Sierra Pacific Industries

Option A Demonstration of Maximum Sustainable Production

for all lands managed by

Sierra Pacific Industries

in

The Northern State Forest District

January 1, 1999

PREPARED BY:

Edward C. Murphy
RPF #2066

SPI Northern State Forest District Option A

TABLE OF CONTENTS

Table & Chart Locations

SPI Northern State Forest District Option A

INTRODUCTION

The following document is submitted by Sierra Pacific Industries (SPI) to comply with Section 14 CCR 933.11(a) of the California Forest Practice Rules (FPR) as promulgated under the Z'berg Nejedly Forest Practice Act (FPA). It covers the lands owned and contractually managed by SPI within the boundaries of the Northern State Forest District. It is the result of our best professional analysis. This analysis is the by-product of detailed and extensive efforts in watershed analysis, site-specific timber harvest planning, and analysis of associated impacts. We have invested much time and money in this effort for the past decade. We continue to refine and update this process / analysis as we engage in activities on the lands and monitor the effect of our activities.

The long-term sustained yield value for the Northern State District SPI lands is presented in this document. The same analysis will be submitted separately for the SPI lands in the Coast and Southern Districts.

Our findings regarding harvest, growth, and yield are projections. They are dependent on many assumptions tempered with professional judgment. Many of the variables involved can change over time. Calibration of growth models after comparison with on the ground results, weather-related and other stochastic events such as wildfire and insect attack, can influence results over time.

This analysis assumes a relatively stable regulatory climate with regards to the FPR and FPA. Regulatory requirements along with landowner goals limit to some extent the current range of management options. All models and derived values were constrained to meet or exceed the requirements of the FPR and FPA. The FPR requires that the sufficiency of the information necessary to demonstrate the balance of growth and harvest over time for this assessment area is determined by practicality and reasonableness in light of the size of the ownership, and the time since adoption of this requirement. We believe we have met these tests with this effort.

SPI has a substantial ongoing investment in our continuous inventory and monitoring systems. These inventory systems collect data and monitor effects for many other forest values in addition to tree volume and growth. We monitor our inventory, growth and harvest activities over time, and will submit updates to this document as necessary. We will use the Option B – FPR section 1091.13 rule as guidance for determining whether updates are substantial or minor. ("any deviation from the average harvesting projections in any ten-year period which exceeds ten percent" shall be deemed substantial and would require modification or amendment of this document.)

We submit this Option A dated 1/1/99 to reflect the most recent date of a substantial inventory effort. We are nearing completion of an ownership wide standing inventory, and developing the software to grow and deplete the inventory at the plot level. The starting point for this assessment is set at 1/1/99 to reflect the most current information. We are committed to maintain and improve inventory estimates over time.

Our past harvest was sustainable and our future harvest will continue to be sustainable. Our past five-year average harvest level is within ±5% of the values established in this assessment.

CONFIDENTIALITY ---- TRADE SECRETS

In order to provide the public a meaningful review, summary presentations of our findings are provided in this document. Our statewide total long-term sustained yield value and corporate-wide projection of inventory, harvest and growth over time are displayed in order to demonstrate how we achieve the goal of Maximum Sustained Production (MSP). These values will allow the public to assess our compliance with FPR requirements. SPI operates in a very competitive worldwide marketplace, both in terms of raw materials and finished products. We must restrict disclosure of the level of site-specific production from our lands and its associated yield streams, so as to prevent our competitors from obtaining information that would put SPI at a competitive disadvantage. Localized detailed information and its use falls under well-established legal precedents for protection of trade secrets. It will be subject to confidential audit by CDF.

SPI has a detailed and proprietary inventory management system. The data collected, programs for data management, maintenance, and reporting are all considered trade secrets by SPI. This extends to the planning model and its software, and the implementation of silvicultural prescriptions and timing of activities. SPI will cooperate with CDF in its responsibility for confidential audit of all our data sets and models. SPI will transfer to CDF additional confidential data that is not included herein to allow for audit, approval and tracking of the assessment over time. The provision for confidential review of Option B, and by extension Option A assessments, reside in section 1091.4.5(C)(4) reproduced below:

> (4) A discussion of the accuracy of the inventory data for the management unit and/or ownership. Inventory data, models and growth and harvest projections utilized for harvest scheduling projections shall be available for confidential audits by reviewing agencies along with the basis for such data, including but not limited to the cruise design and sample plot data and statistical validity of such estimates.

It is clear that the trade secrets laws (Gov. Code sec 6254.7) that provide this level of protection in Option B assessments are applicable to the same data in an Option A assessment.

The above requirements do nothing to alter the disclosure requirements embodied in the Timber Harvest Plan permit process required prior to any harvesting activity. CDF filing, review, and approval of this assessment does not permit SPI to engage in any management activity related to timber harvesting. The assessment will be attached by reference to all timber harvest plans; permission to harvest still resides in the Timber Harvest Plan approval process.

APPLICABLE REGULATORY SECTIONS AND DISCUSSION

In deciding to submit an Option A demonstration of MSP rather than an Option B (SYP), SPI understands that site specific discussions of SPI's mitigation and protection of other forest values will continue to be accomplished in the THP and through the FPR process. SPI has developed this Option A assessment to demonstrate how it will achieve MSP in the Northern State Forest District. This assessment was developed in response to Section 14 CCR 933.11(a) of the FPR. The California State Board of Forestry promulgated this section of the FPR in response to a policy statement contained in the in FPA, Division 4, Chapter 8, Public Resources Code Section 4513. This policy section says:

> **4513. Intent of Legislature.** It is the intent of the Legislature to create and maintain an effective and comprehensive system of regulation and use of all timberlands so as to assure that:
>
> **(a)** Where feasible, the productivity of timberlands is restored, enhanced, and maintained.
>
> **(b)** The goal of maximum sustained production of high-quality timber products is achieved while giving consideration to values relating to recreation, watershed, wildlife, range and forage, fisheries, regional economic vitality, employment, and aesthetic enjoyment.

The Board passed Section 14 CCR 933.11 under the guidance of article 4, section 4551 of the FPA;

> **Article 4. Rules and Regulations**
>
> **4551. Adoption of district forest practice rules and regulations**. The board shall adopt district forest practice rules and regulations for each district in accordance with the policies set forth in Article 1 (commencing with Section 4511) of this chapter and pursuant to Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code to assure the continuous growing and harvesting of commercial forest tree species and to protect the soil, air, fish and wildlife, and water resources, including, but not limited to, streams lakes and estuaries.

Finally the FPR state that MSP can be achieved under 933.11(a) in a Timber Harvest Plan (THP) as follows;

> **933.11 Maximum Sustained Production of High Quality Timber Products**
>
> The goal of this section is the *(sic:to)* achieve Maximum Sustained Production of High Quality Timber Products (MSP). MSP is achieved by meeting the requirements of either (a) or (b) or (c) in a THP, SYP or NTMP, or as otherwise provided in Article 6.8, Subchapter 7.
>
> **(a)** Where a Sustained Yield Plan (14 CCR 1091.1) or Nonindustrial Timber Management Plan (NTMP) has not been approved for an ownership, MSP will be achieved by:
>
> **(1)** Producing the yield of timber products specified by the landowner, taking into account biologic and economic factors, while accounting for limits on productivity due to constraints imposed from consideration of other forest values, including but not limited to, recreation, watershed, wildlife, range and forage, fisheries, regional economic vitality, employment and aesthetic enjoyment.

(2) Balancing growth and harvest over time, as explained in the THP for an ownership, within an assessment area set by the timber owner or timberland owner and agreed to by the Director. For purposes of this subsection the sufficiency of information necessary to demonstrate the balance of growth and harvest over time for the assessment area shall be guided by the principles of practicality and reasonableness in light of the size of the ownership and the time since adoption of this section using the best information available. The projected inventory resulting from harvesting over time shall be capable of sustaining the average annual yield achieved during the last decade of the planning horizon. The average annual projected yield over any rolling 10-year period, or over appropriately longer time periods for ownerships, which project harvesting at intervals less frequently than once every ten years, shall not exceed the projected long-term sustained yield.

(3) Realizing growth potential as measured by adequate site occupancy by species to be managed and maintained given silvicultural methods selected by the landowner.

(4) Maintaining good stand vigor.

(5) Making provisions for adequate regeneration.

At the plan submitter's option, a THP may demonstrate achievement of MSP pursuant to the criteria established in (b) where an SYP has been submitted but not approved.

Additionally, only for owners with timberland ownerships that exceed 50,000 acres, a portion of 933.11(c) subparagraph (c) applies as shown emphasized below;

(c) In a THP, or NTMP, MSP is achieved by:

(1) For evenage management, meeting the minimum stand age standards of 933.1(a)(1) meeting minimum stocking and basal area standards for the selected silvicultural methods as contained in these rules only with group A species, and protecting the soil, air, fish and wildlife, water resources and other public trust resources through the application of these rules; or

(2) For unevenaged management, complying with the seed tree retention standards pursuant to 933.1(c)(1)(A) meeting minimum stocking and basal area standards for the selected silvicultural methods as contained in these rules only with group A species, and protecting the soil, air, fish and wildlife, water resources and other public trust resources through the application of these rules.

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

(4) Timberland ownerships totaling 50,000 acres or less may use subsection (c) to show MSP.

(5) Timberland ownerships of 50,000 acres or more may use subsection (c) through December 31, 1999. Thereafter they may use subsection (c) if an SYP or demonstration of achievement of MSP pursuant to 933.11(a) has been filed with the department and has not been returned unfiled or approved.

(6) For scattered parcels on timberland ownerships of 50,000 acres or more, subsection (c) may be used to show MSP.

A necessary definition found in Section 14 CCR 895.1 is:

Long Term Sustained Yield means the average annual growth sustainable by the inventory predicted at the end of a 100-year planning period.

LANDS COVERED BY THIS OPTION A

SPI owns and/or contractually manages 1,504,481 acres located in 19 Northern California counties. SPI has milling and manufacturing facilities at 15 locations in California and often hauls logs great distances from the point of origin to the facility where they are ultimately processed. In many cases logs are hauled from timberland in one State Forest District to a processing plant in another State Forest District. A complete tax parcel listing of these lands is included in the Confidential Data maintained for this Option A at Sierra Pacific Industries headquarters in Anderson. A map showing the extent and location of the current distribution of these timberlands and facilities is found on page 9. This document submits the 1,158,770 acres of land under our management in the Northern State Forest District as the assessment area for this Option A. This ownership is distributed in 583 state planning watersheds encompassing some 5,670,344 acres (See Northern State Forest District Map found on page 10). The forest vegetation characteristics of lands managed by SPI in the Northern State Forest District are displayed below.

