance of Growth and Harvest Using Uneven-aged Regeneration Methods and Other Appropriate Silvicultural Prescriptions **2**

NTMP Content *3*

Silviculture *4*

Demonstration of MSP--Important Concepts **6**

Sustained Yield versus Long Term Sustained Yield *6*

Option B or C Demonstrations *10*

Option C 10

Option B 11

What Constitutes a Demonstration? *11*

Data Presentation **11**

Commonly Used Models for Growth and Yield Projections **12**

Re-evaluations **13**

CAL FIRE's Approach to the Review of NTMP Growth and Yield Related Information **14**

Inventory *14*

Growth Projections and Harvest Schedule *14*

Silviculture *16*

APPENDIX I **18**

Information about NTMP Submissions, Return Rates, Reasons for Return, etc. *18*

2003 to 2005—Non-Industrial Timber Management Plans (NTMPs), Frequency of Return *19*

Reasons for Return 20

APPENDIX II **21**

CAL FIRE Review Guidelines for CAL FIRE Review Team Staff Evaluating Maximum Sustained Production in Nonindustrial Timber Management Plans (NTMPs) *21*

1. PURPOSE AND NATURE OF THE REVIEW GUIDELINES 21

2. ALL NTMPs 21

2.1 BALANCING GROWTH AND HARVEST OVER TIME 21

2.1.1 Inventory Estimates 21

2.1.2 Growth Projections 22

2.1.3 Planning Horizon 23

3. ADDITIONAL REQUIREMENTS FOR USING OPTION B 23

3.1 BALANCING GROWTH AND HARVEST OVER TIME 23

3.1.1 Growth Projections 23

3.1.2 Long Term Sustained Yield (LTSY) 23

3.1.3 Planning Horizon 24

3.1.4 Consistent Prescriptions 25
3.2. CONSTRAINTS IMPOSED BY OTHER FOREST VALUES 25
Information Requirement: 26
Review Guidelines: 26

APPENDIX III 27

Inventory Stratification 27
Stand versus Management Unit 27
Regulatory Requirements and Guidance 28
Application of the Forest Practice Rules 29
14 CCR § 913.2 [933.2, 953.2] Regeneration Methods Used in Unevenaged Management 29
14 CCR §1090.5(g) 29
14 CCR §1090.5(i) 30
14 CCR §1090.5(j) 30
Management Planning 30
Individual Tree Growth and Silvics of the Species Present 31
Stand Growth 32
Stand Typing and Stratification 33
(1) Density 33
(2) Site Productivity 34
(3) Age 35
Age—Structure Relationships 35
(4) Species Composition 35
Competition and Stand Differentiation 36
Inventory Designs for Making Management Decisions 36
Sampling Design and Intensity 37
Combining Stand Types 38
Defining an Appropriate Mapping Resolution for Sustainability Assessments 38
Aids to Delineation--Cruise Plot Mapping 39
RPF Efficiency—Professional Responsibility—Scope of Project 39
Conclusion 39

APPENDIX IV 40

CDF Policy Regarding Applicability of Intermediate Treatments In NTMPs That Demonstrate MSP by Option C 40
Summary of February Policy Memorandum 40
Policy Revision 41
Data Presentation 42
Acceptable Models for Demonstration 42
Re-evaluations 42
Effective Date of Policy Revision and Allowance for Variances 42
Conclusion 42

Page 2: [2] Deleted ehuff 9/2/2010 11:40:00 AM

[1]).

Once the NTMP is approved, subsequent operations under the plan can be conducted under a simple notification, which is non-discretionary and allows the landowner to begin operations under the notice immediately. This ability to begin operations with a harvest

[1] **4593. Legislative findings and declaration.**
(c) The Legislature further finds and declares that it is the policy of the state to encourage prudent and responsible forest resource management of nonindustrial timberlands by approving nonindustrial timber management plans in advance and withdrawing governmental discretion to disapprove nonindustrial timber harvest notices submitted pursuant to the approved nonindustrial timber management plans.

notice is what provides the greatest flexibility for the landowner as it pertains to scheduling of harvests and the ability to take advantage of fluctuations in timber markets. These elements have been extended to the plan proponent in exchange for a clear program for managing the timber stands contained within the plan, and for a certification by the RPF that operations:

Will implement best management practices for the protection of water, soil stability, forest productivity, and wildlife, or

Are consistent with the approved plan and will not result in significant degradation to the beneficial uses of water, soil stability, forest productivity or wildlife (PRC § 4594(h)

Page 2: [3] Deleted **ehuff** **9/2/2010 11:41:00 AM**

[2]).