SPI Lands in Northern State Forest District - Forest Land Characteristics

Acres of Species Types	
Douglas Fir	259,915
Mixed Hardwoods	26,685
Other Conifer	4,954
Mixed Conifer	82,530
Ponderosa Pine	354,358
True Fir	288,632
Brush, Grass, Water, other	94,851
Non Forest	46,845
Total	1,158,770

Acres by FPR Site Class	
I	352,645
II	378,347
III	284,687
IV	96,246
Non Forest	46,845
Total	1,158,770

Note: Tables are based upon plot point samples.

Acres by Canopy Class		
Dense	60 to 100%	438,651
Moderate	40 to 60%	135,545
Low	10 to 40%	382,264
Open	0 to 10%	155,465
Non Forest		46,845
Total		1,158,770

Note: Canopy from only trees ≥6" DBH

Acres by Size Class	
>24" DBH	238,016
16 - 23"DBH	415,553
8 - 15" DBH	279,701
0 - 7" DBH	83,805
No Tree Size/Non Forest	141,695
Total	1,158,770

Lands with Hardwood Basal Area	
Hardwood > 30% BA	242,628
Hardwood < 30% BA	785,492
Plantations	83,805
Non Forest	46,845
Total	1,158,770

Note: this includes 26,685 acres of hardwood type.

Table 1

Basal Area by DBH Class

Basal Area Inventory
Units: Sq. Ft. / Acre
TAA: SPI – Northern State Forest District
Acres: 1,111,925.2 (Non Forest Acres Omitted)

	SPECIES									
DBH	PP	SP	IC	DF	WF	RF	LP	OC	MH	Totals
2	0.26	0.06	0.29	0.49	0.53	0.08	0.02	0.02	0.61	2.35
4	0.69	0.15	0.87	0.87	1.18	0.21	0.04	0.01	1.71	5.75
6	1.51	0.25	1.08	1.42	1.82	0.33	0.04	0.04	2.52	9.01
8	1.32	0.37	0.93	1.54	1.86	0.37	0.05	0.06	2.51	9.00
10	2.10	0.43	0.97	2.11	2.62	0.32	0.05	0.07	2.24	10.91
12	1.97	0.68	0.90	2.50	2.77	0.43	0.08	0.06	1.87	11.26
14	1.95	0.59	0.93	2.58	2.87	0.40	0.07	0.07	1.25	10.71
16	1.95	0.69	0.75	2.72	2.93	0.43	0.10	0.09	1.00	10.67
18	1.94	0.66	0.69	2.61	2.67	0.47	0.07	0.07	0.67	9.86
20	1.78	0.64	0.53	2.29	2.27	0.51	0.04	0.02	0.65	8.73
22	1.48	0.70	0.49	1.80	1.82	0.44	0.05	0.04	0.44	7.26
24	1.19	0.71	0.44	1.54	1.48	0.41	0.03	0.04	0.37	6.22
26	0.89	0.61	0.35	1.18	1.08	0.31	0.04	0.01	0.31	4.79
28	0.83	0.47	0.16	0.74	0.57	0.21	0.02	0.01	0.18	3.19
30	0.39	0.38	0.24	0.45	0.46	0.20	0.02	0.02	0.18	2.34
>30	0.94	1.06	0.86	1.65	0.91	0.50	0.07	0.03	0.53	6.55
Totals	21.19	8.46	10.48	26.49	27.86	5.64	0.81	0.64	17.03	118.60

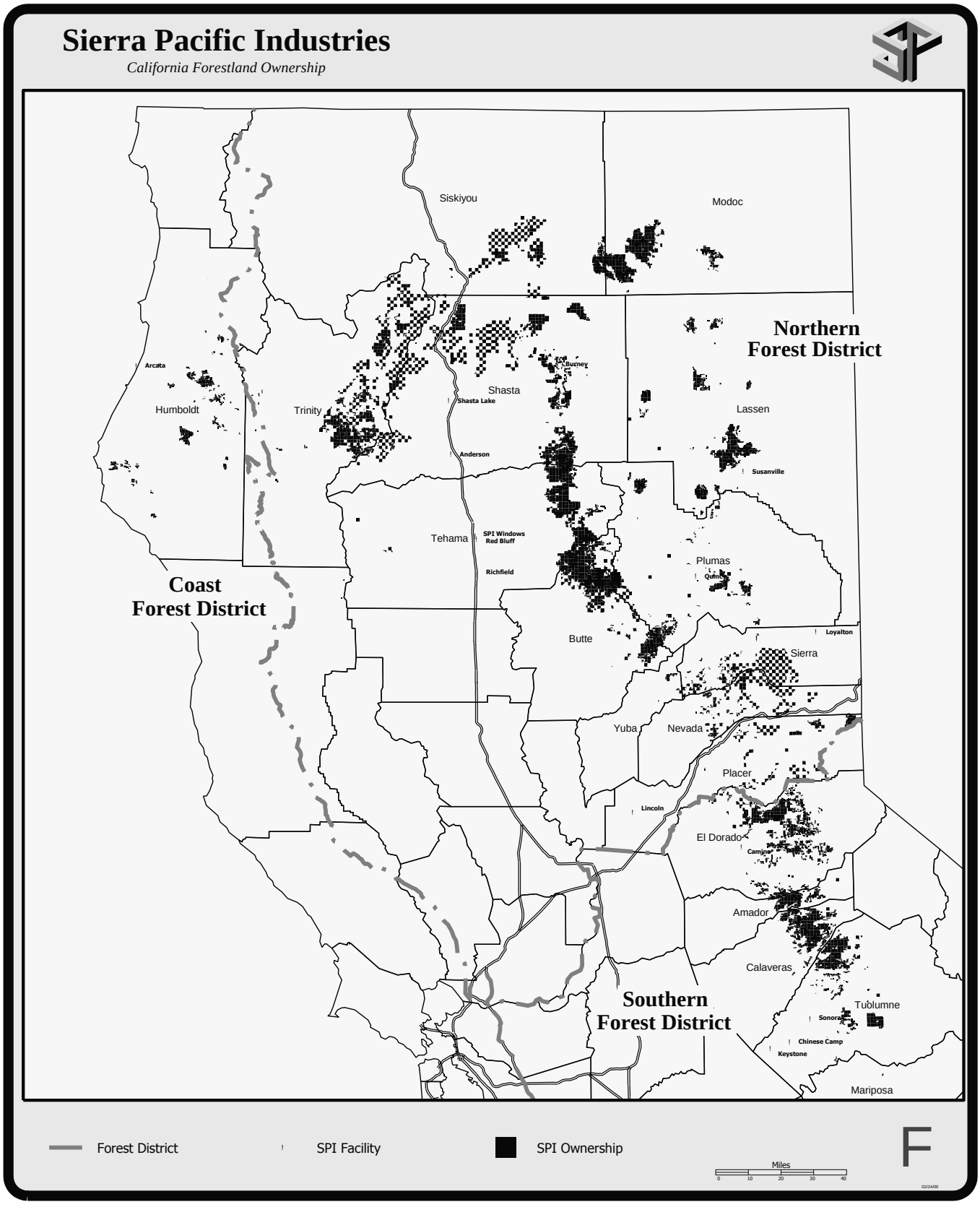
Table 2

Trees Per Acre by Species and DBH

Tree Frequency Inventory
Units: Trees / Acre
TAA: SPI Northern State Forest District
Acres: 1,111,925.2 (Non Forest Acres Omitted)

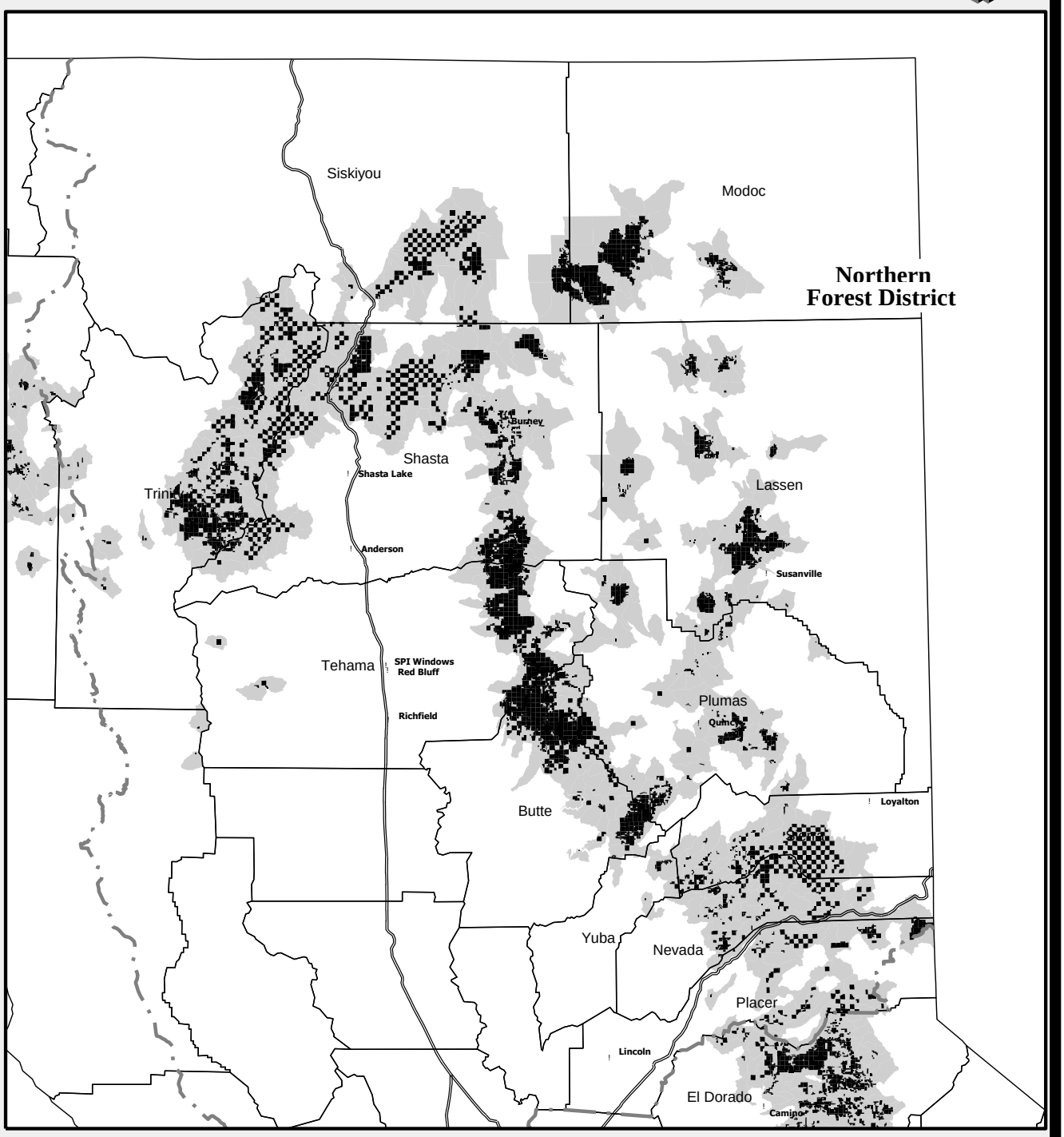
	Species									
DBH	PP	SP	IC	DF	WF	RF	LP	MC	MH	Totals
2	21.59	3.09	12.39	22.63	24.84	3.63	0.65	1.00	27.78	117.60
4	7.91	1.66	10.34	10.02	13.70	2.40	0.53	0.12	19.62	66.32
6	8.30	1.29	5.60	7.27	9.31	1.70	0.21	0.21	12.84	46.75
8	3.82	1.06	2.69	4.43	5.35	1.06	0.13	0.18	7.18	25.90
10	3.85	0.78	1.78	3.88	4.82	0.59	0.09	0.12	4.11	20.03
12	2.54	0.87	1.15	3.19	3.55	0.56	0.10	0.08	2.38	14.40
14	1.84	0.56	0.87	2.43	2.71	0.38	0.06	0.07	1.17	10.09
16	1.40	0.50	0.54	1.96	2.11	0.31	0.08	0.06	0.71	7.67
18	1.10	0.38	0.40	1.49	1.53	0.27	0.04	0.04	0.38	5.62
20	0.82	0.30	0.24	1.06	1.05	0.23	0.02	0.01	0.30	4.03
22	0.56	0.27	0.19	0.69	0.69	0.17	0.02	0.01	0.17	2.77
24	0.38	0.23	0.14	0.49	0.47	0.13	0.01	0.01	0.12	1.99
26	0.24	0.17	0.10	0.32	0.29	0.09	0.01	0.00	0.09	1.31
28	0.19	0.11	0.04	0.17	0.13	0.05	0.01	0.00	0.04	0.75
30	0.08	0.08	0.05	0.09	0.09	0.04	0.00	0.00	0.04	0.48
>30	0.13	0.14	0.11	0.22	0.14	0.07	0.01	0.00	0.08	0.90
Totals	54.77	11.48	36.62	60.35	70.79	11.68	1.98	1.93	76.99	326.60

Table 3


Sierra Pacific Industries
California Forestland Ownership
Siskiyou
Modoc
Northern
Forest District
Arcata
Humboldt
Trinity
Shasta
Shasta Lake
Burney
Lassen
Susanville
Anderson
Tehama
SPI Windows
Red Bluff
Richfield
Plumas
Quincy
Coast
Forest District
Butte
Loyalton
Sierra
Yuba
Nevada
Placer
Lincoln
El Dorado
Camino
Amador
Calaveras
Southern
Forest District
Tuolumne
Sonora
Chinese Camp
Keystone
Mariposa
Forest District
SPI Facility
SPI Ownership
Miles
0 10 20 30 40
F

Sierra Pacific Industries

California Forestland Ownership



LANDOWNER GOALS AND OBJECTIVES

SPI manages approximately 1.5 million acres of commercial forestland in Northern and Central California (See Ownership Map). Dominant forest types under SPI management include Douglas Fir, Ponderosa Pine, Klamath and Sierra Mixed Conifer, Mixed Hardwood-Conifer, Red Fir, White Fir, and Jeffrey Pine (Meyer and Laudenslayer, 1988).

SPIs' management objective for our entire ownership is to provide an adequate, stable, predictable, and cost-effective supply of raw materials for a variety of forest products. This objective will be accomplished while managing for the long-term health and diversity of the forest lands, including provisions for the habitat needs of fish and wildlife species which occur, or potentially occur, on our forest lands.

Sierra Pacific Industries used the following guiding principles to aid in our land management decisions:

1) SPI's overall management objective of providing for a stable, predictable and cost-effective supply of raw materials for a variety of forest products will primarily determine future landscape conditions.

2) SPI recognizes that, in order to achieve this overall management objective, the Company must create and maintain healthy and productive forest conditions capable of providing moderate to high levels of other forest values.

3) Disturbance is an inherent and required component of California forest stands and landscapes.

4) Forest management activities can be conducted in a manner that approximate the stand density conditions of pre-European forest disturbance regimes.

5) There are very few existing forest stands or landscapes from which we might study how forests looked and functioned prior to European management influences. In addition, forest stands and landscapes that existed prior to these influences did not meet today's needs for wood products.

6) Landscapes and stands that are capable of supporting a wide range of vertebrate wildlife species, including both species thought to be "at risk" and species thought "to benefit" from forest management activities, are key elements of what is termed a healthy forest.

7) A management program that combines research and monitoring with effective management adaptation can describe and create the stand and landscape conditions of a healthy and productive forest, over both the short and long-term.

While SPI provides the previous list of principles to indicate the larger goals and objectives of our management, this document will primarily focus only on our achievement of Maximum Sustained Production.

MAXIMUM SUSTAINED PRODUCTION

MSP as defined includes the following: "Producing the yield of timber products specified by the landowner …: " SPI primarily is interested in production of sawlogs from our timberland, but does produce logs for paper chips, and biomass. For the purposes of this plan the primary product will be sawlogs measured in thousands board feet Scribner scale (mbf). The other products produced are small in volume in comparison to sawlogs and usually are products that originate from material not normally quantified in growth and yield models. SPI's facilities can utilize all commercial species of trees found on the lands it manages.

STANDING INVENTORY

For our standing timber inventory, SPI has a grid-based inventory, with a variable radius temporary plot intensity of one plot per 4 acres (a 10 chain by 4 chain grid of plot centers). Contract cruisers beginning in 1997 established the majority of these inventory plots. SPI has check-cruised 10% of all contract plots on a section-by-section basis. We plan to use summer crews to replace sample plots two years after non-clearcut harvests. We have re-sampled areas after 10 years of growth and will use these re-measurements to calibrate our growth estimates and monitor snag numbers over time. We wait two seasons past logging to allow logging caused mortality to potentially express itself. Plantation stands will be re-sampled on the same grid when they reach merchantable status. In-house proprietary software integrates G-Space, Cactos and Systum-1 as growth models. This software grows and harvests, if necessary, each sample plot annually. There are over 350,000 plots in place in our "continuous tree monitoring system" (CTMS). Other resource values and parameters are measured but they do not relate to current harvest or yield estimation. SPI has continued to invest in cooperative growth and yield estimation studies, including Cryptos, Cactos, Systum-1, and G-Space. We continue to cooperate by providing data to USFS when they develop new variants of the Prognosis model, but do not currently use it. Our current inventory processes produce weighted average standard error estimates at less than 1%; well below the FPR rule guide of less than 15% standard error.

The resulting inventory for the first planning period developed from plots collected from the entire SPI property is displayed in Table 4, on page 13. Although there are no specific standards for statistical confidence for Option A analysis, our estimate of the total standing inventory is developed predominately from strata which have standard errors well below the standard set for an Option B analysis. This standard is found in FPR section 1091.4.5(c)(4):

> **(4) A discussion of the accuracy of the inventory data for the management unit and/or ownership. Inventory data, models and growth and harvest projections utilized for harvest scheduling projections shall be available for confidential audits by reviewing agencies along with the basis for such data, including but not limited to the cruise design and sample plot data and statistical validity of such estimates. The SYP shall describe how the submitter will, over time, make reasonable progress to**

improve inventory estimates for the major WHR or vegetation types, with a goal of achieving standard errors that are no greater than 15% of their respective inventory estimates within the effective period of the SYP.

The major WHR types include all tree-dominated habitats in size classes 4, 5, and 6 with canopy closure classes of S, P, M, and D.

The base period combined standing inventory estimate is a compilation of specific strata defined by site class and includes all timbered lands. The base Inventory with detail for each State Forest District is contained in confidential appendix pages A-1 through A-411. The weighted average standard error of these strata is ± 0.97%; an order of magnitude more accurate than the ±15% standard. Standard error calculations for each of the separate State Forest District are also provided in the confidential appendix attachment B-1 though B-11.

Sierra Pacific Industries - Summary Base Inventory

Board Ft. Scribner Gross Volume **January 1, 1999**

(1,439,350.95 acres) (Non forest acres omitted)

DBH CLASS	PP	SP	TF	DF	IC	OC	TOTAL
8	69,603,768	20,802,735	115,650,221	92,275,778	33,149,887	3,131,312	**334,613,701**
10	194,730,496	41,213,991	237,452,845	198,736,513	55,477,865	6,010,075	**733,621,785**
12	213,331,429	71,530,041	357,454,115	297,380,109	76,523,667	9,991,948	**1,026,211,310**
14	263,582,743	81,618,122	464,862,719	373,445,799	97,129,022	12,596,599	**1,293,235,003**
16	344,933,056	110,300,846	577,489,404	437,320,727	86,195,403	19,931,500	**1,576,170,936**
18	385,917,941	120,676,233	650,673,839	506,987,761	108,887,312	20,471,720	**1,793,614,806**
20	416,994,339	140,459,405	644,390,280	485,621,472	94,884,668	11,467,304	**1,793,817,468**
22	387,007,495	159,384,241	622,308,924	431,643,592	98,249,705	13,932,265	**1,712,526,223**
24	357,525,993	193,629,769	575,357,875	390,698,702	101,931,086	12,746,305	**1,631,889,730**
26	319,918,105	178,736,205	472,368,432	330,699,567	86,194,954	10,349,523	**1,398,266,786**
28	326,750,515	147,679,446	328,201,205	232,278,068	63,066,603	6,750,065	**1,104,725,902**
30	174,872,207	136,465,731	259,193,710	160,034,354	67,044,909	9,527,036	**807,137,946**
32	125,109,390	100,323,656	165,900,883	125,984,986	52,870,596	6,356,606	**576,546,116**
34	101,036,221	91,871,201	153,889,484	117,654,358	47,036,978	5,673,652	**517,161,893**
36	77,288,803	70,701,151	73,150,135	72,687,316	41,429,313	3,032,506	**338,289,224**
38	42,951,193	58,255,709	63,528,551	65,336,383	25,880,156	2,019,141	**257,971,133**
40	32,464,173	43,953,581	41,342,105	44,421,958	21,806,196	1,854,138	**185,842,151**
42	29,331,202	31,463,959	26,779,298	35,761,980	16,209,691	457,425	**140,003,554**
44	27,077,185	34,400,438	16,316,285	47,238,707	10,195,186	1,019,708	**136,247,509**
46	16,507,654	17,925,141	10,024,191	31,030,592	5,626,650	1,403,070	**82,517,297**
48	14,673,662	16,161,588	10,299,772	29,380,211	12,089,842	0	**82,605,075**
50	8,813,508	8,157,950	13,337,002	6,907,729	11,268,079	2,294,305	**50,778,573**
>50	15,833,873	37,542,207	27,405,662	124,756,507	41,485,429	1,510,139	**248,533,816**
TOTAL	3,946,254,951	1,913,253,345	5,907,376,936	4,638,283,167	1,254,633,196	162,526,341	**17,822,327,937**