The Rules applicable at the time of NTMP approval govern the plan over its lifespan, thus, to a degree, sheltering the NTMP from subsequent rule changes. This sheltering is subject to the certification standards of PRC § 4594(h). Examples of where sheltering may not be appropriate include, but are not limited to, newly listed species under the state or federal Endangered Species Act or unforeseen catastrophic events.

Legislative Findings

As per PRC § 4593, the following are the legislative findings and declarations pertaining to NTMPs:

The Legislature finds and declares that a substantial acreage of timberlands of the state are held by private nonindustrial owners and that it is the policy of the state to increase the productivity of these timberlands under prudent management plans to serve the public's need for timber and other forest products.

The Legislature further finds and declares that minimal environmental harm is caused by prudent management of nonindustrial timberlands because low volume production and dispersion around the state of these small tracts reduces damage to aesthetics, air quality, watersheds, and wildlife.

The Legislature further finds and declares that it is the policy of the state to encourage prudent and responsible forest resource management of nonindustrial timberlands by approving nonindustrial timber management plans in advance and withdrawing

[2] **4594. Notice of harvest within area covered by a plan; contents of notice.** The nonindustrial tree farmer who owns, leases, or otherwise controls or operates on all or any portion of any timberland within the boundaries of an approved nonindustrial timber management plan, and who plans to harvest any of the timber thereon during a given year, shall file a nonindustrial timber harvest notice with the department in writing. A notice shall be filed prior to the harvesting of any timber and shall be effective for a maximum of one year from the date of filing. If the person who files the notice is not the owner of the timberland, the person filing the notice shall notify the timberland owner by certified mail that the notice has been submitted, and shall certify that mailing to the department. The notice shall be a public record and shall include all of the following information:

(h) A certification by the registered professional forester that the notice as carried out will implement best management practices for protection of the beneficial uses of water, soil stability, forest productivity, and wildlife as required by the current rules of the board, or a certification that practices consistent with the original plan will not result in any significant degradation to the beneficial uses of water, soil stability, forest productivity, or wildlife.

governmental discretion to disapprove nonindustrial timber harvest notices submitted pursuant to the approved nonindustrial timber management plans.

It is not the intent of the Legislature by the enactment of this article to limit the penalties and the enforcement provisions of this chapter.

Page 30: [4] Deleted **CDF** **7/4/2007 9:10:00 AM**

[3] describe "three essential elements…required to manage and plan a forest in any coherent, quantitative way. Each element has a corresponding management decision that must be made at the outset of planning." These essential elements include the following:

- A land-type classification scheme which is based on dividing a forest into homogeneous stands.
- A management activity schedule describing the timing, methods, and conditions by which the vegetation and other resources will be manipulated or disturbed to achieve desired outcomes, including
  - Logging rules (e.g., marking prescriptions).
  - A timber thinning and harvest schedule.
  - Regeneration techniques for the next tree crop.
- A quantitative growth and yield projection, which "numerically describes how much timber is expected for commercial harvest; specifically, volumes removed at each thinning and final harvest entry for both the existing and subsequent regenerated stands."

The Rules do not explicitly speak to item (1), but much of the documentation in the Board's Silviculture Rule Making Files include chapters excerpted from forestry text books. Much of the subject matter is based on the concept of stands or homogeneous vegetative units.

Item (2) is encompassed in the Rules for what are defined as silvicultural methods and silvicultural system. 14 CCR § 895.1 states that silvicultural methods is synonymous with silvicultural system, which is defined as "the planned program of forest stand treatments during the life of a stand. It consists of a number of integrated steps conducted in logical sequence leading to or maintaining a forest stand of distinctive form for the level of management intensity desired."

Item (3) is addressed in various sections of the Act and Rules. 14 PRC § 4593.2 of the Act along with 14 CCR § 895.1 define sustained yield as "the yield of commercial wood that an area of commercial timberland can produce continuously at a given intensity of management consistent with required environmental protection and which is professionally planned to achieve over time a balance between growth and removal."

[3] Davis, Lawrence S., K. and Norman Johnson, Forest Management, Boston: McGraw Hill, 1987.