Table 4

MODELING GROWTH AND YIELD

The Long Term Sustained Yield (LTSY) values and the underlying growth and yield scenarios were developed using a proprietary planning model that makes efficient use of a number of standard growth models. All the growth models were developed through cooperative research and data sharing among cooperators, either at the University of California, Berkeley or at the United States Forest Service's Pacific Southwest Silvicultural Research Station in Redding. They include the California Conifer Timber Output Simulator (CACTOS), Simulating Young Stands Under Management (SYSTUM 1) and The Growing Space Model (G-Space). Existing stands are grown using the standard regional calibration files by the Cactos growth model. Systum 1 is used to grow plantations until they are large enough to be grown by CACTOS. Systum I was run assuming control of competing vegetation. Calibration files for CACTOS have been developed to grow plantations after they leave SYSTUM 1. The calibration files used to calibrate Cactos for modeling plantations after being grown by Systum 1 were developed by SPI, guided by the results of 10 years of cooperative research with the University of California, using Dr. Stone and Cavallaro's model, G-Space. These calibration files and all subsequent growth and yield scenarios developed to model this 100 year planning horizon have been submitted to CDF for confidential review.

This is not a linear programming effort; therefore there is no objective function or model formulation as would be the norm in that environment. We did construct an expert based simulation model of growth, harvest, and a multitude of other real world interactions, pertaining to FPRs as well as the best available growth estimation process we are aware of. This proprietary model is called the Graphical Planning Interface (GPI).

We incorporate, through our referencing process, specific relational quantitative knowledge that served to guide and make more realistic our non-spatial Option A demonstrations of our achievement of MSP. This planning effort is accomplished through a proprietary software system called the Graphical Planning Interface, which manages the inventory, harvest and growth of each stratum and allows for the aggregation of this information to the Option A State Forest District level. Both Cactos and Systum-1 models are called by GPI. Tree lists comprised of strata level plots developed into scenarios with the addition of harvest, ingrowth, and mortality events over a 100-year timeline are passed seamlessly through that planning model. All calibration files in their native model form are included. Complete detailed output of our proprietary planning model has been submitted to CDF for confidential audit.

For inventory and modeling purposes the timber stratum used for these Option A demonstrations was based upon non-spatial stratification by site index class of measured inventory plots within 14 sub regions across the three Option A demonstrations. We used all site trees measured on each of the 14 sub regions to distribute individual site/sub region strata class acreage. Strata created for the existing stands were modeled using these average 50-year base site estimates, and were cross walked to FPR site class groupings I, II, III and IV, using the Robards conversion equation. The stratum symbology represents the finite combination of 14 SPI sub

regions and each sub region's individual variation of site potential. The stratum symbology reflects the sub region area and the site class. While each of the 14 sub regions across the entire ownership individually had 5 timbered site classes (A, I, II, III, and IV), we further refined these classes to create 10 possible site classes over the entire ownership ranging from a High A to IV. The equivalent classes based on a site index with a 50-year base are sites 120, 110, 100(high end), 100(low end), 90, 80, 74, 59, 50 and 45. We also compressed all sites measured as site 120 or greater into the maximum planning site, Site 120.

At each sub-region we used measured site and professional judgment to estimate the future site of plantations. Assuming every acre was converted to plantations, the weighted average site of these collective assignments over the SPI ownership would be an increase of 8.12 site potential points. The actual adjustment in measured site, which predominately comes from trees that have had some portion of their growth reduced due to competition or shade, is very small and likely to be conservative. These estimated site classes were only used when growing existing and future **plantations**. Each stratum and plot had actual measured site classes, which were used without adjustment when growing **existing stands** with Cactos.

Research shows that roads do not produce significant yield effects; most final crop tree spacing goals can easily accommodate the width of the preponderance of our roads. Some experts postulate that roads do not remove growing space, but may enhance growth due to the increased light provided to the trees growing along the road. SPI also includes roads in its inventory plots and therefore has accounted for any tree or volume effect of roads in our systematic grid based sample.

Harvest scheduling within the Option A plans is a relatively direct process. We allocate "referenced" percents of the landbase to each regeneration method based upon insights gained from the most similar completed THP planning effort. This is why we call this a "referenced" process. The detailed planning effort percent results are distributed across site classes, within the sub-unit area of these plans. The operational impacts of adjacency constraints and unit size limitations learned as a result of our THP efforts prevents targeting any specific site class or biasing the harvest away from the average site distribution within each area. All non-operational and non-forest areas are carefully delineated at this level. This base line level of site specific THP planning that underpins this non-spatial model is ongoing but as yet incomplete for the entire ownership.

At the time of submission of these Option A demonstrations of achievement of MSP, we had completed over 400,000 acres distributed throughout the geographic and site capability range of SPI's landbase. We have now completed nearly 1,000,000 acres and find that the referenced values were accurate estimators. This level of feasibility testing for specific THP planning is too detailed to provide the direct basis of Option A level projections. But it serves as confirmation that acres by silvicultural prescriptions, thresholds constraints, etc, are accurately modeled by this referenced process in the non-spatial Option A. This confirmation and confidence comes from the real world modeling and application of all of the following constraints:

the Forest Practice Rules,
non-declining flow constraints,
self-imposed 10-year adjacency constraints,
internal wildlife habitat goal considerations,
limitations on regeneration harvests due to local visual and political considerations,
watershed considerations,
actual area-specific listed wildlife species protection harvest limitations.
actual WLPZ widths,
coincident timing of WLPZ and adjacent silvicultural systems,
harvest unit-size constraints,
stand specific basal area retention requirements.

WLPZ HARVEST MODELING

WLPZ harvest entry is scheduled to occur with adjacent evenage or unevenaged harvesting. There is a direct relationship to acres of WLPZ harvesting and percentage of the area harvested by other adjacent harvests. It is assumed that harvesting is distributed across the land base; therefore, if 10% of an area is harvested by a particular method in a decade, 10% of those WLPZ acres will be adjacent and harvested at the same time. In WLPZ strata, an analysis is conducted to determine if the WLPZ by site class strata has >50% canopy closure (CC), if so, selection harvesting is prescribed with harvest being constrained to meet the 50% CC post harvest requirement. If less than 50% CC exists prior to harvest, sanitation salvage is prescribed, and constrained to maintain FPR basal area standards. If less than 50% CC and little or no harvest volume above FPR basal area constraints, no harvest is prescribed.

Unevenaged adjacent harvest results in a cutting cycle of 20 years. Evenaged adjacent harvest results in harvesting at time of regeneration. Commercial thinning re-entry occurs at either 40 or 50 years from the first adjacent regeneration harvest. During the life of this plan, regardless of adjacent regeneration system, WLPZs do not have any ingrowth, since canopy retention requirements preclude successful regeneration. Due to the long period of re-entry with adjacent evenage regeneration, calibration factors are reduced by 50% to control unreasonable growth rates by the Cactos model. Therefore, this non-spatial model is constrained in the same way that detailed planning area models are - by directly coordinating adjacent system cycles with WLPZ harvest entry events.

EVENAGED REGENERATION SYSTEMS

The target or desired modeled rotation average was 80 years; no evenaged regeneration clearcuts were planned to rotate less than 60 years from the first regeneration harvest. Rotation less than 80 years was only necessary when we had a large single age class stand, like those that originate from catastrophic wildfires. It is expected and is consistent with this plan that minor number of stands that do not meet FPR minimum age constraints might need to be harvested under evenaged prescriptions. SPI's future harvest growth and yield are based upon regenerating across all site classes in an area. There are few areas in our landbase that fall below

FPR minimum age classes. Given the non-spatial nature of the plan, harvesting current existing stands that are less than these ages would not have a significant effect on our yield trajectory. Upon approval of this plan by CDF, the Option A will suffice to demonstrate MSP, and age limitations per (913.1(a)(1), 933.1(a)(1), 953.1(a)(1)) will not apply. As we track actual performance of plantations over the next few decades, the desired 80-year rotation could change, given our conservative growth estimates. This change would be based upon our ability to better estimate effects from tree improvement programs, and the ever-increasing knowledge of how to manage habitat for various wildlife species. Such a potential change would be discussed in future Option A submission efforts.

Timing of entry and marking guidelines for future planted acres are based on G-space model research. Commercial thinning generally occurs in the 4^{th} or 5^{th} decade after planting (depending on site quality) and attempts to achieve 65-70 trees per acre (tpa) stocking - a 26 ft. spacing. Thinning of existing stands is based upon meeting SPI standards for residual stocking, usually 100 to 160 sq. ft. of basal area. Commercial thinning marking is guided by the 26 ft. spacing from G-space to provide for optimal growing space, but in no case were commercial thins ever modeled to fall below the site class based basal area stocking standards of the Forest Practice Rules (FPR).

In using Systum-1 for the growth of plantations, SPI assumes an early single competing vegetation treatment if conditions warrant. We assume that the trees are successfully established and that the plantation is maintained in a free to grow condition. We do, very rarely, experience poor plantation establishment, and even more rarely, plantation failure. These conditions have always been corrected within the 5-year THP stocking requirement. We do not need specific modeling recognition, since the harvest scheduler works in ten-year increments. These plantation problems, if corrected within 5-years, will allow the plantation to make rotation age or commercial thinning in their originally scheduled decade.

UNEVENAGED REGENERATION SYSTEMS

All modeled unevenaged harvests meet or exceed retention standards based on FPR basal area retention requirements for specific site classes. Generally, SPI leaves higher amounts of basal area than FPR limits require, due to site occupancy and/or windthrow considerations. SPI manages the species mix it inherited from past management. We only model ingrowth when canopy closure post harvest has been reduced to less than 50%. Other than scenarios developed specifically for WLPZs, selection harvesting is modeled on a 20-year cutting cycle.

SPI does not manage for a specific diminution quotient or desired diameter distribution, since it only enters these areas on long cutting cycle intervals. We currently model using the Cactos growth model and use professional discretion as to the timing and composition of ingrowth. We professionally review results and believe the yield streams have been conservatively modeled. SPI models unevenaged harvest areas as two, three or four aged stands. We have begun research with Professor Kevin O'Hara and graduate students from University of California at Berkeley to better estimate yields from uneven or multiple age class stands.

GROUP SELECTION

We do have some minor amounts of past group selection silviculture in scattered locations in our existing stands. SPI retains the option of using some group selection in areas projected as unevenaged silviculture. Similarly SPI may convert some evenaged acreage to group selection. Any substantial change would be subject to the 10% deviation constraint under FPR sec.1091.13. SPI has committed to a review of the Option A upon approval to consider the possible implications on growth an yield of our new policy relating to Visual Retention in our Sierra Nevada holdings. It is our professional opinion at this time that it will not warrant an amendment to this plan.

REAL WORLD MODELING; CALIBRATION and CONSERVATISM

As described earlier, aggregate modeling of the complex interactions of FPR, individual species, and landowner intent over time needs professional oversight. G-Space projections have been used to conservatively calibrate Systum-1 and Cactos projections to simulate evenage management with an all age stand management program. We run Cactos calibrated to simulate G-Space. Cactos allows us to manage harvest, tree crowns and tree lists to more effectively cross walk to other stratification systems. By “conservatively”, we mean that calibration has been targeted to produce volumes and mean annual increment values that are reduced approximately 20% from G-space comparable projection values. We predict future plantation growth, using both Systum-1 and Cactos in a sequential fashion for 10 decades. The first 20 years or less of stand development is projected by Systum-1. The tree list is then passed to Cactos to complete the projection over 10 decades. It is in this 2nd phase that Cactos is calibrated to replicate conservative G-space yield expectations. These Cactos calibration efforts are only applied to plantations produced under these Option A demonstrations.

The future projections of plantation growth have been guided by UC Berkeley cooperative research. While we are confident they will materialize over time, we reduced those research projected yields by 20% in our modeling effort. We visited many plantations through the weeklong review with CDF and DFG across the entire ownership; we did not find any that were under performing the growth trajectories portrayed in our Option A documents. We visited existing plantations that did not have all of SPI’s current early stand treatments; they are still achieving acceptable growth rates. The Elliot Ranch plantation, (now fifty years old on USFS land) was planted at 8 ft x 8 ft spacing and ignored until it was 25 years old. It currently demonstrates achievement of our projected tree sizes at 50 years. It is important to note that any concern about the projected rate of growth estimates of our plantations do not effect any of the proposed harvest volumes for the next fifty years. The volume to be harvested in the next 50 years is already standing on the land and has been measured in the inventory. The question at that time will be how much higher will harvest levels increase to, not that current first decade harvests are not sustainable. These estimates only apply to those portions of our land base to be evenaged harvested while the remainder is always projected to grow using the Cactos model. Cactos has proven to be very reliable when appropriately modeled.

SPI continues to invest in tree improvement and superior tree seed collection etc, all which are known to increase yield. None of these increases are included in future growth projections. We will, as indicated in the response to question 8, provide CDF with confidential reports demonstrating the measured results from monitoring our plantations over time.

> Note: virtually every board foot of production predicted by this plan for the next fifty years comes from trees that are already in the ground, sampled in our inventory and being grown by Cactos with regional calibration. Should it become necessary, there would be ample time in which to make any necessary corrections based on tracked plantation performance.

INGROWTH and MORTALITY

Ingrowth only occurs in non-WLPZ selection harvest and only when vertically projected canopy closure is reduced to below 50% as a result of planned harvest. The ingrowth files generally reflect existing stand composition, but we limit the percent ingrowth of Ponderosa Pine.

Generally we do not have confidence in mortality estimates from Cactos. Plantations under G-Space spacing guidelines and stands under stocking density management, except for post harvest caused mortality, have lower expectations of mortality than those typically projected by Cactos. We generally turn the Cactos mortality function off except for the two decades following precommercial thinning, shelterwood prep steps and the decade after selection harvest entries.

REALIZING GROWTH POTENTIAL AS MEASURED BY ADEQUATE SITE OCCUPANCY

SPI has chosen to simulate a professionally determined mix of silvicultural and cultural methods over a 100 year planning horizon. This allows SPI to demonstrate how MSP and all associated yields will be achieved. Thinning treatments in the models are timed to not only maintain maximum desired growth on the remaining individual stems but also optimize the distribution of trees in a stand to adequately occupy the site. SPI through cooperative research with the University of California at Berkeley has established spacing guidelines that help ensure adequate site occupancy.

SPI in the site-specific THP process determines silvicultural prescriptions to meet many objectives. SPI utilizes all silvicultural methods allowed in the rules, including but not limited to evenage and unevenage regeneration methods, intermediate treatments, special prescriptions and alternative prescriptions. SPI has used the previously mentioned growth models to simulate these prescriptions in our planning model.

MAINTAINING STAND VIGOR

SPI monitors the progress of its stands and plants, thins, prunes, or otherwise treats the stands to ensure healthy, vigorous tree growth. As active participants in a

number of tree improvement cooperatives, and as owner of, or cooperator in, a number of seed orchards, we will continue to maintain trees and seed sources for future planting that will promote healthy and vigorous future stands.

SPI has a good track record of not only meeting its planned application of treatments but also actually catching up on the backlog of treatments that should have been done by previous landowners. As properties were scheduled for sale over the last decade, discretionary future stand improvement investments usually became low priority for the seller. SPI has brought those treatments up to date. In the context of these investment treatments, SPI has absorbed huge annual swings in regeneration and precommercial thinning / pruning programs while responding to non-mandatory reforestation of wildfire damaged timberlands. SPI's is currently rehabilitating the decades old fires on the recently acquired Andrus-Surdna lands. It is important to note that while the investments in stand management are necessary to achieve projected long-term yields, there is some flexibility as to which year such investments are made. While there are many influences on discretionary capital investment decisions in any one year, rarely do these influences last more than five years, and we would not expect significant long-term yield effects caused by delaying discretionary investments up to five years from our planned timing. Replanting after harvest would not be considered discretionary and this investment has the greatest effect on future yields. The yield effects of our existing and planned investments are realized many decades into the future. Given the non-declining nature of these projections, we will have many decades of Option A plans upon which to make any necessary corrections.

PRUNING AND TREE IMPROVEMENT

SPI currently prunes many of its plantations. We do not estimate any effect on yield, since our pruning guidelines call for 50% crown ratio retention. We have established pruning study plots to monitor growth effects. No yield effects are estimated, or have been detected from the pruning program. The main purpose of pruning efforts is to increase wood quality. These efforts have some positive effects on vegetation diversity, and some effects on fire risk reduction. SPI has an active tree improvement program, but currently has not modeled any increase yield as a result of these efforts

MAKING PROVISIONS FOR ADEQUATE REGENERATION

In addition to our seed orchards, SPI maintains an extensive bank of seed and plants the commercial species, ponderosa pine, sugar pine, Douglas fir, white fir, red fir (except incense-cedar) harvested under this Option A. Prior to the year of harvest, regeneration foresters determine the quantity and species required for reforestation purposes. These seed are sown at contract nurseries, grown for at least one season, and then sent to the harvest site for planting. The harvest areas are typically prepared for planting using site- specific preparation practices under the supervision of a registered professional forester.

SPI does not have ownership-wide standardized site preparation prescriptions. We do have a goal of well spaced and free-to-grow trees in our plantations, but the

prescription that implements this goal is area-specific and based on post-harvest stand conditions. Our performance, which can be easily reviewed over time, will dictate whether we are achieving predicted growth rates. The specifics of our regeneration program do not significantly affect the near term harvest values in these Option A plans. SPI regeneration foresters evaluate each area post harvest and decide what site prep is needed to successfully regenerate the site. This varies from plant only to broadcast burn, rip, plant, and control competing vegetation. Due to the inherent variability in our timberlands, including the past owners' practices, we do not attempt to predict site preparation in this plan. Site preparation plans are developed and included in the THPs in the site preparation addendum. SPI recognizes that the growth rates projected in this Option A are conservative when compared to the G-space model. Even these reduced growth rates can only be achieved by producing well-spaced free-to-grow conditions in future plantations. As such it is also important to note that periodic field reviews of plantation performance required by SPI's 3rd party audit review for the Sustainable Forestry Initiative (SFI) (see SPI website) should suffice to assure that we are achieving the regeneration success called for in this plan. SPI will also cooperate with CDF audits.

The annual investment with the greatest cost and impact to future yield is the decision to use evenage regeneration methods over the planning horizon. Total component costs range from $300 to $600 per acre and will likely escalate at an annual rate of 1.5% to 4% range over the foreseeable future. The component parts of the annual investment in decreasing order of dollar contribution are site preparation, tree planting, nursery costs, cone collection, tree improvement and growth space research. SPI is fully committed to funding regeneration investments as they are incurred into the foreseeable future.

CONSIDERATIONS OF OTHER FOREST VALUES

Producing the yield of timber products specified by the landowner, **taking into account biologic and economic factors, while accounting for limits on productivity due to constraints imposed from consideration of other forest values, including but not limited to, recreation, watershed, wildlife, range and forage, fisheries, regional economic vitality, employment and aesthetic enjoyment. (14 CCR 913.11, 933.11, 953.11 (a)(1).)**

Since our Option A process attempts to allocate our property to different futures and is a model of the real world, not a linear programming effort, each acre always is allocated to many such values. The acres allocated to differing potential silviculture and the rates at which silvicultural prescriptions are applied are the main constraint on yields. Additionally, all acres of our property are at different times contributing to maintenance of the condition of the aggregate other forest values. Clearly, these allocations will always have overlapping and synergistic effects.

In our proprietary-planning model and GIS, SPI has tracked silvicultural options that provide some of the considerations for other forest values. Some constraints that can be tracked specifically and provide for many other forest values include WLPZ management, nest site protection, archeological sites, and aesthetic areas. Other

constraints are less easy to directly track, but are, in aggregate, provided for by silvicultural options that do not maximize mean annual increment. Many of these decisions are made site specifically during the THP process. We have used a referencing process from actual site-specific plans to reproduce the effects of such decisions. Many decisions have effects on more than one of the listed other forest values. We will detail management decisions that limit productivity.

In order to show how these constraints imposed from consideration of other forest values limit productivity, we need to establish a baseline of productivity. This approach allows us to demonstrate the effect the existing rules and the consideration that other forest values have on a landowner's ability to maximize yield. One approach would be to display the maximum potential long-term sustained yield assuming no constraints of the existing rules apply. Thus, the maximum potential long-term sustained yield would be the acres by site class multiplied by the highest mean annual increment (mai) produced. This highest mai value is developed from application of evenaged silviculture to each site class. Application of this approach leads to a maximum potential long-term sustained yield of 1.671 billion board feet.

Aesthetics & Recreation - Throughout SPI's landbase there are specific areas that are given specific treatment for aesthetics and recreation. These include scenic highways, lands directly adjacent to State and federal parks and lands inside of National Recreation Area boundaries. These considerations are accomplished by the use of shelterwood and selection silviculture systems. In the Northern State District there are 12,121 acres with known specified visual considerations. The percentage reduction in maximum productivity from a hypothetical average acre is 15%. These constraints produce an annual reduction in SPI's combined potential LTSY of **3.15 (mmbf)** annually from specified visual considerations. Numerous other site-specific THP decisions result in considerations for aesthetics. (See combined considerations below.) A significant portion of SPI's land is open to the public for recreational uses including but not limited to, hunting, hiking, and fishing, but no specific reduction in yield is expected from these uses.

Range and forage – These values are considered in the cumulative effect analysis in the THP process on a watershed specific evaluation. Although important to many species, range and forage production is a normal and expected outcome of many of our silviculture decisions but does not directly limit yield expectations.

Watersheds & Fisheries - Watercourse protection directly provides consideration for watershed and fisheries, it also provides consideration for other forest values including but not limited to recreation, wildlife, and aesthetic enjoyment. In the Northern State Forest District SPI has an estimated 103,698 acres in Class I and Class II watercourse and lake protection zones (WLPZ - stream buffers). Timber harvest in a WLPZ is dependent on timing of adjacent non-WLPZ harvesting. The CACTOS model requires special calibration to mimic near stream growing conditions and to prevent the model from producing unrealistic results. The 50% or greater vertically projected canopy retention requirements for WLPZs always produces canopy closure greater than 50% when both sun angle and terrain shading are included. Our simulation of near stream stand growth avoids insertion of ingrowth where canopy closure does not drop below

50%. The actual calibration to mimic growth was a 50% reduction in the indices in the respective regional calibration files. Per acre reduction in maximum productivity from a hypothetical average acre is 58%. This results in a **99.95 (mmbf)** annual reduction in SPI's combined potential LTSY from WLPZ management.

WLPZ acres for Option A demonstrations have been allocated based on correlation with our direct referencing process to actual geographical information system maps where watercourses have been completely classified on SPI ownership. (Now approximately 1 million out of the 1.5 million acres.)

The modeling of WLPZ's did not differ between the three Option A demonstrations. At the time, of Option A preparation, only the Coast Option A plan had WLPZ canopy constraints under "Coho considerations" greater than 50%. Streams on SPI's landbase in the Coast Region are predominately Class 2 or 3 watercourses, and WLPZ harvest is approximately 7.5% of our annual harvest constraint. If we were unable to harvest in our Coast Region WLPZ lands, no amendment of the Coast Option A demonstration would be required.

To implement the canopy constraints, SPI will continue to employ professional foresters to provide ocular estimates aided when necessary, by use of a densitometer (sight-tube) survey. Given the costs of surveys, normally ocular estimators tend to err on the cautious side. This results in retention of higher rather than lower canopy levels to avoid potential violation of the rules.

> Note: SPI's research shows that 50% or greater vertical canopy projection is more than adequate to meet environmental effects mitigation requirements. This research has exhaustively measured canopy near streams and shows that 50% vertical is indeed greater than 85% actual (angular) shade.

Wildlife - Nest site protection provides direct consideration for certain wildlife species, but also provides consideration for other forest values including but not limited to recreation, watershed, fisheries, and aesthetic enjoyment. All Board listed and State or Federal endangered species that nest on our land were specifically modeled and analyzed. Site-specific mitigation measures for wildlife, species of special concern, including listed species, will still be designed in the THPs that implement this assessment. Many of these decisions are made on site during the THP process. We have used a referencing process to actual site-specific plans to reproduce the effects of such decisions. The allocation for simulation of wildlife retention areas, especially listed wildlife nest area acres, came from direct estimation of total numbers of these different species expected to be located on SPI lands. Estimated total nest sites for species of special concern, including listed species were modeled and their specific yield streams tracked. In the Northern State Forest District there are 6,034 acres of nest core areas. The species analyzed include, northern spotted owl, northern goshawk, bald eagle, golden eagle, California spotted owl, heron rookeries, and osprey. A wildlife species dependent mix of no-harvest and selection silviculture was used in the nesting core areas. The percentage reduction in maximum productivity from the hypothetical average acre is 35%. The modeling of these mitigations produced a reduction in SPI's combined potential LTSY of **3.1 (mmbf)** annually from wildlife nest protections.

SPI provides for wildlife other than these nest sites specifically in the cumulative effect analysis in the THP process. SPI believes that to estimate yield effects, these nest core silviculture mitigation estimates are sufficient. SPI often has other protection mitigations, which include timing of harvest and surveys etc. Site-specific mitigation measures used for each wildlife species is clearly a THP issue. The Option A limitation on harvest for this acreage should adequately account for the consideration of these species over time. These estimates will become more refined each decade as increased survey efforts and our knowledge of these species' needs grow.

Snags - SPI has snag retention guidelines *[Available on the SPI website "www.spi-ind.com"]*. Snags and large woody debris (LWD or DWD) provide critical habitat functions for a wide variety of fish and wildlife. . We have used existing primary and secondary cavity dwelling bird studies to estimate necessary snag levels. To date we find snags at levels above our guidelines at the tract or planning watershed scale. Snag creation processes are stochastic and unpredictable. We estimate that past (old) photographic evidence suggests that in our fire dominated landscapes, there were less snags and DWD then we have today. Past practices attempted to eliminate snags for safety and fire hazard reduction reasons. Even with retention policies, SPI does not expect this issue to impact predicted growth and yield levels. When using prescribed burning, we attempt to not burn in conditions, which consume the existing larger DWD. If we continue to monitor and meet our snag guidelines, we will have snags that will over time create future DWD. Harvesting also creates DWD.

Going forward, SPI has live green cull and other habitat retention guidelines (like our new Visual Retention alternative silvicultural prescription), which specify that certain trees are retained in harvest areas. These are not mitigation for harvest effects, but act like an insurance policy to maintain small-scale heterogeneity in our future landscapes. Current management results in 2% retention in small 1/10th to 1/5th acre size areas. These retention areas are prescribed in approximately half of the tractor harvest units where this diversity is not provided for by an in place WLPZ component. While some localized growth effects from these small habitat retention areas are expected, they are expected to be well within the accuracy range of the currently available growth models. Retention of live green culls is random and consists of isolated individual trees or trees in watercourse zones. Due to this isolated random distribution, they are likely to eventually die and are unlikely to significantly effect growth of planted trees around them.

HABITAT TRENDS

In order to help assess whether or not there are potentially significant adverse effects on wildlife habitats that might prevent this proposed future production of timber, SPI offers the following trend charts of the major habitat forms over time. These major habitat forms are early seral, small tree, open forest, and large tree/dense closed canopy forest conditions. A chart showing the expected distribution of these habitat forms for our property is shown below.

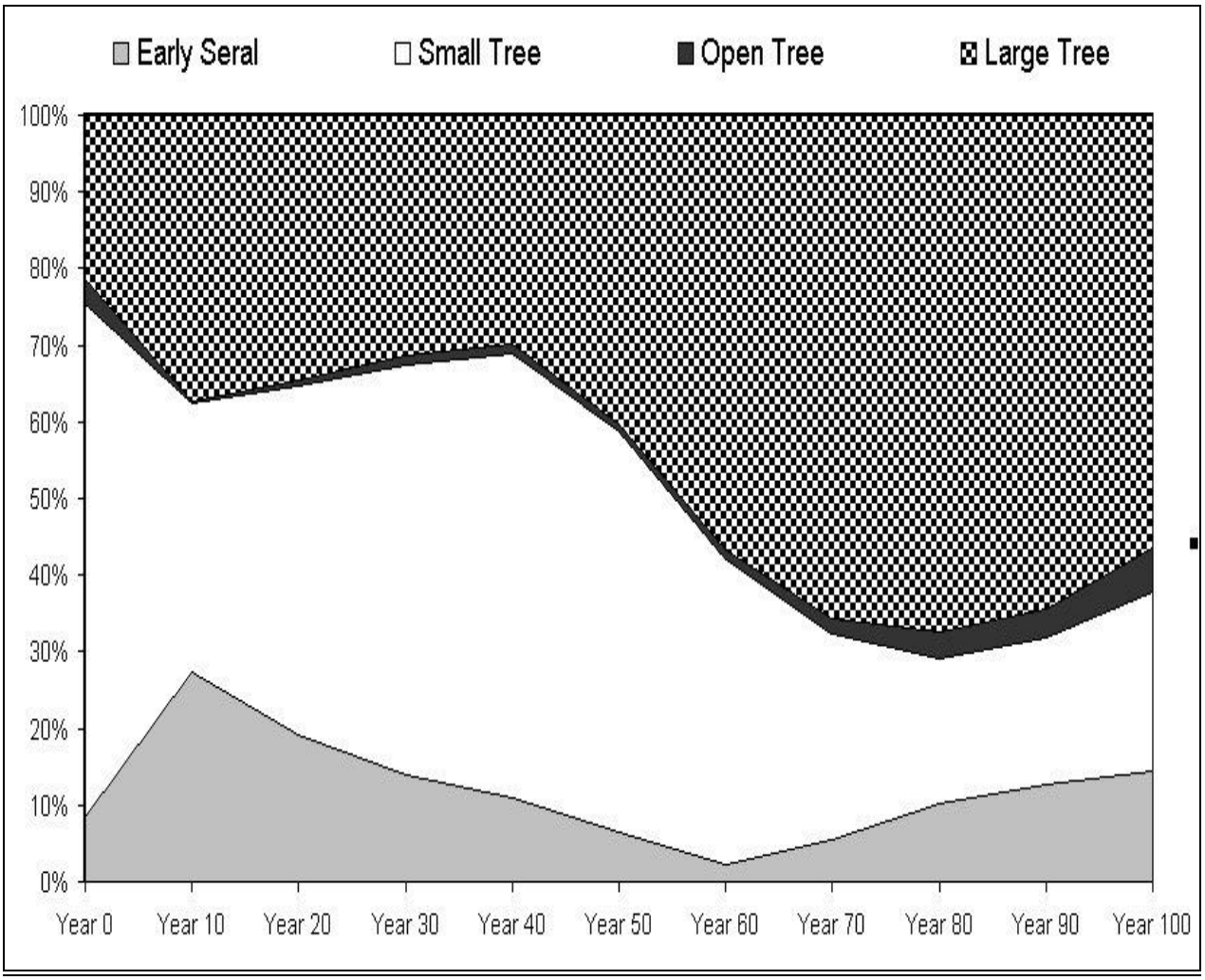


Chart 1

Habitat Form Over Time

Note: The trend charts above are non-spatial and apply only to SPI land, while the THP process looks at site-specific habitat issues, including all other owners within a designated assessment area.

These trend charts show maintenance and distribution of the large tree/high canopy closure forest over time. This is the stand type in which we have found successful reproduction of a wide variety of “mature or late seral” associated wildlife. The chart also demonstrates steady long-term production of habitat conditions that support the production of many of the prey species which these same “mature or late seral” species rely on. The increase in both of these habitats comes from the reduction in the small tree dense forests, which have developed from the effects of past harvesting techniques and fire suppression.

The Habitat Form chart summarizes trends in habitat types that can be useful in assessing landscape level wildlife and cumulative effects issues. Average diameter of trees increases from the 18” class to the 32” class. The average diameters are

expected to increase steadily over time. Standing inventory in all size classes greater than 18 inches, steadily increase over time. (See DBH Over Time Chart 2 below.)

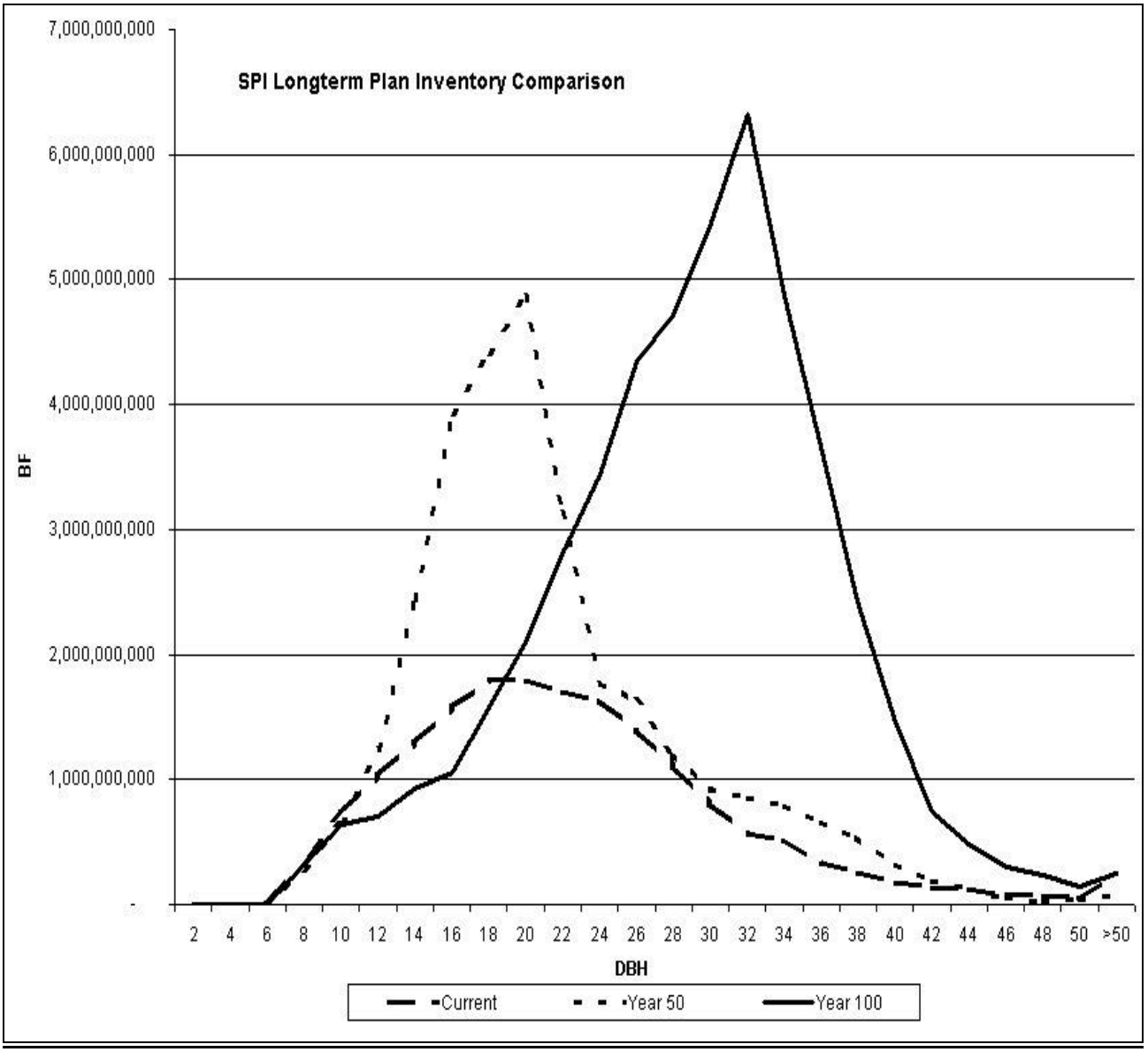


Chart 2
DBH Over Time

Increased edge opportunities, habitat diversity, and fire risk reduction should mitigate wildlife related concerns associated with rehabilitation of some SPI forest stands. These landscape level shifts, carefully planned and monitored, have the potential to create, maintain or enhance habitats for both special status, and non-status species on SPI properties, including prey species.

Employment & Regional Economic Vitality - In consideration of regional economic vitality and employment, SPI has chosen to operate under the self-imposed constraint of non-declining flow. This never declining harvest level has been chosen to assure stable long-term economic vitality and employment potential from an ever-increasing supply of raw materials. Considerable annual investment in stand health and maintenance activities are undertaken to improve current growth and produce the yield streams estimated in this Option A. Since numerous silvicultural decisions are made that produce non-declining flow, no direct reduction could be tracked to estimate the limits on productivity from consideration of employment and regional economic vitality. (See section on combined other value consideration below.)

This even flow constraint was modeled iteratively at the individual detailed planning area level, and has been included in scaling up to this Option A submission. We begin with all potential first decade silvicultural opportunities and then begin the growth and harvest allocation process. As evidence that the aggregate effect of non-declining flow is a true constraint; we must reschedule available potential 1st decade harvest into future decades. These available potential harvests meet all adjacency, wildlife and watershed effect constraints. This becomes an iterative process because whenever harvest is delayed, additional growth occurs on existing stands and adjacency constraints need to be reevaluated.

Combined Other Value Consideration - Accounting for limits on productivity due to constraints imposed from consideration of other forest values cannot always be directly tracked in yield models. These considerations come from the site-specific THP decisions. We have used a referencing process that examines actual site-specific plans to reproduce the effects of such decisions. The effect of all other combined considerations was calculated by subtracting the sum of constraints discussed above from the theoretical maximum LTSY and then subtracting the resulting average decade growth from that value. The actual value includes the modeling of evenage and unevenage, shelterwood (including prep steps), seed tree, sanitation salvage, and rehab silviculture to the remaining acres. In our THPs, SPI foresters conduct a cumulative effects analysis, which includes many methodologies, and analyses that help better understand whether cumulative effects are likely. One such analysis that may be used to guide and sometimes restrict harvest allocation at the THP level is an equivalent roaded acres analysis (ERA). Delay of harvest or infrastructure improvements are also employed to mitigate cumulative effect concerns. As a result yields of wood resource are seldom negatively impacted. All simulations incorporate by reference reductions associated with detailed planning. Mitigation of cumulative effects that do reduce yields has been addressed. In summary, the effect of site-specific timing, adjacency limits, non-declining flow and restrictions to avoid cumulative effects produce a reduction in potential LTSY of **424.28 (mmbf)** annually. The percentage reduction in maximum productivity from a hypothetical average acre is 29%.

SUMMARY OF CONSTRAINTS

Public trust resources are the water, the air and in some cases wildlife. Since our Option A process attempts to allocate our property to different futures and is a model of the real world (not a linear programming effort) each acre is allocated to many such values. The acres allocated to differing potential silviculture and the rates at which silvicultural prescriptions are applied are the main constraint on yields. Every acre of SPI forestland provides a number of "other" forest values. SPI does not allocate any individual acre of land for any one resource objective. Virtually all of the land is managed for multiple resource objectives. An individual acre cannot be evaluated in terms of production of one individual resource value without attempting to account for the effects on or enhancements to other values. Potential benefits and/or negative impacts resulting from SPI management mix in time and space. The detailed, site-specific THP process is the proper scale of analysis for this assessment. Aggregating the THP planning process up through SPI's referencing analysis for the 400,000 acres finished to date is the only accurate way to deal with these complex interactions.

The predominant constraints that effect near term yield are the non-declining flow constraint, the adjacency constraint (especially the additional 5 years of our 10-year adjacency constraint), and the high visual consideration acres. As a practical issue, many of the ongoing small changes in THPs to mitigate impacts are inherently in our modeling, since we used the referencing to approved plans to develop our long-term yield trajectory.

A summary of the effects of constraints on timber production from these considerations for other forest values is presented below.

99.95 (mmbf) annually from WLPZ management

3.10 (mmbf) annually from wildlife nest protections

3.15 (mmbf) annually from specified visual considerations

424.28 (mmbf) annually from silviculture which does not maximize mai or reductions from effects of other FPR like adjacency constraints or other cumulative effects constraints and constraints imposed by non-declining flow considerations.

These constraints total:

530.48 (mmbf) annual combined total constraints on timber production.

Subtracting this value from the hypothetical maximum LTSY leaves a residual value of **1,140.35 (mmbf)**, which is the combined average total SPI theoretical LTSY value. This represents a 31.7% reduction in average per acre yield as a result of considerations of other forest values. Theoretically, when all acres in all site classes are in fully regulated conditions and no additional constraints, new laws or new rules apply the theoretical annualized long-term sustained yield would be 1,140.35 (mmbf).

Since it is impossible to achieve perfectly regulated conditions due to many stochastic events, and the site specific consideration of other forest values, the actual LTSY resulting from our best effort to represent the site specific application of these considerations is presented in summary in Table 5, on page 29 and in a graphical format in Chart 3 on page 30. State Forest District level LTSY actual values are presented in Table 6 on page 30.

Details and break down of these specific limits on productivity for each State Forest District were made available for confidential audit by CDF.

BALANCING GROWTH AND HARVEST OVER TIME

SPI provides this California ownership summary to the public with summary values of SPI's inventory, harvest and growth by decade. District level LTSY values are summarized below. To protect our trade secret and confidential information detail at the State Forest District level is only available for confidential audit by CDF.

Achievement of Maximum Sustained Production Report
For TAA: Combined SPI All California Forest Districts
2,002 scenarios
1,439,350.95 acres (Non forest acres omitted)

		Board Feet Scribner				
Years	Beginning Inventory	Harvest Volume	Residual Inventory	Total Growth	Ending Inventory	Growth bf/ac/yr
0 - 10	17,822,123,342	5,223,087,694	12,599,035,649	5,460,411,126	18,059,446,775	379
10 - 20	18,059,446,775	5,232,931,676	12,826,515,099	6,163,877,866	18,990,392,965	428
20 - 30	18,990,392,965	5,685,778,802	13,304,614,163	7,073,725,610	20,378,339,772	491
30 - 40	20,378,339,772	5,706,865,303	14,671,474,469	9,290,844,461	23,962,318,931	645
40 - 50	23,962,318,931	6,331,666,935	17,630,651,995	12,511,294,421	30,141,946,416	869
50 - 60	30,141,946,416	7,049,037,970	23,092,908,446	15,103,106,506	38,196,014,951	1049
60 - 70	38,196,014,951	10,150,878,450	28,045,136,501	15,545,282,479	43,590,418,981	1080
70 - 80	43,590,418,981	10,729,309,132	32,861,109,849	15,411,797,591	48,272,907,440	1071
80 - 90	48,272,907,440	12,917,332,527	35,355,574,913	14,149,892,255	49,505,467,167	983
90 - 100	49,505,467,167	13,915,398,644	35,590,068,523	13,324,333,648	48,914,402,172	926
Totals		82,942,287,134		114,034,565,963		

Table 5

Note: In Table 5, the harvest volume in period 10 appears to exceed the growth estimate. 14 CCR 913.11, 933.11, 953.11 (a)(2) includes wording to the effect that these projections be guided by the principles of practicality and reasonableness. Accuracy bounds relative to projections for all decades must be considered. The value of a harvest projection 100 years out being within 5% of the estimated LTSY is essentially the same number when guided by such principles.

The following chart places these values in a graphical format for easier decade-by-decade comparison of inventory, harvest and growth over time.

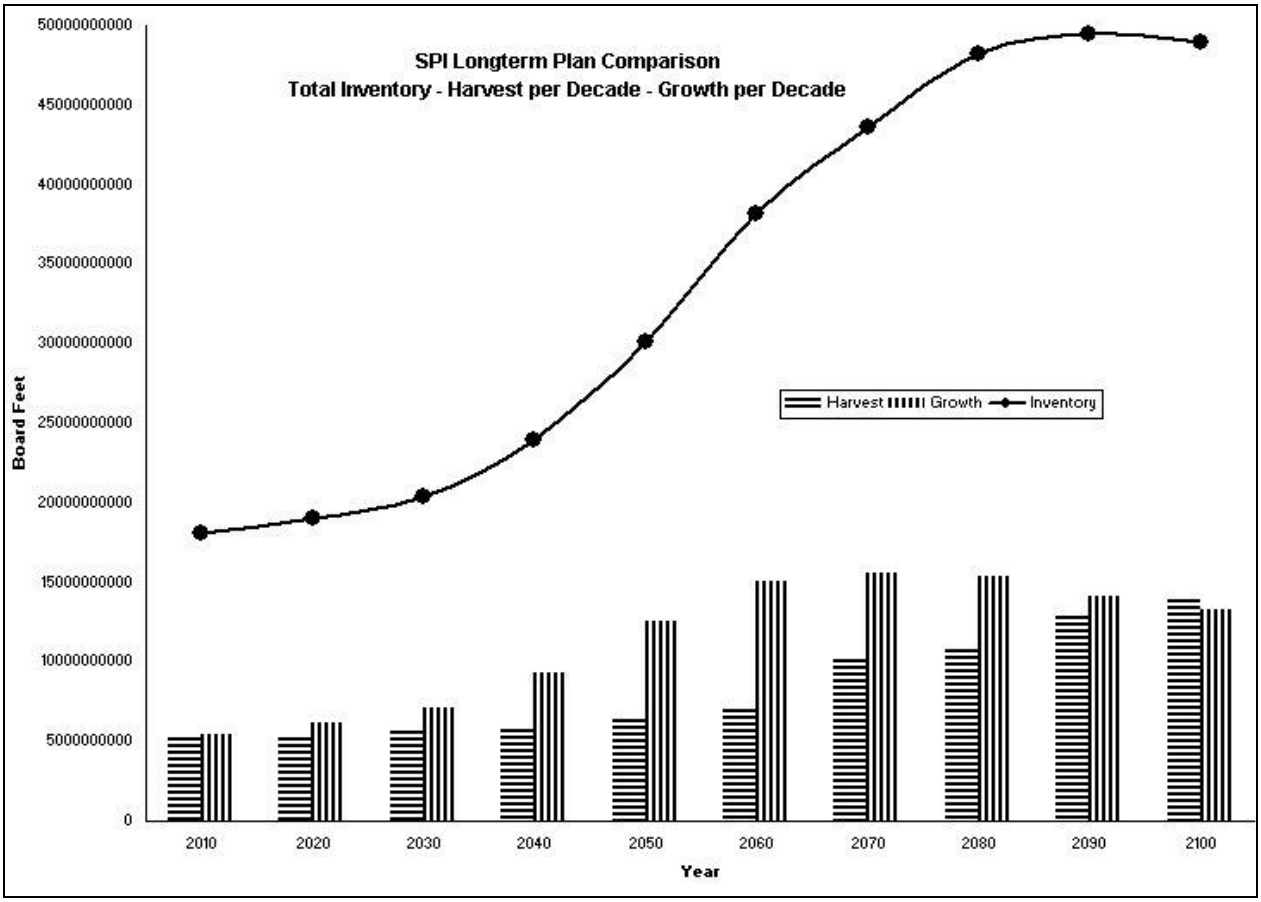


Chart 3

LONG TERM SUSTAINED YIELD

Long Term Sustained Yield means the average annual growth sustainable by the inventory predicted at the end of a 100-year planning period.

Total and State Forest District Values	LTSY
SPI's All State Forest Districts LTSY (1,439,351 acres)	1,332.45 (MMBF) per year.
The Northern State Forest District LTSY (1,111,925 acres)	883.67 (MMBF) per year
The Southern State Forest District LTSY (293,964 acres)	408.80 (MMBF) per year
The Coast State Forest District LTSY (33,461 acres)	39.97 (MMBF) per year

Table 6

LAST DECADE INVENTORY

Guided by practicality and reasonableness, we have chosen to constrain the planning model in the last three decades to not harvest more than the average growth shown for those three decades. This constraint is implemented to specifically meet the requirement that:

> **The projected inventory resulting from harvesting over time shall be capable of sustaining the average annual yield achieved during the last decade of the planning horizon.**

There are few standard tests for assessment of “capable of sustaining the average annual yield”. It is both practical and reasonable to assume that if the average harvest has been maintained at or below the average growth for 30 years, the residual inventory should be able to sustain that harvest level for a reasonable time into the future. Many unpredictable stochastic events will cause the actual harvest and growth values 10 decades from now to fluctuate around each other, but both harvest and growth in the planning horizon increase dramatically compared to the current or first decade levels. We regulate each of the three separate State Forest District level SPI analyses to guarantee that the sum of the final 3 decades of harvest does not exceed the sum of the final 3 decades of growth. This growth constraint has been implemented at the Forest District level.

MONITORING

SPI will track the accomplishment of the broad silvicultural targets on an acreage basis with an Option A confidential report submitted for CDF yearly review. This report would include the type and acreages of all early stand treatments. We would also make summaries at the Option A level of State Board of Equalization (SBE) harvest volume yield tax reports available for CDF review. It is expected that salvage acres will vary from the Option A estimates, because the referencing areas were predominately developed over the last 4 years. While mortality from drought is unpredictable our current salvage operations remove very low volumes per acre on average, and fall well below confidence limits resulting from the projection of future growth. Salvage harvest would be part of the volume reported in our SBE summaries and are part of the expected yield stream. The ongoing results of spacing management and response to past waves of drought mortality should make future stands less susceptible to these effects. This is especially true when combined with greater pine components as a result of plantation species mix. It is not expected that significant volume shifts will occur from the primary silviculture systems proposed. If sudden drought, insect or fire mortality were to occur in large enough quantities to warrant modification of the plan, an amendment would be submitted.

SPI will confidentially provide validation of growth projections and inventory updates as they become available. We maintain the original Cactos set of CFI plots, but we rely on re-cruise for inventory updates.

Information will be provided in each THP that allows establishing whether the THP falls within the Option A assessment area. SPI will provide assessors parcel numbers (APNs) in its THPs and will state that they were in or were amended into an APN parcel list held confidentially by CDF in each of its regional offices. We are required to state under Question 14 of the THP which method, of MSP demonstration, the THP complies with.

SPI will submit annual reports of actual harvest volumes and acreages of each silvicultural prescription modeled in the Option A plan. An acceptable level of detail and format will be developed, (approved by CDF) and submitted prior to year-end 2003. A general summary will be available for public review, and a portion of this annual reporting process, at the detailed level, will remain confidential.

REVISION OF THIS ASSESSMENT

Ownership changes (sales or purchases) in and of themselves or in combination with other factors that cause a greater than 10% deviation from the average annual projected harvest level will require a revision of this Option A plan. This is a stricter criterion than the SYP (14 CCR 1091.13) constraint, which is 10% deviation from the 10-year average harvest level. The 14 CCR 1091.13 criteria will be used to determine if changes in watershed or fish and wildlife values will trigger an Option A revision.